

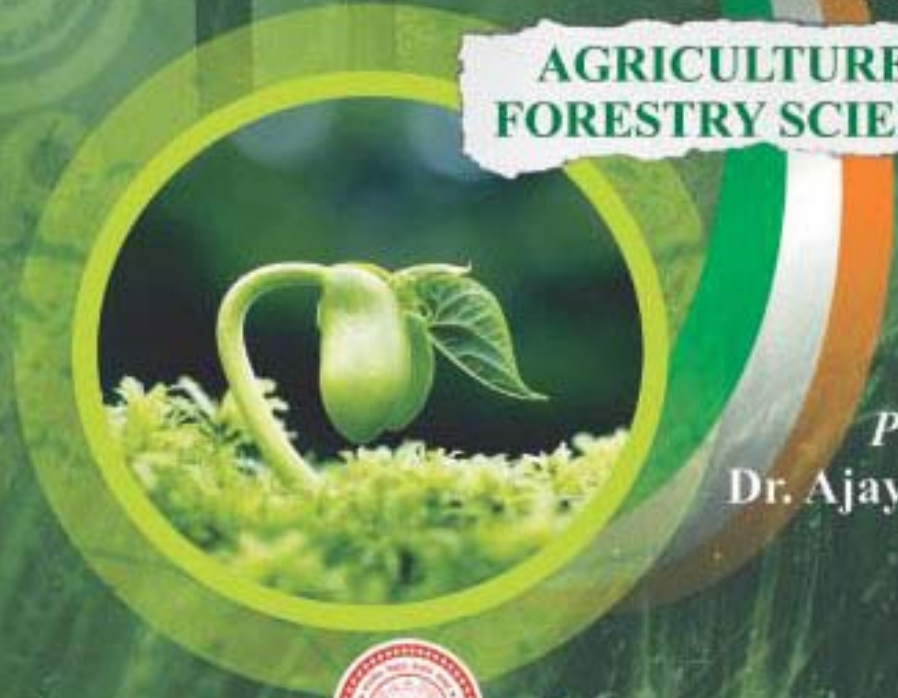


3-7 January, 2012 - Bhubaneswar

99th Session of the Indian Science Congress

SECTION OF

**AGRICULTURE AND
FORESTRY SCIENCES**



President
Dr. Ajay Parida



The Indian Science Congress Association

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PART II

**SECTION OF
AGRICULTURE AND FORESTRY SCIENCES**

President: Dr. Ajay Parida

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I

PRESIDENTIAL ADDRESS

President: Dr. Ajay Parida

PRESIDENTIAL ADDRESS

Role of Agriculture in Alleviating Poverty and Malnutrition

Ajay Parida

M. S. Swaminathan Research Foundation,
III Cross Street, Institutional Area,
Taramani, Chennai 6000 113, India

Esteemed Chairman of the Session, Prof. M. S. Swaminathan, and the Awardees, Distinguished Participants and Ladies and Gentlemen.

At the outset allow me to express my deep sense of gratitude to the fraternity in Agriculture and Forestry Sciences for having elected me as Sectional President. It is not only a great honour but a rare privilege to be part of the continuum of many stalwarts in the field that nurtured and illuminated the path of Agricultural Research, Education and Policy development in our country over a century. Their sustained efforts have enabled the transition of India to a food secure nation as well as developing and nurturing a cadre of scientific, technological and committed professionals shaping agriculture growth and development in the country. Their unstinted efforts have brought us to the level where we feel securely anchored today. I realize my limitations, and still venture to step into their shoes.

The agricultural sector is at the heart of the economies of many developing countries, including India. Agriculture accounts for a large share of GDP, employs a large proportion of the labour force, represents a major source of foreign exchange, supplies the bulk of basic food and provides subsistence and other income the growing population. The strong linkages it has with other economic sectors - forward and backward - provide significant stimulus for growth and income generation. Therefore, significant progress in promoting economic growth, reducing poverty and enhancing food security cannot be achieved without developing a vibrant agriculture system with concurrent attention to the human potential and productive capacity of the agriculture sector. These in turn will enhance contribution

of agriculture to the overall economic and social development. Therefore, a strong and effective food and agricultural system forms the primary pillar in the strategy of overall economic growth and development, and more specifically for the developing nations.

In the Indian Context, agriculture has played and will continue to play a dominant role in the growth of Indian economy. It represents the largest sector contributing to around 20 percent of the GDP, the largest employer providing more than 60 percent of the jobs and is the prime contributor for enhancing the living standards for seventy percent of India's population particularly those living in the rural areas. These factors together with a strong determination to achieve self-sufficiency in food grains production, with appropriate use of science, technology and policy option as well as participation and involvement of large pool of farmers and farm workers, have ensured a high priority for agriculture sector in the successive development plans of the country. The green revolution of 1970's pushed the productivity growth that enabled the transition of the country to a food secure nation. However, in the recent years, growth in agriculture has stagnated relative to other sectors. Last year the agricultural sector grew at a rate of 2.7%, relative to about 10% growth in both the service and industry sector. Agricultural incomes are lower and the rate of growth is slower than incomes in other sectors. This has resulted in persistence of unacceptable levels of hunger, poverty and malnutrition among large section of India's population.

Indian has been witnessing a rapid urbanisation trend. According to the State of World Population Report 2007, it is estimated that by 2030, people living in urban areas in India will be to the tune of 40.68 per cent. However, despite rapid urbanisation in India, about 70% of the population still lives in rural areas. India is still a land of small-scale farmers: about half of all farms are less than 1ha in size, and another 20% are less than 2 ha. There are strong, direct relationships between agricultural productivity, hunger, and poverty. Most poverty is concentrated in rural areas, especially amongst small scale farmers and landless families. The slow pace of poverty and hunger reduction points to an urgent need for

strategies that better target the areas where poor people live and the activities on which their lives depend.

Despite progress made since the 1996 World Food Summit that set the goal of halving the number of undernourished people by the 2015, serious food insecurity persists in many parts of the world. Although more food is being produced worldwide than ever before, some 800 million people are still chronically malnourished and lack purchasing power even the food is available in the market. Ensuring household food and nutrition security, increasing farm productivity and income, alleviating poverty and minimizing production risks on account of climate change, are among the major challenges facing the country that predominantly depend on agriculture, besides ensuring overall natural resource management and environmental security.

Fostering a rapid and sustained agricultural and rural growth and development has remained and continue to be among the key priorities of the Government of India. Although agriculture contributes only about 20% of India's total gross domestic product (GDP), its importance in the economic, social, and political fabric of India goes well beyond. The large number of poor agricultural households and their income vulnerability are major concerns among policymakers. These concerns, in turn have been the guiding force in developing both agricultural policies and public expenditures strategies in agriculture. India made significant advances towards achieving its goals of rapid agricultural growth, improving food security, and reducing rural poverty during the last four decades. To a large extent, sustained emphasis on food grain production growth had enabled India to achieve food grain self-sufficiency, eliminating the threat of famines and acute starvation in the country. The increased demand for rural labour generated by agricultural intensification in the 1970s to 1980s raised rural wages in combination with several poverty alleviation programmes and low food price, contributed to, reduced poverty in rural areas. Aided by sustained, although much slower, agricultural growth, the rural poverty rate has considerably declined. However, the slowdown in agricultural growth is a major concern. Hence, the Government of India's National

Agricultural Policy and its Plans place high priority on raising agricultural productivity to achieve an annual agricultural growth rate of 4 percent.

Despite these achievements, the major challenge that faces India is in ensuring that Agriculture becomes a vehicle for change. It would require attentions to the factors that adversely affect the agriculture growth and their impact on reducing hunger, poverty and malnutrition. Some of these are discussed below:

Harnessing potential of Agrobiodiversity

Agricultural biodiversity is the biodiversity associated with agricultural ecosystems and indispensable in sustaining key functions for food production. It is the outcome of the interactions among the environment, genetic resources and the agricultural practices. The diversity of cropping pattern, as witnessed today is the result of years of crop husbandry practices followed by the farming communities. The farming communities over the years, have identified and managed higher levels of agricultural biodiversity those also provided source material for reduced pest incidence, improved soil nutritional levels, crop pollination, and hydrological functions. Agricultural biodiversity also provided significant values in conserving and managing diverse genetic resources that formed the basis for the development of new crop varieties and animal breeds. Despite seminal contribution of the cultivators and conservers, the biodiversity rich regions represent the regions those inhabit poor and marginalised people. This dichotomy of poverty of people and prosperity of nature is a major concern in the development process.

Proper management of agricultural biodiversity is required in order to preserve the key-functions of agro-ecosystems. Rapid loss of wild relatives and landraces of many crop plants has been a global concern. It is generally viewed that loss of every gene and species will limit our option for further improvement in productivity and prosperity. There is the need to develop a wide range of practices which are location specific and differ according

to the degree of human intervention in the natural system. These systems range from the highly managed *ex situ* gene and seed banks to *in situ* conservation which takes place in farmers' field or undisturbed wilderness areas (e.g. maintaining wild relatives of cultivated species in wilderness areas). These two approaches are largely complementary: the *ex situ* collections preserve a static set of genetic resources, while *in situ* efforts preserve a dynamic process of evolution, as genetic resources adapt to changing pressures from natural and human selection.

Agricultural biodiversity underpins agricultural productivity and therefore makes a critical contribution to agricultural sustainability. Local crops and the role of intra-specific crop diversity for income generation, dietary diversification and ecosystem health deserve greater attention in research and conservation efforts. Numerous studies have pointed out that agro-ecosystems and agro-biodiversity contribute to sustainable livelihood securities at the local, national and global levels. They provide a range of goods and services including food, fodder, climate change mitigation, biodiversity conservation and water quality options. Farmers and farming communities have a significant role to play in the preservation and conservation of these resources and ecosystems and using them sustainably in enhancing the productive agriculture systems, through integration of locally available and adapted genotypes.

In spite of concerns relating to the depletion of agro-biodiversity, awareness of their potential uses is increasing. With growing pressure on land, demand for crops for use other than food production, such as fuel production and biofortified food will result in increasing the demand for agro-biodiversity. This will require much understanding and integration of locally adapted food crops those are nutritionally rich, underutilised and have resilience to the climate change scenarios. This pressure will affect the way in which farming will be carried out in the future. It is, therefore, crucial that farmers are encouraged to continue farming rather than moving to non-farming activities as the mainstay of their livelihoods. Adding value to the resources and integration of off-farm livelihood enterprises will enhance the livelihood

of the agrarian communities through diversification of their income sources. There is a need to follow a system that integrates conservation, cultivation, consumption and commerce as a continuum ensuring an economic stake in conservation efforts at the local levels. This would essentially require developing mechanisms for an incentive system for farmers.

Biodiversity loss in agricultural landscapes affects not just the production of factors of agriculture systems, but also a range of ecological services supporting clean water supplies, habitats for wild species, and human health. Research is needed to understand the predicted effects of biodiversity loss on environmental change as well as to show how the utilization and conservation of biodiversity can provide ecosystem services to satisfy both current and future needs. It is also essential to establish the scientific of the trade-offs between food production, biodiversity conservation, ecosystem services, and human well being in agricultural landscapes. The key research area that requires immediate and urgent attention include: (a) assessing status and trends of biodiversity in agricultural landscapes and the anthropogenic drivers of biodiversity change; (b) identifying the goods and services provided by agrobiodiversity at various levels of biological organization, e.g., genes, species, communities, ecosystems, and landscapes; and (c) evaluating the socioeconomic options for the sustainable use of biodiversity in agricultural landscapes. Adoption of innovative biodiversity-rich farming systems and farming practices that utilize and conserve biodiversity may ultimately improve environmental quality and limit agricultural expansion. Conservation of biodiversity and human knowledge from traditional agroecosystems is an urgent priority, to support human societies that rely on its cultural services, and for its potential for solving agricultural problems, now and in the future.

Future biodiversity research will be assisted by a number of advances in the scientific approaches. Through a series of global efforts, genomic structure for several major crop species and their wild relatives have now been described and these information provides an uncommon opportunity that can be used for describing biodiversity at the genetic level and its use in improving crop productivity. Advances in the field of plant breeding and agronomic

research has emphasized integrated systems that shows benefits of biodiversity-based practices such as cover crops, intercropping, rotations, and hedgerows on agricultural productivity and environmental quality. Using satellite imaging systems, the distribution of ecosystems in agricultural landscapes can now be described with high resolution, yielding information on how to better manage agricultural species, invasive, and wild species. New efforts to merge biological and economic approaches are generating information on how policies can affect the conservation and use of agrobiodiversity for enhancement of human well-being. These progressed will contribute immensely in our effort on unlocking the potential of agricultural biodiversity to address issues of improving agricultural productivity and ensuring food and nutrition security.

Alleviating Hunger, Poverty and Malnutrition

The Rome Declaration on World Food Security and the World Food Summit Plan of Action in 1996 proposed that “each nation must adopt a strategy consistent with its resources and capacities to achieve its individual goals and, at the same time, co-operate regionally and internationally in order to organise collective solutions to global issues of food security.”

At the United Nations Millennium Summit in September 2000, the international community agreed to a comprehensive vision of development, enshrined in what is today referred to as the Millennium Development Goals (MDGs). The MDGs place human development at the center of social and economic progress, and emphasizes the value of global partnerships for development.

Although there are on-going efforts worldwide to achieve the MDGs by 2015, progress on this front has been slow and uneven. Similar development targets have also been set by policy makers in India, and in some ways these are more ambitious than those stated in the MDGs. The realization of these targets in India is vital not only for attaining human development and economic growth within the country, but given its enormous size, they are critical for reaching the MDGs worldwide.

Poverty is widespread in India, with the nation estimated to have a third of the world's poor. According to a 2005 World Bank estimate, 41.6% of the total Indian population falls below the poverty line of US\$ 1.25 a day. A recent report by the Oxford Poverty and Human Development Initiative states that 8 Indian states have more than 410 million poor, more than combined number of poor in 26 poorest African nations. According to IFPRI's recent report, India's poverty rate is projected to drop to 22% by the year 2015 indicating that in South Asia, only India, is on track to cut poverty in half by the 2015 target date. However, the 2011 Global Hunger Index (GHI) Report ranked India 15th, amongst leading countries with hunger situation and places India amongst the three countries where the it went up from 22.9 to 23.7 between 1996 and 2011.

Numerous studies from countries in sub-Saharan Africa, South Asia and Latin America points out to the negative impacts on productivity of poor nutritional status of the rural labor force. Poor nutritional status leads to people's susceptibility to illness, less productivity, put them at risk of intergenerational transmission of nutritional status, and impacts children's performance at school. There is mounting evidence that the accumulated effect of under-nutrition negatively affect macroeconomic performance and growth. With agriculture at the heart of the poverty reduction agenda, the policies for reduction of hunger must place emphasis on enhancing agricultural productivity of the small and resource poor farmers.

Agricultural performance, more especially productivity increases have contributed immensely in many countries round the world to achieving reduction of poverty. This is achieved through agriculture contributing to direct and relatively immediate impact on enhancing rural incomes. This also enables availability of and access to cheaper food for both urban and rural poor. Agriculture's contribution to growth and the generation of economic opportunity in the non-farm sector have also been a contributory factor towards providing additional livelihoods to the communities. In addition, it also stimulates and sustains economic transition when the countries also shift from primarily agricultural sector towards a broader base of manufacturing and services.

According to FAO, there were 105 million more hungry people in 2009 than in the previous year and the number of malnourished people now stands at 1.02 billion. Individual productivity losses due to malnutrition are equivalent to 10% of lifetime earnings, resulting in gross domestic product (GDP) losses of up to 3%. There are highly disturbing reports pointing out that close to 10 million children, in the world, die before their fifth birthday every year, over one-third of which are associated with under nutrition. In the developing countries, one in three every children under the age of five are stunted due to chronic under nutrition and poor health. Some 148 million children are reported to be underweight. In addition, micronutrient deficiencies or “hidden hunger” affects around 2 billion people worldwide accounting for about one third of the world’s population. These vitamin and mineral deficiencies, especially of iron, iodine, zinc and vitamin A, lead to poor physical growth and development, lowered mental capacities, reduced productivity, impaired immune systems, blindness and death - all of which are preventable.

The World Food Summit of 1996 defined food security as existing “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life”. Commonly, the concept of food security is defined as including both physical and economic access to food that meets people’s dietary needs as well as their food preferences and is built on three pillars:

- Food availability: sufficient quantities of food available on a consistent basis.
- Food access: having sufficient resources to obtain appropriate foods for a nutritious diet.
- Food use: appropriate use based on knowledge of basic nutrition and care, as well as adequate water and sanitation.

The nutritional outcomes for India clearly indicate that there are gaps in linking the three pillars of food security. This interrelated and important aspect of food, nutrition and poverty

are yet to be effectively addressed is achieving nutrition security at individual, community and national levels. Despite intervention through several food-based social safety net programs, some of them running over decades, malnutrition levels continue to be severe and persistent. There is an urgent need to implement an integrated nutrition and health program for all vulnerable groups. There is also a need to adequately focus on the role of gender and governance in reducing the prevailing issues of malnutrition at household levels. India ranks the lowest in terms of prevalence of underweight children under age 5. Although the under-5 mortality rate has improved—7.6% in 2006 from 11.5% in 1990—the pace of reduction has not been very impressive. Poor nutritional outcomes of infants and children arise from the poor health status of women, overall poverty, and lack of hygiene and proper health facilities.

Malnutrition is caused by a combination factors. Inadequacies in food, health and supporting systems play a major role. Even when food availability and purchasing power is sufficient, poor monotonous diets those are low in quantity, quality and lack of variety or dietary diversity of foods are often the major contributing factors. The gap between what foods are grown and what available locally and what foods are needed for better nutrition need to be adequately understood and studied. These would require concurrent attentions to increasing the availability, access and actual consumption of a diverse range of foods necessary for a healthy and balanced diet. Many scientific community and policy makers advocate for nutrition-sensitive, food-based approaches that increase access, availability and consumption of a variety and diversity of safe, good quality foods. Food fortification, has been advocated as a sustainable strategy for improving the nutritional status of populations. For many people, especially those living in developing countries, food and nutrition security is commonly mediated through agriculture and agriculture-related activities that in addition provide employment and sustain rural livelihoods. The multiple social, economic and health benefits associated with successful food-based approaches that ensures to year-round availability, access to and consumption of nutritionally adequate amounts and varieties of foods are obvious. Ensuring nutritional well-being will contribute to

promoting health of individuals, supporting their incomes and livelihoods and more importantly, will lead to creation and protection of community and national wealth.

Growing body of evidences, available today, suggest that food-based strategies are essential to meet the challenges of micronutrient malnutrition in the developing world. Increasing dietary diversification is the most important factor in providing a wide range of micronutrients, and to achieve this would require adequate supply, access and consumption of a variety of foods. Diets in developing countries generally lack many nutrients, including energy (inadequate amounts of food). Therefore, strategies are needed to place emphasis on an increase in total food intake, in addition to a greater variety and diversity. Agricultural and food policies tend to be oriented to primary agricultural productions, but they could also be formulated to promote and support backyard gardens or home gardens with appropriate mix of crops and small livestock production for the purpose of increasing household consumption of micronutrient-rich foods. The adoption of required and desired dietary patterns for nutrition improvement, e.g. appropriately formulated to meet micronutrient needs, need to be used in the formulation of agricultural policies and programmes. This process could be achieved through support for integrated farming systems oriented to assuring household food security, but also based on a variety of foods that will meet total dietary (including micronutrient) needs. Therefore, availability of energy-rich staples, animal and/or fish as major sources of protein, and vitamin-, mineral- and phytonutrient-rich fruit and vegetables could constitute development of the types of production system that is essential in ensuring adequate availability at the household level and access to nutritious food.. Use of fortified salt as well as grains has also been attempted in many countries as an intervention for addressing problems of malnutrition. The cultivation of edible indigenous plants as additional sources of micronutrients could also be added. The low bioavailability of some key micronutrients from foods, such as Fe, is substantially enhanced with the right food combinations and with appropriate food processing and preparation techniques. Appropriate technology for the preservation of micronutrient-rich foods would need further development and promotion for their year-round availability.

With an emphasis on increasing the variety of foods consumed and linking community development policies to national programmes, is probably the best strategy for improving micronutrient malnutrition sustainably and for the alleviation of hunger and malnutrition. In addition creating adequate knowledge base and community empowerment programmes that would enable nutrition awareness and literacy will hold the key in future.

One sustainable agricultural approach to reducing micronutrient malnutrition among people at highest risk (i.e., resource-poor women, infants and children), that is being advocated globally is to enrich major staple food crops (e.g., rice, wheat, maize, beans and cassava) with micronutrients through plant-breeding strategies. Available research carried out at international level (eg. HarvestPlus Programme of the CGIAR) and at national level (eg. India Crop Biofortification Programme) has demonstrated that micronutrient-enrichment traits are available within the genomes of these major staple food crops and appropriate strategies such as screening for high micronutrient containing germplasm, use of marker assisted selection and breeding as well as employing genetic modification approaches that enhances transport, partitioning and accumulation of high micronutrient traits, would create opportunities for development of micronutrient dense varieties and will allow for substantial increases in the levels of Fe, Zn and provitamin A carotenoids (as well as other nutrients and health-promoting factors) without negatively impacting crop yield. The time has come to invest in agricultural technologies to find sustainable solutions to micronutrient malnutrition. Plant breeding is one such technology that should be adopted by the world's agricultural community and that should be supported by the world's nutrition and health communities. Therefore, the intrinsic linkage between agriculture and malnutrition is the agenda of global communities in the recent years.

Improving Crop Productivity:

Investments in agriculture are important to increase food security. This is a complex issue requiring multiple interventions. Rising productivity increases rural incomes and lowers food prices, making food more accessible to the poor. Other investments—such as improved

irrigation and appropriate varieties of crops—reduce price and income variability by mitigating the impact of a drought. Productivity gains are key to food security. The contributions that agriculture makes to food security need to be complemented by medium-term programs to raise incomes of the poor, as well as insurance and safety nets, including food aid, to protect the chronic and transitory poor.

Crop productivity is a function of a range of factors and services. These include:

- land and water related factors (such as nature and size of farms/ location, quality of land, source of water, quality and quantity of water, and timing of water application, etc.)
- climatic factors (rainfall, temperature, precipitation, frost, cold etc.)
- agronomic factors such as quality, quantity and timing of input application (seed, fertilizers, weedicides, labor, etc.)
- socioeconomic factors (such as farmer education level and experience in farming, farm size, tenancy terms, land fragmentation, availability of credit)
- farm management factors (adoption of modern production technologies, farm planning and management practices, etc.)

The high incidences of under nutrition and poverty are ascribed to the decelerated production growth rates in recent years and this need to be seen as the most important issue and foremost challenge before the nation. Appropriate investments are needed for application of farm technology, deficiencies in the input supply chain, information and knowledge capacity with the farmers. Detailed analysis are required for bridging the huge yield and productivity gaps, addressing the issues of poor infrastructure, including that of the market and price volatility in agricultural commodities. Adequateness of the extension services, and dearth of suitable and appropriate technology and support systems for targeted groups such as women farmers and for small and marginal farms, are among the priorities in ensuring enhancement of agriculture productivity. .

The ever increasing pressure of human population (also livestock population) in the country is a major cause of shrinking as well as fast deterioration of the natural resources like land, water, biodiversity, genetic resources and forests. The problem is most serious and challenging in India. While India accounts for a mere 2.4 per cent of the world land surface area of 135.79 million ha, it supports 16.7 per cent of the global population. The population pressure on sharing of natural resources is bound to increase as India's projected total population in 2010 will be 1.19 billion, comprising 815 million rural people (68 per cent of the total population).

Agricultural intensification and extensification can impact the natural assets of land, soil and water in a number of ways. For example, poor land and soil management will result in massive water and wind erosion, overuse or misuse of pesticides and fertilizers will lead to soil and water contamination, and the overuse of irrigation will cause increased salination of productive soils. Water efficiency in agriculture is generally low and there are major concerns over resources depletion, unsustainable exploitation of ground water, falling water tables and conflicts over water use. Long term sustainability of water resources that take into account the multiple uses of water means that agriculture must pay greater attention to efficiency of farming system that would include appropriate crop mix.

Conservation of natural resources is an important issue from the point of view of sustainability of food security. The fast shrinking and deteriorating natural resources like land, water, biodiversity, forests, and changing climate including global warming are threatening the sustainability of food and nutritional security systems round the globe and particularly in India. The major Challenge to achieve increased productivity would therefore depend on our ability to ensure proper and judicious utilization of natural resources that will contribute to an sustainably high production of food and other agricultural crops. Further, Indian agriculture is still largely weather dependent, hence is full of uncertainties. Because of this and other factors, there are no standard solutions. Only way is to overcome them by experience, collective wisdom, and of course thorough appropriate research based technology application.

Genetic improvement of crops for enhanced productivity has been often regarded as a product of random or selection of spontaneous mutations ever since agriculture was practiced. Through the elucidation of the laws of genetics, plant breeding became a deliberate and predictable activity with the result that tailor-made crops are now in place. Traditional plant breeding methods have been very successful, providing the volume of food required to allow the world population to grow to its present scale. Breeding efforts have led to creation of remarkable diversity amongst various crop species.

However, recent trends in crop productivity indicate that traditional methods alone will not be able to keep pace with the growing demands for food, fibre and fuel. A remarkable increase in the total grain production was noticed between 1960 and 1980, while only a marginal increase was realized during 1980-1990 and subsequently. Much of the early increase in grain production resulted from an increase in an area under cultivation, irrigation, better agronomic practices and improved cultivars. In the seventies, a quantum jump in yield was achieved in wheat and rice by modifying the plant architecture. Yields of several crops have already reached a plateau, and therefore, most of the productivity gains in the future will have to be achieved through better natural resources management and crop improvement. Productivity gains are essential for long-term economic growth, but in the short-term, these are even more important for maintaining adequate food supplies for the growing world population. Per capita availability of land is shrinking and there is an urgent need to increase the yield potential of food crops in an environmentally sustainable manner.

Focussing on Rainfed Agriculture Systems

India ranks first among the countries that practice rain-fed agriculture both in terms of extent of land and value of production. Out of an estimated 140.3 m ha net cultivated area in India, about 79.44 m ha (57%) is rainfed and contributes 44% of the total food grain production. Even after achieving the full irrigation potential, nearly 50% of the net cultivated area will still remain dependent on monsoon rains. Rain-fed agriculture supports nearly

40% of India's estimated population. Rainfed agriculture system in our country accounts for production of nearly 90% of coarse cereals, 90% of pulses, 80% of oilseeds and 65% of cotton. In the rain-fed areas, farmers' dependence on livestock, besides agri based farming, as an alternative source of income is high. It is estimated that nearly two out of three heads of cattle population in India thrive in rain-fed regions. These factors emphasize the crucial role played by rain-fed agriculture in India's food security. However, the state of rain-fed agriculture in India is precarious and the problems associated with includes low cropping intensity, high cost of cultivation, poor adoption of modern technology, uncertainty in output, low productivity, increasing number of suicides among farmers, lack of institutional credit, inadequate public investment and high incidence of rural poverty.

The 2008 World Development Report emphasized that in order for agriculture to meet future food demand, water productivity improvements through water management and water uptake capacity of crops need to be achieved in the rainfed areas. Estimates suggest that about 75% of the increased water requirement, needed to attain the 2015 hunger reduction target of the Millennium Development Goals set by the United Nations. This improvement has to come from water investments in rain-fed agriculture. Numerous reports have emphasised on the correlation between poverty, hunger and water stress. An intensified efforts to upgrade rain-fed agriculture through balancing water for food and for ecosystem essential. Water resources management in rain-fed agriculture requires a landscape perspective and involves interactions from farm households to watersheds, to national and regional levels. Therefore, broader knowledge is needed for investments at national, regional and local levels.

Upgrading rainfed agriculture requires integrated approaches to social and ecological management. A challenge facing low-productive rainfed agriculture is the need for innovations in management of water that require novel technologies and practices such as water harvesting and conservation agriculture. Both innovation and adaptation are needed for successful adoption and out-scaling. One promising approach is adaptive co management

between local communities and knowledge institutions, in which knowledge sharing and transformation can be achieved through concerted joint efforts. Recently many institutions are employing several important tools for adaptive co-management those include participatory approaches, farmer field schools, and action research methods, with varied levels of success.

The common approach in an integrated rainwater management in general address the links between investments and risk reduction, between rainwater management and multiple livelihood strategies, and between land, water, and crops. Many on field demonstrations and pilot scale initiatives have developed strategies for upgrading, including technologies and management in watershed areas and watershed development plans. However, the missing links for scaling-up and scaling-out are social and economic processes and institutions that can link to suitable policies as well as sustainability of the institutions. India has experienced important success from integrated watershed management, with local ownership combined with tangible economic benefits among rural households. However, India's experience also highlights the limitation of a compartmental approach. The benefits of increased productivity were not realized to the desired extent, equity issues were not addressed, and community participation was not achieved, resulting in neglect of the various water-harvesting structures in the watersheds. Therefore, an integrated on farm approach to land, water, and crop management is required. At the same time watershed and basin development strategies are essential to increase yields in rainfed agriculture. Investments in upgrading rainfed agriculture need to consider the wide range of benefits from rainwater that contribute to the overall resilience of rural communities

Application of Molecular Genetics and Biotechnologies

The recent development in the field of molecular biology, biotechnology and bioinformatics offers uncommon opportunities to aid and improve classical plant breeding programs, and it is hoped that these will contribute to enhancing agricultural productivity. Location specific crop varieties are essentially the first and foremost necessity for an productive system

Using modern approaches, both the phenotype and the genotype of new/ existing varieties can be analyzed and the performance of specific new traits can be predicted. The molecular breeding or Marker Assisted Breeding has enabled successful transfer of several genes of interest, as well as Quantitative Trait Loci involved in polygenic traits, in many crop plants. Over the past two decades, scientists have developed large bioinformatics systems for breeding programs, based on the large scale sequencing information now available for crop species and their relatives. The availability of molecular data, linked to pedigrees and phenotypic evaluation, now makes breeding analysis much easier. Several international research centers in developing countries together with National Agricultural Research Systems have been using bioinformatics tools to utilise large repository of genetic resources for crop improvement information. Development of genomics and associated DNA technologies is hugely increasing molecular understanding of important plant breeding traits. Advanced marker technologies, such as Single Nucleotide Polymorphisms or second-generation massive parallel DNA sequencing technologies offer new ways to improve efficiency and effectiveness of many breeding programmes.

The field of genetic modification allows transfer of desired genetic combinations from across sexual barriers. The impact of GM crops has been well documented and dramatic since the mid 1990s when the first commercial varieties of herbicide and insect-resistant crops were released. Now, more than half of the areas planted to corn, soybean and cotton in the US utilise transgenic varieties and there is widespread use in South America, the India subcontinent and Australia. GM crops provide promising solutions for addressing a particular problems in agricultural production. The proprietary nature of the technology, however, limits the options for addressing the needs of the farmer, especially in low productivity regions where smallholder farmers are faced with a challenging environment in which to grow their crops. Only a few GM traits have been successfully developed and these mainly replace or reduce chemical inputs such as herbicides or insecticides. Agronomic traits, such as abiotic stress tolerance, and output traits such as yield or quality improvements have not yet emerged from the research phase, while there are several promising leads.

Plant biotechnology offers opportunities to improve the production and composition of crops with benefits to the environment and consumers. Application of molecular plant breeding is now focusing to discover new genes and their functions opening new avenues for basic plant biology research. For example, the work of M. S. Swaminathan Research Foundation has demonstrated that genetic characters from across the sexual barriers can be mobilized to generate transgenic materials free from IPR. The work on identifying and isolating the genes from mangrove species and transferring them into locally cultivated rice varieties have been successful in developing rice cultivars with tolerance to salinity, drought and quality enhancement. This and many other ongoing work at Indian Public and private institutions have opened up new avenues for enhancing agricultural productivity of major crops in our country. When carefully deployed, modern biotechnology will become an integral supplement to conventional plant breeding and its enormous potential should be harnessed to the best advantage of the entire humankind.

To date, globally, commercial GM crops have delivered benefits in crop production, but there are also a number of products in the pipeline which will make more direct contributions to food quality, clean environment, pharmaceutical production, and livestock feeds. Examples of these products include: rice with higher levels of iron and beta carotene; long life banana that ripens faster on the tree and can therefore be harvested earlier; maize with improved feed value; delayed ripening papaya; papaya ring spot virus resistant papaya; tomatoes with high levels of flavonols, which are powerful antioxidants; drought tolerant maize and wheat; maize with improved phosphorus availability; arsenic-tolerant plants; insect resistant eggplant and rice; edible vaccines from fruit and vegetables; low lignin trees for paper making among others.

The potential benefits of biotechnology should not divert our attention from the real concerns about the application of the new science. We need to invest much on developing adequate scientific infrastructure and human resources for biotechnology research, product development and more specifically in the area of safety assessment and safety management

both pre- and post deployment. Issues of bioethics and biosafety, and of intellectual property rights will be ceaselessly and inconclusively debated unless all those concerned have a genuine desire to reach accommodation based on practical realities, not on emotion or ideology. Adequate and effective ways of public education and capacity building of stakeholders is the key for instilling confidence of people in the technology.

Use of genetically modified varieties in most of the countries will depend on the development of appropriate regulatory capacity by the public sector to address food safety and environmental issues. Investment in technology appropriate for farmers and the establishment of effective, science-based regulatory capacity in the countries are linked in a circular way. Effective intellectual property regimes are important for any long-term investment, whether for internal innovations or in relation to those originating outside a country. Regional cooperation in intellectual property and biosafety has great potential for simplifying both technology access and agricultural trade.

Integrated Farming Systems

The previous sections has highlighted the fact that Indian economy is predominantly rural and agriculture based, and the declining trend in size of land holding poses a serious challenge to the stability, sustainability, productivity and profitability of farming systems. In view of the decline in per capita availability of land from 0.5 ha in 1950-51 to 0.15 ha in 2000-01 and a projected further decline to less than 0.1 ha by 2020, it is essential to develop strategies and agricultural technologies that enable adequate employment and income generation, specifically for the small and marginal farmers who constitute more than 80% of the farming community, in the country. It is absolutely essential that we make shift from crop and cropping system based research to a farming systems based research those are carried out in a holistic manner for the sound management of available resources by small farmers. Under the gradual shrinking of land holding, it is necessary to integrate land based enterprises like fishery, poultry, duckery, apiary, field and horticultural crops, etc. within the bio-physical

and socio-economic environment of the farmers to make farming more profitable and dependable. No single farm enterprise is likely to be able to sustain the small and marginal farmers without resorting to integrated farming systems (IFS) for the generation of adequate income and gainful employment year round. Farming systems approach, therefore, is a valuable approach to addressing the problems of sustainable economic growth for farming communities in India.

The farming system mode involving (i) in situ recycling of organic residues including farm wastes generated at the farm to reduce the dependency on external inputs (ii) decrease in cost of cultivation through enhance input use efficiency as well as engagement of family workforce, (iii) effective forward and backward linkages within the farm components (iv) upgrading of soil and water quality and increased diversity in the fields, (v) effective water management and productivity, (vi) nutritional security through soil-plant–animal- human chain, offers unique opportunities for improving productivity of the system. Farming system provides a vast canvass of livelihood gathering, a better risk coping strategy, continuous flow of income and employment throughout the year for small landholders. Therefore, farming system represents an appropriate combination of farm enterprises, viz., cropping systems, horticulture, livestock, fishery, forestry, poultry and the means available to the farmer to raise them for profitability. It interacts adequately with environment without disclosing the ecological and socio-economic balance on one hand and attempts to meet to national goal on others.

Concluding Thoughts

Globally we are witnessing a rapid surge in our concern and actions in making the hunger and malnutrition a history. This is exemplified by numerous political, scientific and stakeholder consultations, meetings and declarations that underlines necessity of concerted actions at local, regional and global level several initiatives and actions for reducing hunger, poverty and social deprivation. Role of agriculture and allied activities have assumed a

centre stage in all these initiatives. However, the recent global food price crises have highlighted the vulnerability of poor rural people's livelihoods to price volatility and price shocks. This therefore places food and nutrition security at the centre of any viable strategies for eradicating rural poverty. The global communities have also highlighted the inadequacy of global and domestic food systems in addressing the problems of a large number of people in conditions of chronic undernourishment or malnutrition. Developing sound and effective policy frameworks that enable farmers and food producers to contribute effectively to a stronger and more stable food supply system at national level is the urgent need and priority.

Overcoming the emerging agrarian and agricultural crises and their impact on poor and vulnerable people will require a combination of short-term and long-term actions. These measures must support agriculture development which is ecologically and economically sound, viable and sustainable. Addressing food security, nutrition adequacy and poverty reduction agenda, and strengthening the capacity of smallholder farmers to overcome poverty by becoming part of the solution to global food insecurity is essential to strengthen vulnerable livelihoods in rural areas. Policy initiatives are required in the areas of agricultural production, ensuring greater productivity per unit of land and water, sustainability and resilience issues in the era of climate change, large investment in infrastructure for storage, processing, post harvest technologies and transport, agricultural and food markets and trade, and putting in place adequate social protection and safety net programmes. Investment in Agricultural R&D that has been in the decline in the recent years also needs to be reversed.

It is also critical that poor rural people are supported in their ability to overcome poverty by seizing new opportunities at reduced risk. Therefore overcoming poverty can be the result of poor and marginal farmers operating in an enabling policy environment and supported by policies that recognize their importance and capacity to actively contribute to meeting the prevailing and emerging local, regional and global challenges, both today and in the longer term. Therefore, investing in building confidence in the poor, deprived and marginal communities will enable making hunger and poverty a history.

Commenting on the World Disasters Report 2011, Prof. M. S. Swaminathan has made following observations. “Hunger and malnutrition are the worst enemies of humankind. They deny to children – even at birth – an opportunity for the full expression of their innate genetic potential for physical and mental development. Freedom from hunger is the first requisite for sustainable human security. This will depend upon the productivity, profitability and sustainability of agriculture. Therefore, if food and nutrition policies go wrong, nothing else will have a chance to go right.”

I only echo these observations and hope our collective efforts – that of farm and rural women and men, scientific and technical professionals, extension workers, policy makers and political leadership – will bring in an era of Evergreen Revolution that ensures productivity increases in perpetuity enshrined in the principles of good ecology, economics and sound ethics. Together we can and we must bring in a change in agriculture that ensures adequate and balanced food and ensures remunerative income for all.

I thank you for your kind attention.

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II

ABSTRACTS OF PLATINUM JUBILEE LECTURE

PLATINUM JUBILEE LECTURE

Abiotic Stress Tolerance: Genes, Genomics and Genetic Engineering

K.C. Bansal

National Bureau of Plant Genetic Resources
IARI Campus, New Delhi 110 012, India
kailashbansal@hotmail.com; director@nbpgr.ernet.in

Abiotic stresses impose severe constraints on agricultural production; drought being a major stress that affects agriculture in about 45 % of the world's geographical area. Irrigated land is contributing to major agricultural production; however, unfortunately about 20 % of irrigated agricultural land is affected by salinity. Temperature extremes further exacerbate drought and salinity stresses and are also the limiting factors of crop production even in irrigated environments. Furthermore, global climatic changes suggest a future increase in the frequency of abiotic stresses in many parts of the world including India.

To supplement the conventional breeding methods, efforts are required to use the latest tools of biotechnology. Transgenic technology is one such tool that is being used globally to develop improved crop cultivars; however, novel genes for targeted genetic engineering of crops is one of the options, and the limitation as well, to enhance crop productivity in abiotic stress affected regions. Physiological and molecular genetic dissection of abiotic stress tolerance has revealed the complex stress-tolerance mechanisms that are governed by many component traits. Several genes controlling the component traits have been identified and validated for their function in transgenic background. Currently several genomics tools have become available and are being employed to identify novel genes.

We report here cloning of several candidate genes governing different mechanisms of abiotic stress tolerance. Transcriptome engineering by genetic manipulation of transcription factors or signaling proteins appears to be a promising means of improving

abiotic stress tolerance in crop plants including rice. CBF – a stress-induced transcription factor appears to play a central role in multiple stress tolerance. Hence, we have cloned *Arabidopsis* CBF transcription factor homolog from wheat, rice *LIP19* homolog from wheat, *Arabidopsis* *ZAT10* and *ZAT12* homologs from *Brassica* species, and *Arabidopsis*. We have also cloned AP2-transcription factor that regulates leaf wax biosynthesis from *Brassica* species. The potential of signaling proteins such as protein-farnesyltransferase for genetic improvement of water use efficiency and drought tolerance has been recently demonstrated in *Brassica* species. In order to use this strategy effectively in monocot crops such as rice and wheat, we have cloned a protein farnesyltransferase β -subunit gene from wheat. Reactive oxygen species (ROS) management is a common defense of plants under all abiotic stresses. One of the ROS detoxifying enzymes, ascorbate peroxidase (APX) present in chloroplasts is very critical for abiotic stress tolerance. In order to employ this strategy in genetic engineering, we have cloned a thylakoid-APX gene from wheat. LEA proteins play vital role in stress damage control and detoxification and thus protect cells under various stresses. We have cloned group V *LEA* and group I *LEA* genes from different oil seed *Brassicaceae*. The necessity of stress responsive promoters for precise regulation of transgenes under abiotic stress conditions is well demonstrated. However, only few stress responsive promoters are often used in genetic engineering. Hence we have cloned a *LEA* promoter that is induced by drought, salt, cold and ABA. The transcriptional regulators, effector genes and stress-inducible promoters cloned in our laboratory are currently being employed in engineering abiotic stress tolerance of crop plants like tomato, mustard, wheat and rice.

However, in order to introduce durable resistance to multiple abiotic stresses in crop plants, genes controlling different component traits need to be pyramided through genetic engineering and molecular breeding approaches.

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III

ABSTRACTS OF AWARD LECTURE / YOUNG SCIENTIST AWARD PROGRAMME

PROF. S.K. MUKHERJEE COMMEMORATION LECTURE

Improvement of Water-Deficit and Salinity Stress Response of Rice

Akhilesh Kumar Tyagi

National Institute of Plant Genome Research
Aruna Asaf Ali Marg, New Delhi 110067, India

Department of Plant Molecular Biology
University of Delhi, South Campus, New Delhi 110021, India

Development and growth of rice are severely affected by water-deficit and salinity resulting in significant yield loss. We have analysed response of rice for the same at transcriptome level. Analysis of data from our investigation along with information in data base on various water-deficit stress conditions imposed in one reproductive and six vegetative stages of rice development has helped identify >5,000 differentially expressed genes. Detailed analysis for transcription factors and metabolic pathway genes identified potential key components of stress response. The A20/AN1 zinc-finger containing stress-associated protein (SAP) gene family has been found to be closely related to stress response in rice and other plants. Using Y2H and FRET approaches, its member OsSAP1 has been found to interact with self, another homolog OsSAP11 and a receptor-like cytoplasmic kinase, OSRLCK253. A20 domain has been found to be crucial for such interaction(s) taking place differentially at nuclear/plasma membrane and/or in nucleus. Overexpression of these genes during water-deficit and in the presence of salt condition confers tolerance in homologous and heterologous transgenic systems, including protection against yield loss. The target genes influenced by their overexpression show significant overlap in addition to the specific complement. Similarly, overexpression of bacterial choline oxidase in rice confers stress tolerance. Further, with a view to avoid deleterious effects of constitutive expression of transgene(s), two novel stress-inducible rice gene promoters have been characterised for their activity. These promoters have been found to be salt/water-deficit/heavy metal stress-inducible, but do not respond to exogenous ABA treatment. Such investigations should help unravel molecular basis of gene action and soil-related stress tolerance.

PRAN VOHRA AWARD LECTURE

Characterization of Mitogen Activated Protein Kinase gene family in *Oryza sativa*

Kudupudi Prabhakara Rao*

Scientist, Biotechnology, Division of Crop Improvement
Central Tobacco Research Institute, Rajahmundry-533105, AP
Email: prabhakarabt@yahoo.co.in, Tel: 7702664572

Mitogen activated Protein Kinases (MPK) are universal signal transduction modules involved in transducing the extracellular stimuli in to intra cellular responses in eukaryotes. Despite of their importance very less information is available in rice compare to Arabidopsis. In the present investigation 16 MPK genes were identified from the redundant database, they were cloned from indica cultivar of rice, sequenced and compared with japonica rice which elucidated the differences at the nucleotide level between the two cultivars. All the MPKs were analyzed under heat and cold stress at the level of transcript and protein and found the activation of OsMPK7 and OsMPK3 in respective stresses. Further, the detrimental effect of arsenic stress on the photosynthetic efficiency and growth of rice seedlings was studied and analyzed the MAPK cascade genes for their involvement in arsenite mediated signal transduction. The rhythmic expression in the basal MAPK activity was analyzed and correlated with the diurnal/circadian rhythms. Analysis of the transcripts of group A, B and C members of MPKs under these conditions by quantitative real time PCR revealed that the members of group C exhibit periodic rhythm. Insilico analysis of rice proteome database was carried out using different bioinformatic tools and identified 75 MAPKKKs and classified into 3 groups by phylogenetic analysis. Further expression analysis of the MAPKKKs in MPSS database revealed that their transcripts were differentially regulated in various stress and tissue-specific libraries. The list of rice MAPKKKs identified will be very significant for further investigating the regulation mechanism of MAPKKKs in response to extracellular stimuli and their central roles in various biological functions. Additionally the comprehensive information generated about MAPKs will serve purpose in elucidating the MAP kinase cascade in plants in general and in rice in particular.

YOUNG SCIENTIST AWARD PROGRAMME LECTURE

Coordinated changes during seed development and germination in candidate plus tree of *P. pinnata*, a versatile forest tree as revealed by morphological, biochemical and ultrastructural studies

Vigya Kesari

Department of Biotechnology, Indian Institute of Technology Guwahati
North Guwahati, Assam, India 781 039

Key words: *Pongamia pinnata* (L.) Pierrie, candidate plus tree, maturation, morphology, germination, lipids, SDS-PAGE, seeds, seed storage proteins, SEM, ultrastructure, TEM

Systematic seed characterization of candidate plus tree of *Pongamia pinnata* w.r.t phenology, protein profile and storage reserve accumulation and utilization during maturation and germination respectively was studied. Seed maturation was categorized into seven developmental stages (I-VII, 90-350 DAF). Significant changes in total soluble protein and SDS-PAGE were observed amongst seven seed maturation stages, vegetative and other reproductive tissues and in cotyledons of germinating (5th-45th DAG) seedlings. Further, microscopic studies (SEM and TEM) during seed maturation and germination helps to localize the gradients of storage reserve deposits. The findings can be helpful in efforts to improve *Pongamia* as promising biodiesel crop.

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IV

ABSTRACTS OF SYMPOSIUM / INVITED LECTURE

1. **Sea Farming: An alternate and additional source of livelihood for women in coastal India**

Dinabandhu Sahoo

Department of Botany, University of Delhi, Delhi 110007, India
Email: dbsahoo@hotmail.com

Key words: Sea farming, Women empowerment, Livelihood

India has a long coastline of more than 7500 km. The people living in the coastal areas mainly depend on fisheries and related activities for their livelihood. Since their daily earnings are meager many of them sucked into activities like coral mining or indiscriminate harvesting of fisheries resources which are harmful for the marine ecosystem. Disease, malnutrition, lack of job opportunities, and a host of other problems force many to migrate to nearby towns. Thus, there is an urgent need to enhance the earning capabilities of the people and empower them economically. Seaweed cultivation and utilisation is one of the alternatives, which can create earning opportunities especially for women who are left behind while the men go fishing during the day. A programme unique in its concept, implementation strategy, uniformity in training module and co-ordination with a number of institutes, universities and Non Government Organisations (NGOs) and Self Help Groups has been successfully implemented through “**Chilika Model**”.

2. **Arbuscular Mycorrhizal Fungi for Sustainable Agriculture, Horticulture and Forestry**

D. Joseph Bagyaraj

Centre for Natural Biological Resources and Community Development
41 RBI Colony, Anand Nagar, Bangalore 560 024, India
Email: djbagyaraj@gmail.com

The role of arbuscular mycorrhizal fungi (AMF) in improving plant growth is well documented. The beneficial effects being improvement in the uptake of diffusion-limited nutrients, synergistic interaction with beneficial soil microorganisms, production of plant growth promoting substances, greater ability to withstand water stress and root pathogens. Though these endophytes are not host-specific there is enough evidence of their host preference, thus enabling the possibility of selecting an efficient AMF for a particular crop.

AMF being obligate symbionts mass production is not as easy as other bio-inoculants. Hence, it will be more practical to concentrate on crops normally grown in nursery beds, root-trainers or polybags and then transplanted to the field. Our investigations with plants important in agriculture, horticulture and forestry, including medicinal and aromatic plants, have shown great potential in using AMF inoculation for improving growth and productivity. The micro-propagated plantlets as well as perennial crops already established in the field respond positively to inoculation with efficient AMF. In horticultural plants it was found that AMF inoculation made the root stocks ready for budding/ grafting much earlier than uninoculated plants. Inoculation made flowering ornaments to flower early and to have a longer vase-life. In plantation crops like cashew AMF helped in overcoming the transplant shock when planted in the field. Studies on delivery systems brought out the optimum method and level of inoculum placement. Co-inoculation of AM fungi with other beneficial soil microorganisms is more useful in improving plant growth thus suggesting the need for development of suitable 'microbial consortia' for inoculating different crop plants. Recently, we brought out that 'microbial consortia' developed using efficient AMF + PGPRs helped in the successful re-vegetation of degraded forests.

3. Increasing Nitrogen Use Efficiency and Protein Contents of Plants - A Transgenic Approach

Naveen C. Joshi & Baishnab C. Tripathy

School of Life Sciences, Jawaharlal Nehru University, New Delhi 110067

Email: bctripathy@mail.jnu.ac.in

Carbon, nitrogen and sulphur metabolisms are highly dependent upon one another. Carbon metabolism is usually mediated by photosynthesis and respiration. Nitrogen metabolism is regulated via nitrate uptake by the root system and its reduction to NH_4^+ . The S and N assimilation is mediated by a prosthetic group siroheme, synthesized from uroporphyrinogen III, an intermediate of biosynthetic pathway of Chl, an essential pigment of carbon assimilation in oxygenic prokaryotic and eukaryotic autotrophs. In the present study the genetic manipulation of tetrapyrrole biosynthesis pathway that governs carbon, nitrogen and sulphur assimilation has given an insight to the co-regulation of these three

different but inter-dependent biological processes. In the present study metabolism of chlorophyll, nitrogen and sulphur is genetically manipulated by over-expression of and sirohydrochlorin ferrochelatase (*SirB*) required for carbon, nitrogen and sulphur assimilation.

AtSirBx plants were bigger in size and greener in colour as compared to that of WT. The fresh weight and dry weight of *AtSirBx* were more than that of WT whereas in antisense plants were less than that of WT. This could be due to increased nitrogen, sulphur and carbon assimilation in sense plants. The Chl and carotenoids contents of *AtSirBx* plants were higher than that of WT. Similar to Chl, the total protein and N contents of mature (3-week-old) *AtSirBx* plants were higher than that of WT. This was due to increased NR and NiR activities of *AtSirBx* plants. The increased activity of NR was due to increased gene expression of *Nia2*, that encodes nitrate reductase structural gene, involved in nitrate assimilation. The augmented NiR activity was due to increased *NiR* gene (*Nii*) and protein expression in *SirBx* lines. Therefore, increased activity of NiR was due to increased availability of apoprotein and the prosthetic group siroheme. To ascertain if these plants could tolerate N starvation, WT and *AtSirBx Arabidopsis* plants were grown in N deficient media. Due to N deficiency the phenotype of WT plants looked pale-green and in extreme N starvation (0.1N of control), they almost blanched. This was due to reduced Chl accumulation. Under identical growth conditions the *AtSirBx* plants looked greener than WT and had higher amounts of Chl than that of WT.

Sulphate is taken up and then assimilated to cysteine and reduced in the chloroplast. The limited supplies of sulphur in plants result in decreased plant tissue sulphur content. Decreases in sulphur content results in the inhibition of sulphate assimilation, decreased cysteine and methionine contents, reduced chlorophyll, total protein and nitrogen imbalance. Overall, these changes lead to a reduced rate of metabolism and growth. After 7 days of growth in S-deficient medium (0.1S) the phenotype of WT plants were deficient in Chl and looked pale-green whereas the *AtSirBx* plants accumulated higher amounts of Chl and looked greener than that of WT.

4. Forage crop research will improve life in our industrialized planet and help sustainability of agriculture

Surya N. Acharya

Agriculture and Agri-Food Canada Research Centre
Lethbridge, Alberta, Canada T1J 4B1 acharya@agr.gc.ca

***Key words:** Forage crops, biodiversity, sustainability, multipurpose crop*

Forages are a group of crops used as food for cattle and other ruminants providing meat and milk that are major sources of protein in human diets. Many perennial forage species are widely adapted, can grow in relatively less fertile land and have proven useful for reclamation, revegetation and desertification control in many parts of the world. Forages belonging to many plant families and genera when incorporated in the farming systems contribute to biodiversity. In addition, many forage legumes attract insects for pollination and so their presence in the landscape further aids biodiversity. Some well known forage crops are now used in as human food and others are being investigated extensively for their nutraceutical properties. Forage crops can fetch a good price in the market place and are grown as cash crops for export to areas lacking land base or unfavorable conditions for plant growth. Forages are especially important for sustainability of agro-forestry in countries such as India, because this country has the largest number of cattle in the world. Without improved supply and management of feed for cattle and other ruminants the vegetation in forests throughout India will be progressively degraded.

Improvement in understanding the nature of these crops including management and production will be important for the expansion and sustainability of the agro-industry in general. Increased research activity on forage crops and enhanced awareness of their beneficial economic and environmental effects could aid in the conservation of plant diversity in forests and more effective use of range and marginal lands. Due to their adaptation to marginal lands, ability to grow in mixed stands and high biomass yield forages have the potential to be useful as bioenergy crops. Furthermore, research on their use in rotations with other crops detrimental for soils and following industrial disturbances including application of excessively high doses of manure will promote soil conservation, land stewardship and prevent ground water contamination. Increased research on forage crops will give a much needed boost to a segment of the agricultural industry which in countries such as India and China, has been largely ignored.

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V

**ABSTRACTS OF
ORAL PRESENTATION**

1. Performance of short duration fruit and medicinal crops under agri-silvicultural agroforestry system

A.K. Patra, P. J. Mishra, B B Behera, S. Das and B. P. Gantayat

All India Coordinated Research Project on Agroforestry, Orissa University of Agriculture & Technology, Bhubaneswar, Orissa 751 003
Email: alokpatra2000@yahoo.co.in

Key words: *Agri-silvicultural system, Acacia mangium, Gmelina arborea, Andrographis paniculata, Curcuma amda, Aloe vera and Ananas comosus*

Forest area is decreasing alarmingly due to population growth and infrastructural developments which causes environmental pollution, ecological imbalance, global warming and climate change. Availability of per capita forest in India is only 0.06 ha as against world average of 0.64 ha and that of developed countries at 1.07 ha. Thus, with the modern day crisis of shortage of agricultural and forest land, agroforestry is well positioned to provide a perfect balance and a solution. Agri-silvicultural system where annual crops are grown with trees could be one such promising and viable option to achieve diversification as well as assured income from the system. Also, this would extend physical and ecological benefits including reduction in risks in the monsoon dependant cropping, improved opportunities of carbon sequestration with enhanced ecological stability and efficient nutrient cycling through multiple land use activities.

The compatibility of three medicinal crops kalmegh (*Andrographis paniculata*), ghee kuanri (*Aloe vera*) and mango ginger (*Curcuma amda*) and one short duration fruit crop pine apple (*Ananas comosus*) was studied during 2009-2010 and 2010-11 at Bhubaneswar. The crops were grown in the alley space of nine year old trees *Acacia mangium* or *Gmelina arborea* planted in east-west direction at a spacing of 8 m x 2 m. *Acacia mangium* was found to be more suitable for the system due to its faster rate of growth, higher biomass, more crown spread and, more importantly for soil ameliorating characteristics. There was absolutely no difference in growth of annual intercrops with that of the respective sole crops. Pine apple as an intercrop recorded maximum yield recovery as compared to sole crop in association with *Acacia mangium*. Among the tree species, yield recovery for all the crops were the highest with *Acacia mangium*. Pine apple in association with *Acacia mangium* gave the highest net return closely followed by pine apple in association with *Gmelina arborea*.

2. Dry direct-seeding of rice for mitigating greenhouse gas emission

H. Pathak¹, S. Sankhyan², D.S. Dubey¹, A. Bhatia¹ and N. Jain¹

¹Division of Environmental Sciences,
Indian Agricultural Research Institute, New Delhi
²PepsiCo Foods Private Limited, Gurgaon, Haryana

Conventional puddled transplanted rice (TPR) is major source of greenhouse gas (GHG), particularly methane, causing global warming and climate change. Direct-seeded rice (DSR) is a feasible alternative to mitigate methane emission, besides saving water and labour. Field experiments were carried out in kharif season (May to October), 2009 and 2010 to quantify GHG mitigation and water and labor saving potentials of the DSR crop compared to TPR in three villages in Jalandhar district of Punjab, India. Collection of gas samples was done using the closed-chamber technique. Concentrations of CH₄ and N₂O in the samples were analysed by gas chromatograph. Measurements of soil and plant parameters were carried out and data on crop management were collected. The InfoRCT simulation model was used to calculate emission of CO₂ besides CH₄ and N₂O in different districts of Punjab, India. Average global warming potential (GWP) due to all the three GHGs (CO₂, CH₄ and N₂O) in transplanted rice was 2.91 t CO₂ eq. ha⁻¹ ha⁻¹ whereas in the DSR the GWP was 1.9 t CO₂ eq. ha⁻¹. Total GWP in transplanted rice in various districts of Punjab ranged from 2.0 to 4.6 t CO₂ eq. ha⁻¹ and in the DSR it ranged from 1.3 to 2.9 t CO₂ eq. ha⁻¹. Extrapolating the data to the entire state showed that total GWP of TPR in the state is 8.3 million ton (Mt) CO₂ eq. If the entire area under TPR in the state is converted to DSR, the GWP will be reduced by 33% and if 50% area is converted to DSR the GWP will be reduced by 16.6% of the current emission. The DSR crop saved 3-4 irrigations compared to transplanted rice without any yield penalty. Human labour use also reduced to 45% and tractor use to 58% in the DSR compared to TPR. The two-year study showed that the DSR reduces GHG emission, and saves irrigation water and labour without yield penalty compared to the conventional TPR.

3. Appropriate agronomic and irrigation management strategies for Potato under Climate Change scenario

R. K. Panda, D. Halder, C. K. Das

Professor, Agricultural and Food Engineering Department
Indian Institute of Technology, Kharagpur-721302, WB, India
Telefax- 03222-283138; Email: rkpanda56@gmail.com

SUBTOR Potato model was used to simulate the effect of increasing CO₂ concentration, rising temperature and varying rainfall on potato crop. Sowing dates were adjusted to suit the climate variability. Deficit irrigation (DI) and partial root-zone drying (PRD) techniques were compared to determine their suitability under climate change and water deficit conditions. PRD improves the water and nutrient use efficiency as compared to DI. Model simulation was done for 33 years (1977-2011) and was authenticated by pot experiments. PRD decreases biomass allocation to leaves, roots and stems while increasing to tubers and therefore suitable under climate variability conditions.

4. Molecular dissection of stress tolerant plant *Prosopis juliflora* for understanding pathways of plant abiotic stress tolerance

Suja George and Ajay Parida

M.S.Swaminathan Research Foundation
Third Cross Street, Institutional Area
Taramani, Chennai-600 113, Tamil Nadu, Email: ajay@mssrf.res.in

Key words: *Abiotic stress tolerance, Prosopis juliflora, cDNA library*

Molecular dissection of stress adaptable model plants is important in understanding pathways of tolerance. This study chose *Prosopis juliflora*, a drought/heat/heavy metal tolerant tree of *Fabaceae* as model plant for identifying and isolating genes functioning in abiotic stress tolerance. A cDNA library was created from drought stressed leaf tissue of *P. juliflora* and several ESTs were randomly sequenced resulting in the identification of several genes reported to function in stress tolerance in addition to many previously uncharacterized ones. Many of these genes were characterized in detail. The study provided better understanding of stress tolerance mechanisms of *P. juliflora*.

5. Transferability of pigeonpea SSR markers across eight genera of Papilionoideae subfamily for elucidates legume evolution

Sutapa Dutta¹, Tapas K Bandhopadhy², Rajeev K Varshney³, Nagendra K Singh¹

¹National Research Centre on Plant Biotechnology
IARI, New Delhi 110 012

²Dept. of Molecular Biology and Biotechnology
University of Kalyani, Kalyani, WB 741235

³ICRISAT, Patancheru, Andhra Pradesh 502324

Keywords: *Comparative mapping, Transferability, Genic-SSR, Legume*

The transferability of genic-SSR markers from pigeonpea [*Cajanus cajan* (L.) Millsp.] to all major pulse yielding taxa (belonging to four major clade of Papilionoideae sub-family) has revealed varied levels of marker transferability within and across the Dalbergoid, Genistoid, Hologalegina and Millettoid clade. The transferability rate varied from 12.5 % (Genistoid clades) to 24.5 % (Dalbergoid clade). Only two markers (ASSR-211 and ASSR-525) have amplified in all 7 legume genera though all accessions of each species were not amplified. 128 markers (64 %) were amplified in at least one legume species, whereas 72 (36 %) markers did not amplify in legumes indicating the uniqueness of these loci to the *Cajanus* genus only. Forty-four markers produced polymorphic band profiles across legumes even though intra-specific polymorphism was not observed. In comparison to the size of the reference species *C. cajan*, the cross-genera amplicons were varied greatly in size (80-800 bp). The amplicon size of the allelic data generated by ASSR-247, was varied from 130 (soybean) to 400 bp (mungbean). Different size alleles amplified for one loci across the legumes were sequenced. Sequence comparisons at ASSR-211 has revealed that high sequence conservation in the SSR motif but there are differences of repeat motifs as well as variability of the flanking sequences marked by in-dels/point mutations as comparison with pigeonpea sequence from where marker has developed. Using the UPGMA method and Nei and Li (1979) coefficient of similarity, a SSR based dendrogram of major clade of Papilionoideae sub-family was constructed based on the 200 genic SSR markers which revealed closeness of Millettoid and Hologalegina clade is supported by 98 % bootstrap value followed by 82 % with Genistoid clade. These common transferable DNA markers among legumes would provide us tools to compare legume genomes and allow gaining insight into relationship of legumes and elucidating legume evolution.

6. Effect of Elevated CO₂, Temperature on Methanotrophy and Methanotrophic Diversity in a Tropical Paddy

Suwendu Das and T.K. Adhya

Laboratory of Soil Microbiology, Division of Crop Production, CRRI, Cuttack-753006, Orissa

Impacts of elevated CO₂ (550±30 μmol mol⁻¹ CO₂) and temperature (2°C higher than the ambient temperature) on methanotrophic diversity was studied by PCR denaturing gradient gel electrophoresis (DGGE) and subsequent cloning and sequencing. Sequences affiliated with *Methylococcus capsulatus*, *Methylocaldum tepidum*, *Methylosphaera hansonii* and a group of uncultured bacterium *pmoA* gene was detected in all the treatments. The phylogenetic affiliation of the recovered sequences suggested the predominance of type I methanotrophs. In addition, elevated CO₂ and interactive effect of elevated CO₂ and temperature significantly decreased CH₄ consumption; however the decrease was less in interactive effect of elevated CO₂ and temperature compared to elevated CO₂.

7. Molecular markers based characterization in versatile forest tree species, *P. pinnata*

Latha Rangan¹, Vigya Kesari¹, Madurai S Vinod² & Ajay Parida²

Department of Biotechnology

Indian Institute of Technology Guwahati Assam 781 0391

MS Swaminathan Research Foundation, Taramani Institutional Area, Chennai 600 1132

Key words: CPT; Forest species; Markers; *Pongamia pinnata*.

Pongamia pinnata, a forest tree has many traditional uses. The application and informativeness of PCR based molecular markers (RAPD, ISSR and AFLP) to assess the genetic variability and relatedness among 10 CPTs of *P. pinnata* was investigated. Molecular markers discriminated the individuals efficiently and generated a high similarity in dendrogram topologies derived using UPGMA. The 3-dimensional scaling by principal coordinate analysis (PCA) supports the result of clustering. Comparing the results obtained with three DNA markers, AFLP indicated higher efficiency for estimating the levels of genetic diversity and proved to be reliable for fingerprinting, mapping and diversity studies in *Pongamia* in view of their suitability for forest plantation.

8. Isolation of ascorbate peroxidase from rice and cowpea cultivars

Prikhshayat Singh^{1*}, Hendrik Fuhrs² and Walter J. Horst²

Biochemistry Division, Indian Agricultural Research Institute, New Delhi 110012¹,
Institut für Pflanzenernährung, Leibniz Universität Strasse 2, 30419 Hannover, Germany²

Key words: Rice, pea, Mn-tolerant, Mn-susceptible cultivars, ascorbate peroxidase

Ascorbate specific peroxidase (APX) is one of the four enzymes that constitute the ascorbate-glutathione cycle. This enzyme (APX) along with other three enzymes plays a major role in the cells under environmental stress. The method for the isolation and assay of APX was standardized from rice. The presence of 0.1 mM ascorbic acid in isolation medium with pH 7.7, had beneficial effect on enzyme activity and stability. The enzyme assay from rice leaf has optimum pH of 7.0. The enzyme activity was quite stable even after 24 hours storage at 0-4°C. The enzyme was active even after six days of cold storage and had 20% of the initial activity, but the frozen conditions were harmful for the enzyme and enzyme was substantially inactive after 12 hours. The same medium, worked out for rice was used to isolate enzyme from different cultivars of cowpea. It was observed that Mn-sensitive cowpea cultivar had 150% higher activity as compared to that from Mn-tolerant cultivar, but 38% lower than that from rice leaf. It seems that higher activity of APX in Mn-sensitive cultivar may have to play a role to effect protection to Mn-sensitive cultivar against environmental stress. The results are discussed in the light of these findings that how plants react towards various environmental stresses.

9. Differential accumulation of β -carotene and tissue specific expression of Phytoene Synthase (*MaPsy*) gene in major Indian Banana (*Musa sp*) cultivars

R. Dhandapani^{1*}, Ambika Rajendran²

¹Division of Plant Physiology, Indian Agricultural Research Institute
New Delhi, India.

²Directorate of Maize Research, New Delhi, India.

Key words: *Musa accuminata*, Nendran, Vitamin A, Carotenoid, β -carotene, Phytoene synthase.

In banana, orange-yellow flesh colour is considered as a quality trait that correlates with high nutritional value in terms of its provitamin A (β -carotene) content. Recently, the potential health benefits of non edible peel of the banana fruits with high amount of β -carotene have been reported. Hence, an experiment was conducted to investigate the molecular relationship between the differential accumulation of β -carotene in peel and pulp of the banana fruit

and the expression of carotenoid biosynthetic pathway gene. The high performance liquid chromatography results showed that all the twelve cultivars analysed were accumulated 2-3 times more β -carotene in the non edible portion of the banana fruit. However, south India's famous orange fleshed cultivar 'Nendran' (AAB) accumulated highest β -carotene content (1362 $\mu\text{g}/100\text{g}$) in the edible pulp of the banana fruit. To elucidate the rationale, we first cloned a partial sequence of *Musa accuminata* Phytoene synthase (*MaPsy*) gene, a rate limiting candidate gene responsible for β -carotene accumulation. The semi quantitative RT-PCR analysis results revealed that the increased accumulation of β -carotene in peel was due to 2-3 times increased expression of *MaPsy* gene. Further, the increased level of β -carotene in the non edible portion of the twelve banana fruit and the edible portion of the orange fleshed banana cultivar "Nendran" were due to the presence of two isoforms of *MaPsy* gene. All other cultivars contain only one isoform of *MaPsy* in the edible portion of the banana fruit. These observations demonstrated that the carotenoid accumulation is a tissue specific process and is strongly depending upon the differential expression pattern of the isoforms of *MaPsy* gene in banana.

10. Population structure of dominant tree species in tropical deciduous forest covers of Chandaka Dampara wildlife sanctuary, Orissa, India

R. K. Mishra¹, P. K. Nanda², B. K. Patra³, A. Dash⁴ and R. C. Mohanty²

¹Department of Wildlife and Biodiversity Conservation
North Orissa University, Takatpur, Baripada-757 003

²Department of Botany, Utkal University
Vani Vihar, Bhubaneswar-751 004

³Center for Envotech and Management Consultancy Pvt. Ltd., Bhubaneswar-751 007

⁴ Department of Botany, Maharishi College, Sahid Nagar, Bhubaneswar

Key words: Population structure, Dominant, Tropical deciduous, Wildlife sanctuary.

Population structure based on girth at breast height (gbh) measurements of individuals of nine dominant tree species viz. *Careya arborea* Roxb., *Shorea robusta* Gaertn. f., *Strychnos nux-vomica* L., *Tectona grandis* L. f., *Pterocarpus marsupium* Roxb., *Limonia acidissima* L., *Azadirachta indica* A. Juss., *Cassia fistula* L. and *Aegle marmelos* (L.) Corr. was studied in disturbed and undisturbed forest stands of Chandaka Wildlife Sanctuary (CWS), Orissa. All the dominant species except *Careya arborea*, *Shorea robusta* and *Limonia acidissima* in undisturbed stand and, *Tectona grandis* and *Pterocarpus marsupium* in disturbed stand showed rotated sigmoid type of gbh-density curve. Concave type of gbh-density curve of *Shorea robusta* only in undisturbed forest stand and of *Careya arborea* was recorded both in disturbed and undisturbed forest stands of the sanctuary indicating their strong dominance. However, formation of plateaus and depressions in gbh-density curve of *Shorea robusta*, *Tectona grandis* and *Pterocarpus marsupium* at the disturbed stand reflect the gap phase

type of regeneration with a resultant reduction in survival of individuals during respective stages. A low percentage of established seedlings compared to saplings of *Limonia acidissima* in the undisturbed stand of the sanctuary can be referred to as a fair reproducer as it reproduced in the immediate past and continue to do so at present though at a lower rate. From the present study it is also marked that cut stumps frequently occur in the disturbed stands giving rise to more number of sprouters. This indicates that the dominant tree species are the good coppicers. However, due to frequent lopping of the coppicers there was no substantial regeneration and establishment of trees in the disturbed stand of the sanctuary. With continuance of such activities in the sanctuary, future populations of dominant tree species in the forest covers may be threatened, thus requiring conservation measures to protect these species.

11. Growth, phenology and yield of Rice crop under elevated CO₂ and rising temperature in Eastern India

S.S. Satapathy, D.K. Swain, M. Ghosh

Agricultural and Food Engineering Department
Indian Institute of Technology Kharagpur, Kharagpur – 721 302
Email: swain@agfe.iitkgp.ernet.in

Key words: *Climate change; Elevated CO₂; Open Top Chambers; Rice yield.*

Carbon dioxide concentration of the atmosphere is currently about 385 ppm, which is expected to increase to 535 - 983 ppm by 2100, if mitigation mechanisms are not enforced. Climate change because of increasing concentration of the atmospheric CO₂ may bring benefits to some parts of the world, but is a threat to food security of many nations in tropical and sub-tropical region. Rice, an important food crop for more than half of the world's population, is mostly grown in tropical and sub-tropical countries, where the production has major implication on global food security. A field experiment was conducted in Open Top Chambers (OTCs) to understand the effect of elevated CO₂ and temperature on rice production system of eastern India. The experiment was conducted during dry season (Jan-May) and wet season (June-November) of the year 2009-11 in the research farm of Agricultural and Food Engineering Department, Indian Institute of Technology Kharagpur, Kharagpur (22°19'N and 87°19'E), India. Four rice cultivars of varying duration were grown inside OTCs in ambient CO₂ (385ppm), elevated CO₂ (25% higher than ambient), and elevated CO₂ with 2°C rise in temperature above ambient. The cultivars were grown with their recommended fertilizer level in both dry and wet seasons. Results from the field experiment indicated an increasing vegetative biomass and crop duration of all the cultivars under elevated CO₂ and temperature as compared to ambient. Whereas, the elevated CO₂ and elevated CO₂ with increasing temperature reduced the rice grain yield by 22% and 37%, respectively in dry season and 2% and 7%, respectively in wet season as compared to the ambient condition.

12. **Hastening the breeding cycle through doubled haploid approach**

G.J.N. Rao

Central Rice Research Institute, Cuttack 753 006

Key words: *Doubled haploid, rice, breeding*

Doubled haploid breeding, an innovative and attractive approach, can help the breeders in shortening the breeding cycle of crop plants through production of homozygous recombinants in a single step from a cross combination. Doubled haploid approach offers several advantages over the conventional approach and can be easily integrated into breeding programs. The adoption of hybrid rice, a viable practical option for increasing rice productivity suffers due to constraints like seed cost and grain quality which can be effectively addressed through this new approach. The study presents a detailed report on the success of doubled haploidy in rice improvement.

13. **Characterization of titanium nano particles: pH and humic acid interaction**

Tapan Adhikari

Indian Institute of Soil Science, Nabibagh, Berasia Road, Bhopal 462038

Key words: *Titanium, Nano Particles, pH, Humic Acid.*

The colloidal behaviour of TiO_2 nano particle (<10nm) (NP) was significantly influenced by the solution pH. The physicochemical nature of humic acid (HA) can also dominantly alter the colloidal stability of NPs. In neutral to alkaline conditions, HA could stabilize the TiO_2 NP colloidal system. However, in acidic conditions, HA could stabilize colloidal stability, possibly through a charge neutralization mechanism. The presence of long chain weakly charged fractions of HA strongly decreased the colloidal stability of the NP, possibly through entrapment of NPs in gel line net work. The association of HA to the titanium nano particle surface was identified by AFM phase-contrast imaging, because AFM can distinguish the difference in material properties.

14. Surface and subsurface distribution of Zn, Cu, Fe and Mn as influenced by different cropping systems in Typic Ustocrepts soils of Punjab, India

Gurpreet Singh, S. S. Dhaliwal, B. D. Sharma, U.S. Sadana

Department of Soil Science, Punjab Agricultural University, Ludhiana, India

Key words: Cropping systems, DTPA-extractable and total Zn, Cu, Fe and Mn, surface and subsurface distribution of micronutrients.

Rice-wheat, maize-wheat and cotton-wheat are predominant cropping systems, being practiced by majority of farmers in Punjab. The adoption of these three cropping systems has depleted a huge amount of macronutrients (N, P and K) and micronutrients (Zn, Cu, Fe and Mn) causing deficiency of these nutrients mainly in light textured soils. So, to overcome the deficiency of Zn, Cu, Fe and Mn in such soils, alternative cropping systems like maize-potato-mungbean, cotton-gobhi sarson, groundnut-toria+gobhi sarson etc., are required. Lot of research work has already been done on the predominant cropping systems without inclusion of short duration crops like mungbean, toria, gobhi sarson and onion crops. So there is need to explore research on inclusion of short duration crops in the main cropping systems, which can help in mobilization of Zn, Cu, Fe and Mn. Therefore, the present research study has been conducted with a prime objective to investigate surface and subsurface (depthwise) distribution of Zn, Cu, Fe and Mn under different cropping systems. For this study surface (0-15 cm) and profile (0-120 cm) soil samples were collected from an ongoing field experiment (in progress since 2000) with 10 cropping systems at research farm of Department of Agronomy, PAU, Ludhiana. These soil samples collected at different stages were analyzed for DTPA-extractable Zn, Cu, Fe, and Mn using atomic absorption spectrophotometer (Varion AAS-FSS model). The results of our study concluded that the levels of DTPA-extractable Zn, Cu, Fe, and Mn were significantly higher in soil under all 10 cropping systems as compared to their initial levels. Higher levels of DTPA-extractable Fe and Mn and, Zn and Cu were observed in rice-wheat and cotton-wheat systems, respectively. Among maize based cropping systems, maize-potato-mungbean cropping system reported significantly higher concentrations of DTPA-extractable Zn, Cu, Fe, and Mn. The DTPA-extractable Zn and Cu decreased in soil under maize-potato-mungbean cropping system whereas, Fe and Mn increased. The inclusion of mungbean (T3) increased the available Zn, Cu, Fe and Mn to the tune of 27, 37, 14.4 and 11.3 per cent respectively over T2 cropping system. Similarly inclusion of oil seed crop (African sarson) in T7 improved the available Zn, Cu, Fe and Mn to as 9, 11, 58 and 15.5 per cent respectively over T6 cropping system. Except Mn, the DTPA-extractable Zn, Cu and Fe decreased with increase in the soil depth.

15. Efficient screening for resistance to Iron toxicity in medium and low land rice varieties of Orissa

Sunita Sahoo, A.B.Das & G.R.Rout

Department of Agricultural Biotechnology, College of Agriculture,
Orissa University of Agriculture & Technology, Bhubaneswar- 751 003, Orissa
Email: grout@rediffmail.com

Iron toxicity is a major nutrient disorder affecting rice production of wetland rice in the irrigated and rain fed ecosystem in India. In the present study the experiment was conducted to develop a screen for seedling resistance to Fe toxicity based on individual plants subjected to varying concentration of Fe (0 mM, 50mM, 100mM, 200mM) for germination and 0 mM, 10 mM, 20 mM, 40 mM for effective growth under nutrient culture. The stress duration (1-15 day of exposure) and leaf bronzing score were taken into consideration. Screening of 51 varieties of rice showed the detrimental effect of higher concentration of Fe on seedling growth and germination and also identified the tolerant and non-tolerant varieties. Some tolerant and non-tolerant rice varieties were studied for the protein profile under control and iron stress treatments. Prominent difference including changes in banding pattern including no. of bands, intensity with respect to Fe- toxicity was evident. In stress condition, the number of polypeptide was more in tolerant variety compared to non-tolerant. In 80mM Fe, the tolerant variety showed 43, 20 and 14.3 kDa polypeptides whereas in non-tolerant case all these bands were absent due to heavy Fe-stress. Out of these 3 polypeptide bands which are observed in case of tolerant variety at 80 mM, one polypeptide band having molecular weight 43 kDa was highly induced than the other two polypeptides.

16. Terrestrial Carbon Sequestration- Strategy for conservation and management

Sonali Pradhan, Anuj Kumar Singh and A. K. Sahoo

Laboratory of NAIP on Carbon Finance, Directorate of Research
Orissa University of Agriculture and Technology, Bhubaneswar-751003, India
Email: sonali_pradhan2562@yahoo.com; ksanuj@live.com;
drashokkumars@yahoo.com

Key words: *Carbon sequestration, Carbon conservation, Sustainable development, Afforestation & Reforestation.*

Terrestrial carbon sequestration processes could make a significant contribution to abate CO₂ increment in the atmosphere. Innovative forest management and conservation strategies like managing plantations, agro-forestry practices, soil management techniques not only

serves for effective carbon sequestration but also has huge economic potential. Global carbon markets are now providing a plethora of economic benefits in return of afforestation and reforestation that have the potential to improve livelihoods of forest dependent communities and foster sustainable development at both local and global level.

17. Influence of spacing, seed rate and nitrogen levels on yield and quality of sugarcane under pit method of planting

M.Bharathalakshmi¹, T.Chitkala Devi², N.V.Naidu³ and M.B.G.S. Kumari⁴

Regional Agricultural Research Station, Anakapalle.
Acharya N.G.Ranga Agricultural University,
Rajendranagar, Hyderabad-30

¹Professor (Agronomy), Agricultural Polytechnic, RARS, Anakapalle

²Senior Scientist (Agronomy), Regional Agricultural Research Station, Anakapalle

³Associate Dean, S.V.Agricultural College, Tirupathi, Andhra Pradesh

⁴Scientist (Agronomy), Regional Agricultural Research Station, Anakapalle

Key words: *Pit planting, millable canes, sucrose, commercial cane sugar.*

A field investigation was carried out during 2008-09 and 2009-10 at Regional Agricultural Research Station, Anakapalle, Andhra Pradesh in a red sandy loam soil to find out optimum spacing, seed rate and nitrogen levels for sugarcane grown in North Coastal Andhra Pradesh under pit method of planting. Sixteen treatment combinations consisting of two spacings (1.5 x 1.2 m and 1.5 x 1.5m) two seed rates (15 two bud setts/pit and 30 two bud setts/pit of 90cm diameter) and four nitrogen levels (100,150,200 and 250Kg N/ha) were tested in a split plot design. Experimental results revealed that millable cane population at harvest and cane yield were significantly influenced by spacing, seed rate and nitrogen levels but quality parameters studied in terms of sucrose % and commercial cane sugar % did not vary significantly. Planting of cane setts in pits spaced at 1.5 x 1.2 m recorded higher cane yield (107.2 t/ha) than 1.5 x 1.5m (103.2 t/ha). A seed rate of 15 two bud setts/pit was found optimum for realizing higher millable stalks (82175/ha) and cane yield (107.0 t/ha). Application of nitrogen at 150kg N/ha registered significantly higher millable cane population (82093/ha) and cane yield (106 t/ha) over 100kg N/ha. The two year study revealed that a spacing of 1.5X1.2 m and seed rate of 15 two bud setts/pit with a nitrogen dose of 150kg/ha can be recommended for sugarcane under pit method of planting in red sandy loams of North Coastal Andhra Pradesh.

18. Prediction of Saturated Hydraulic Conductivity of Black Soils through Determination of Particle Size Distribution and Irrigation Water Requirement for Cotton

Mausumi Raychaudhuri¹, D.K. Kundu², Sucharita Mohapatra¹, K.G. Mandal¹, G. Kar¹, Ashwani Kumar¹, K.M. Nair³, R.S. Singh⁴, D.K. Pal⁵, S.K. Ray⁶, Dipak Sarkar⁶ and T.Bhattacharya⁶

Directorate of Water Management, Chandrasekharpur, Bhubaneswar, Odisha¹
CRIJAF, Kolkata, West Bengal², NBSS & LUP Bangalore Centre³, NBSS & LUP
Udaipur Centre⁴, ICRIASAT, Patancheru, Hyderabad⁵, NBSS & LUP Nagpur Centre⁶

Key words: *Black soil, Saturated hydraulic conductivity, Particle size distribution, irrigation water requirement, cotton.*

The black soils of India covers an area of 5.4 lakh sq km area and are dark in colour generally calcareous, low in organic matter and high in clay content. It is common in Maharashtra, western Madhya Pradesh, parts of Andhra Pradesh, parts of Gujarat, and some parts of Tamil Nadu. Black soils may be shallow to deep, highly moisture retentive and suitable for cotton production. Hydraulic conductivity is one of the most important soil physical properties for determining infiltration rate, irrigation and drainage practices, and other hydrological processes. Saturated hydraulic conductivity is one of the soil hydraulic properties which is widely used in environmental studies especially subsurface ground water. As saturated hydraulic conductivity is a basic and important character for soil but the direct measurement is time consuming, costly and not easy to analyse. An attempt has been made to establish relationships as indirect methods in order to estimate saturated hydraulic conductivity from readily available soil hydro-physical properties and also to predict the irrigation water requirement for cotton.

In this study 219 numbers of profile soil samples were collected from various sites of Black Soil Region i.e., Nabibagh, Nimone, Vasmat, Sarol, Bholra, Sokhda, Ghulghuli, Paral, Panjri, Kassireddipalli, Singhpura, Kovillpatti, Coimbatore, Achhamatti, Telgi, Nandayal, Tenali, Siddalghatta. Different chemical and hydro-physical characteristics viz., pH in 1:1 solution and EC in 1: 2.5 solution (soil: water), particle size (sand, silt, clay content) analysis, saturated hydraulic conductivity (Ks) and moisture retention constant at various pressure bars and bulk density were assessed. The pH and EC of the soils ranges from 6.81 (B. Ghulghuli series) to 9.9 (Nandayal series) and 0.04 – 3.25 (Coimbatore series) dSm⁻¹ respectively having respective mean of 8.59 and 0.54 dSm⁻¹. The estimated organic carbon content varied from 0.04 – 1.58% with a mean of 0.48%. The particle sizes varied widely and the sand, silt and clay content ranges from 1.4 – 64.15%, 4.4 – 76.9% and 20.55 –

80.0% respectively with a mean of 20.98, 22.43 and 56.58% respectively. The hydro-physical properties estimated also varied widely. The available water capacity (AWC) and Ks ranges from 8.74 – 39.26% and 0.027 – 6.52 cm/h with a mean of 20.83% and 0.399 cm/h respectively. The results depict that (Clay + silt) and sand are good predictor of saturated hydraulic conductivity. The irrigation water requirement for cotton varied from 11.9 cm to 57.9 cm.

19. Research experiences and potential of system of Rice intensification - status in India, impact and future directions

R. Mahender Kumar*, K.Surekha, Ch.Padmavathi, L.V.Subbarao, V.R. Babu, P.Muthuraman, S.Gopalakrishnan V.Vinod Goud and B.C. Viraktamath

Principal Scientist (Agronomy), Principal Scientist (Soil Science) Senior Scientist (Entomology), Principal Scientist (Seed Technology), Scientist (ICRISAT), Project Coordinator (WWF, ICRISAT), Project Director, (DRR) Directorate of Rice Research, Hyderabad, India
Kumarm213@gmail.com

Key words: *System of rice intensification (SRI), Potential, Impact, Future strategies for upscaling*

Rice is the staple food for more than half of the world's population and thus it plays a pivotal role in food security of many countries. At the current rate of population growth (1.5%), our rice requirement by 2025 would be about 125 m.t. is a gigantic task. The projected trends indicate that the country has to add about 1.5 to 2.0 m.t. of additional rice every year to its food basket. System of Rice Intensification (SRI) developed in Madagascar 25 years ago is gaining wider acceptance in many countries and India is not an exception. SRI methods greatly enhance water productivity because increased output is attained by using only about half as much water as usually applied to irrigated flooded rice crop. There is not yet complete understanding of how SRI achieves the yield increase, which can probably be accounted for by some combination of bio-physical relationships. Further there is need to evaluate the method of SRI in different soil and ecological situations for its suitability and for a better understanding of plant-soil interactions relating to the contribution of soil micro-organisms to plant growth and of other processes which enhance grain yield. The SRI method evaluated across the country (25 locations) for the past 4 years clearly indicated 7-20 per cent higher grain yields over the traditional irrigated transplanted rice. The varieties having better tillering ability, especially hybrids were found promising and recorded higher grain yield over high yielding and scented cultivars. Root volume, dry mass production and dehydrogenase activity in soil (measure of microbial activity) was found to be higher in

SRI method as compared to conventional method. SRI method reduced the seed rate by 80%, water requirement by 29% and growth duration by 8–12 days; thereby enhancing the water productivity and per day productivity of rice cultivars. If the SRI is adopted even on just 4m.ha (10% of the rice area) in India, there would be saving of seed worth 180 crores. The increase in area and production is estimated to be 1.2 m ha and 5.0 m. tones with is equivalent to Rs. 9000 cores. There is also saving of nearly 2280 million m³ of irreplaceable ground water for future. Further there is a shift in work force and drudgery for women especially working in rice due to mechanised weeding which is critical in SRI system. There is a need for further enhancing the productivity of rice under the SRI method by identifying the suitable cultivars, modification of practices to suit local agroclimatic conditions and by understanding the synergy effects among the different practices in enhancing the productivity of rice in the country.

20. Analyzing the pattern of methane emission and water productivity under different methods of crop establishment

Priyanka Suryavanshi¹ and Y.V Singh²

Division of Agronomy, Indian Agricultural Research Institute
New Delhi, 110012, India

Corresponding author Priyanka Suryavanshi¹, priyankaagri@gmail.com

Key words: *alternate wet and dry irrigation (AWDI), double transplanting, global warming potential, methane emission, rice fields, system of rice intensification (SRI).*

A field experiment was undertaken to investigate the influence of methods of crop establishment on methane emission and water productivity of rice. Treatments comprising 3 methods of crop establishment viz., conventional transplanting (CT); system of rice intensification (SRI) and double transplanting (DT) were laid out in RBD with four replications. CT had maximum cumulative methane emission (32.33 kg ha⁻¹) followed by DT (29.30 kg ha⁻¹) and SRI (19.93 kg ha⁻¹). Methane flux fluctuated between 79.68 to 482 under conventional transplanting (CT); 46 to 315 in SRI and 86.7 to 467.25 in DT. Methane flux declined gradually 75 days after transplanting and stabilized till the harvest of rice. Global warming potential of CT was the highest (807.4 kg CO₂ ha⁻¹) and it was lowest in SRI (498.25 kg CO₂ ha⁻¹). However, a reverse trend was observed with Carbon efficiency ratio. The water savings, as reflected in water productivity estimates revealed further the promise of SRI (22% over other practices), as an economically viable option for rice crop.

21. Assessment of genetic diversity of sesamum (*Sesamum indicum* L.), genotypes using inter simple sequence repeat markers

Ray, A.; Pattnaik, A.; Samal, K.C.; Rout, G.R.

Department of Agriculture, Biotechnology, O.U.A.T, Bhubaneswar

Key words: *Sesamum indicum* L., DNA fingerprinting, RAPD, ISSR, AFLP

Sesamum (*Sesamum indicum* L.), is an annual plant that belongs to the family Pedaliaceae. Sesamum seed oil is rich in ergosterols and antioxidants. ISSR markers were analyzed to study phylogenetic relationships among five sesamum accessions. Out of twenty ISSR primers screened, four ISSR primers were finally chosen that gave satisfactory amplification and band resolution. The number of bands produced varied with each primer, ranging from 3 (ISSR-12) to 7 (ISSR-2) with a mean of 5.33 per primer. Out of total 51 ISSR bands generated, 47 bands (92.15 %) were found to be polymorphic. Three unique bands were detected that were able to differentiate sesamum genotypes. The resolving power (Rp) of ISSR primers ranged from 0.56 (ISSR-11) to 1.048 (ISSR-12) whereas polymorphism information content (PIC) was the highest in ISSR-12 (0.69) and it ranged from 0.56 to 0.69. The average Rp and PIC was found to be 1.021 and 0.63 respectively. Average Jaccard's similarity was calculated among all the genotypes and it was found to be 57 %. A dendrogram based on the UPGMA method was constructed using a similarity matrix derived from 47 polymorphic ISSR fragments generated by 4 primers. Cluster analysis clearly grouped 5 genotypes into two major clusters based on similarity indices. The genotype pair 'Prachi' and 'Uma' showed the maximum similarity (0.71).

22. Dimensions of Rural Poverty in Orissa: Macro Analysis and some case studies

Mukesh Kumar Sinha, P. Nanda and Ashwani Kumar

Directorate of Water Management (ICAR), Chandrasekharpur, Bhubaneswar 751023
Orissa

Key words: *Poverty, food security, livelihoods, Orissa*

Using the sustainable livelihoods framework and collecting qualitative and quantitative data from two selected districts of Balangir and Dhenkanal under Village Level Studies Project, the paper looks at agricultural and labour households groups, notably marginal and small scale farming households, labouring rural households and scheduled tribal households. Even though Orissa is virtually self-sufficient in food grains, there is a significant prevalence of food insecurity in the state and around 9 percent of the population are classified as

extremely food insecure consuming less than 1,800 kcal per day. The situation varies significantly within the state: 15 percent of the population in the southern region are extremely food insecure compared to 3 percent of the population living in the coastal areas. The study finds that food insecurity and vulnerability are mainly caused by a limited physical as well human asset base, slow economic growth, limited or no access to welfare provisions and public services, lack of land reform and difficulties in accessing credit institutions. Based on the findings of the analysis, the paper identifies key interventions to address the immediate food needs of the most vulnerable and to stimulate rural development, in particular promoting agriculturally linked livelihoods. Proposed interventions include increased investment in agricultural research, improved watershed development, developing financial services and promoting small scale industries as well as micro enterprises and strengthening anti-poverty programmes within the state. The two district sampled, where more or less half population are under poverty. Livelihood options are limited and skewed towards large farmers in the study villages. Differential land holding, occupational diversification, migratory pattern and agricultural productivity hold key factors of poverty across farmer category and size holding.

23. Gene stacking in rice through marker assisted selection

Gitishree Das¹, D.Prasad², B.C.Marndi¹, H.N.Thatoi³, G.J.N.Rao¹

¹Central Rice Research Institute, Cuttack -753006

²NRCPB, New Delhi - 110012

³CET, Bhubaneswar

Key words: marker assisted selection, rice, gene stacking

Significant progress was achieved in the development of suitable cultivars through sustained efforts by conventional approaches over the years. However, in recent years, breeders are employing new approaches to confer a wider spectrum of resistance to effectively combat many of the biotic and abiotic constraints that affect rice productivity. Among the biotic stresses, Bacterial blight and Blast are the most widespread diseases and Gall Midge is a major insect pest on rice and these stresses cause serious production losses in rice. Of the abiotic stresses salinity and submergence are the major abiotic constraints. The marker assisted selection (MAS) approach offers unique advantages and can contribute significantly to the gene transfer and can hasten the development of resistant cultivars through gene stacking in minimum number of generations with highest accuracy for genetic improvement of rice. The present study deals with introgression of BLB, blast, gall midge, submergence and salinity genes into an IR 64, an elite *indica* cultivar and the results will be presented.

24. **Molecular characterization and mapping of resistance to Rice Tungro Disease**

**M.K. Kar, A. Swain, R. Mishra, S. Samal, D. Prasad,
S. Mohanty, S.K. Singh and G.J.N. Rao**

Crop Improvement Division, CRRI, Cuttack-753006
Email: meera_kar@hotmail.com

Tungro is one of the most important viral diseases that causes serious yield loss in rice. A very complex disease associated with two different viruses, rice tungro bacilliform virus (RTBV) and rice tungro spherical virus (RTSV) and transmitted by leafhoppers, particularly the green leafhopper (GLH) *Nephotettix virescens* (Distant), Rice Tungro Disease (RTD) has attracted the attention of plant molecular biologists and biotechnologists as its etiology and virus-vector relationship are unique. The present study was planned with molecular characterization of tungro resistant rice genotypes and development of an efficient molecular marker linked to resistance against rice tungro disease. For molecular characterization and study of genetic diversity among 16 rice genotypes (5 susceptible and 11 resistant to rice tungro disease), 48 microsatellite (SSR) markers were used. The ten most informative primers with high PIC value were RM 85, RM 208, RM 163, RM 583, RM 70, RM 287, RM 297, RM 204, RM 279 and RM 281. The primer RM 297 showed distinct polymorphism between susceptible genotypes (Tapaswini, Satabdi, TN 1, Durga) and resistant genotypes (IET 16952, CB 98002, Latisail, Pankhari 203, PTB 18 and PTB 21). For molecular mapping of the gene conferring resistance to RTD, the mapping population used in the study was developed using a highly susceptible cultivar Tapaswini and a resistant cultivar IET 16952. Both F₂ and DH populations of Tapaswini/IET 16952 were screened against tungro disease in simulated epiphytotic condition in field as well as under artificial inoculation with viruliferous green leaf hoppers in controlled green house condition. The SSR markers RM297 and RM6569 co-segregated with the trait phenotype in the mapping populations and the map based sequence of rice genome indicated that both the SSR markers RM297 and RM6569 are located at a genetic distance within 1cM region at 132cM position of chromosome 1, which may be the likely position of the tungro resistance gene. Further fine mapping of the gene is in progress.

25. **Strengthening of local Institutions for conservation and Commercialization of rice landraces: Koraput, Odisha**

****Susanta Sekhar Chaudhury¹, Alok kumar Badoghar²,
Kartik Charan Lenka³, Shenaz Ara⁴**

Biju Pattnaik Medicinal Plants Garden & Research Centre
(M. S. Swaminathan Research Foundation) Phulbada, Jeypore – 764 002, Odisha, India
**E-mail: sushantasekhar@rediffmail.com

Koraput, a tribal dominated district in Odisha is earmarked as an agricultural distress region by planning commission of India. Fifty two tribes with a larger proportion of small and marginal farmers inhabit in the area. Low yield, lack of infrastructure and inaccessibility to

market play a significant role in prevailing hunger and poverty among the tribes. For the last one decade, MSSRF is working with the farmers for improving their economy and livelihood by providing training to achieve higher production, improve value addition and better market linkage of rice landraces. This paper discusses benefit - cost ratio (B: C) of different value added products and role of local institutions in conserving and commercializing rice genetic resources for poverty reduction.

26. Characterization of a novel cytosolic Glutathione S–transferase from lichen *Rocella montagnei* (Bél.) emend. Awas. and its role in abiotic stress tolerance in plants

Trupti Mohapatra, G. N. Hariharan and Ajay Parida

M. S. Swaminathan Research Foundation, III Cross Street,
Institutional Area, Taramani, Chennai - 600113

Keywords: *Lichen, Rocella montagnei, Expressed sequence tag, Glutathione S–transferase, Glutathione peroxidase*

Lichens are poikilohydric photosynthetic organisms well known to have strongest desiccation tolerance (even to almost total loss of water from their cells) as well as freezing tolerance, and are distributed widely from deserts to Antarctica. We used *Rocella montagnei*, a fruticose lichen, as a model system for mining genes involved in abiotic stress tolerance, the first attempt at isolation and characterization of genes from lichen systems. Large-scale random EST sequencing from a cDNA library obtained from natural thallus of *R. montagnei* resulted in identification of four different Glutathione S–transferases. The *RocmGSTI* cDNA is 970 bp with an ORF of 639 bp with a coding capacity for a protein of 212 amino acids with a molecular mass of 23.9 kDa. The full-length *RocmGSTI*, a cytosolic GST protein, was over expressed in BL21 strain of *E. coli* and was induced with 0.1 mM of IPTG. The results indicated that *RocmGSTI* protein forms a functional homo-dimer in recombinant bacteria with Glutathione S–transferase as well as Glutathione peroxidase activities *ex planta*.

27. Biogas production potentials of kitchen waste– a feasibility study

**Sanjay K. Ojha, Snehasish Mishra, P.K. Mohanty,
Vijay K. Malesu and Mrutyunjay Suar**

Biogas Development and Training Centre,
School of Biotechnology, Campus-11, KIIT University

Key words: *Biogas, gas chromatography, kitchen waste, physicochemical characteristics*

Due to the ever-growing industrialisation and urbanisation the rural India is diminishing, and so are the various rural technologies such as the ‘gobar-gas’ technology. In order to make the technology relevant in the changing scenario, R&D needs to be undertaken by

changing the substrate from cow-dung and other cattle-shed refuse to the various organic form of refuse from the urban set-up, be it municipal waste, wastes generated from commercial activities, or the kitchen waste. Present study was envisaged to estimate the methane-production potentials of the household kitchen refuse without manipulating the physicochemical or microbiological environment. The refuse was collected, shredded, mixed with three-time water V/V, and packed into a plastic jerry-can till 10% of headspace. The pH was adjusted upto 6.5 by using phosphates solution as buffer, and the ambient temperature was provided. This 30-day study had a weekly sampling schedule, excepting for methane estimation which was made through on-line gas chromatography. The average mean temperature during the period of the experiment was 30.5°C. The set up was monitored for period of 30 days for changes in its physicochemical and biological status, and the methanogenesis potential. As the previous reports suggested close relation of pH and VFA to the CH₄ production, these three parameters were monitored. On the 7th day of the experiment, the pH dropped to 4.8 from 6.5, VFA (mg/l) and CH₄ (%) were recorded 2860 and 12%, respectively. CH₄ production started by the 13th day and the generated biogas remained in a constituent-wise mean range of 58%. During the time, the pH and VFA were 5.2 and 7703, respectively. The pH value showed a constant increment as recorded on the 21st (5.6) and 28th (5.8) day. The VFA level on the same days exhibited constant reduction, *i.e.*, 6138 and 4812, respectively. The CH₄ production was maximum on the 21st day (43%) and gradually decreased to 24% by the end of the study, attributable to the fact that no special measures to ensure anaerobiosis was in place. As the pH lowered, the VFA accumulation increased, which reportedly has an inhibition effect on the CH₄ production. The total microbial count (CFU/ml) was highest on the 7th day (7.5 X 10⁵), and exhibited a constant decrement till the end of the study (8.8 X 10⁴). Some gram +ve bacterial isolates exhibited cellulase activity. The study thus strongly suggests that the kitchen waste which is organically rich has every potential to be replaced as a substrate for biogas generation, possibly with special measures to encourage anaerobiosis by providing oxygen scavengers. Since biogas production is dependent on the quality of the inocula (microbial consortia), it is recommended that further work be carried out on the relevant microbial consortia, both at the organism as well as molecular levels for enhanced and economic biogas production.

28. Community based strategies for Management of Coffee berry borer under organic production Systems

R.Rengalakshmi*, R. Seenivasan.R and S. Malarvannan

Principal Scientist, M.S.Swaminathan Research Foundation
III Cross, Taramani Institutional area, Chennai – 600 113
Email: rengalakshmi@mssrf.res.in

Keywords: *Farmers knowledge, Coffee berry borer, biological method, agronomical and mechanical methods of control*

Certified organic farming is increasingly taken up in the areas where ‘by-default’ the practices aren’t using chemicals.. When the production is oriented towards external markets, produces could not meet/ adhere to the market standards especially in productivity and quality. MSSRF

has been promoting certified organic farming in Thonimalai region of Lower Palni hills in which product quality is a major issue in organic coffee. Among several factors berry borer (*Hypothenemus hampei*) is largely affecting the berry quality to an extent of 60 -80%. The farmer's perceptions, field infestation and traditional management practices were chronicled. Potential non chemical control measures including the mechanical, agronomical and biological methods were collected and appropriately integrated with traditional control measures and social systems. The paper provides a detailed account of the process involved in chronicling the traditional knowledge, integration with scientific knowledge and how these were mobilized around farmers as collective effort for better management.

29. Water Management in upper watersheds of N-W Tract of India: Some key opportunities and challenges

M S Hadda*, R S S Hopper and S S Aulakh***

*Department of Soils, Punjab Agricultural University, Ludhiana - 141004, India

**MS Swaminathan Research Foundation, Chennai- 600 113, India

Email: ms_hadda@yahoo.com

Key Words: *Hydrological parameters; Rain water management practices; Integrated water management*

Water management in the watersheds suffers from management decisions rarely made keeping in view the needs of people, variations in rain, land, soil and vegetation parameters. Some studies conducted in N-W tract of India pointed out about the serious issues affecting the water management and limiting their success and sustainability in upper watersheds. Opportunities and challenges to research this goal can be grouped in five major areas viz. overcoming constraints to technology adoption, managing conflict, balancing local economic and environmental services and strengthening organizational and learning processes. It is a matter of concern to follow the integrated water management options and their sustainable combinations will be the key to future agricultural economic growth and social wealth etc. The constraints reported in the adoption of rain water management practices are topographical problem, followed by lack of technical knowledge and ignorance of rainwater management practices etc. in rain-fed submontane region of Punjab.

30. Some Biochemical Investigations in Relation to Different Diseases among the Mulberry Silkworm, *Bombyx mori* L.

Md. Takhliq and K.B. Sharma

P.G. Dept. of Zoology, Magadh University, Bodh-Gaya, Bihar.

Email: md.takhliq@gmail.com

Key words: *Bombyx mori* L., *Virosis*, *bacteriosis*, *sporozoosis*, *mycosis*, *larval stages*, *Biochemical analysis*.

As a matter of fact the *Bombyx mori* is the principal silk producing insect of great commercial interest. This insect is reared under the indoor condition on the foliage of mulberry host plant during the seed crop seasons for the betterment of our economy and also fruitful source of earning much need foreign currency. The place of this mulberry silk insect in agriculture and industrial development is significant and it constitutes the raw material of India's chief cottage industry.

However the mulberry silk culture suffer great loss of crop owing to its diseases namely virosis, bacteriosis, sporozoosis and mycosis as such the productivity and the quality of silk cocoons get impaired. It is assumed that the said diseases have profound effects on the physiological and biochemical make up of silkworm because under the impact of diseases the metabolic manifestations of the silkworm show significant deterioration at the various stages of its life cycle (Agarwal, 1974, Jolly et al. 1990, Pandey, 1989). It is further known that the sericigenous insects require number of organic compounds namely carbohydrate, fats, lipids, vitamins, steroids and aminoacids as nutrients. (Agarwal, 1994).

Keeping in view the above facts the present project has been proposed which aims at understanding the biochemical changes in the mulberry silkworm, *bombyx mori* at different larval stages under various diseased conditions.

31. Adoption of conservation tillage improves soil aggregation and soil organic carbon pools in a sandy clay loam soil of the Indian Himalayas

Dr. Ranjan Bhattacharyya

Indian Agricultural Research Institute, Pusa, New Delhi 110012

Key words: *No tillage (NT)*; *Conventional tillage (CT)*; *Carbon sequestration*; *Soil aggregation and C pools*; *Finger millet-lentil cropping*

This study evaluated the effect of continuous NT or CT along with seasonal tillage alterations on soil organic carbon (SOC) retention, aggregate-associated C contents and particulate organic matter-carbon (POM-C). Results indicate that the plots under continuous NT had

16% higher total SOC compared with CT (12 g kg⁻¹ soil) in the 0-to 5-cm soil layer. Although the labile pools of SOC were positively affected by conservation tillage, the recalcitrant pool was only influenced by the continuous NT. The results validate that adoption of continuous NT has the potential to improve soil aggregation and POM-C and thus helps in SOC stabilization.

32. Study on Fungal Associates of Two Medicinal Plants, *Azadirachta indica* and *Acacia catechu*

Anand Sagar

Department of Biosciences, Himachal Pradesh University, Summer Hill, Shimla 171 005

Key words: Medicinal Plants, VAM, Mycorrhizosphere, endophytes.

The demand for medicinal plants has been increasing rapidly with the consumption of crude drugs. This led to an increase in the cultivation of medicinal plants to maintain a steady supply to support the increasing demand due to a decline in their natural populations. One important factor which governs the establishment and growth of plants in nature is the mycorrhizal association with fungal partners and presence of other beneficial fungi in the close vicinity of roots as well as within the plant tissues. Fungal associates of two important medicinal plants growing in Himachal Pradesh were investigated, identified and are being reported in the present communication. While the rhizosphere of *Azadirachta indica* revealed twenty two fungal species, the soil samples collected from the vicinity of *Acacia catechu* revealed the presence of twenty three species of fungi. Twelve species of VAM fungal spores belonging to three genera (*Acaulospora*, *Gigaspora* and *Glomus*) were isolated from root adhering soils of these plants. Further, leaves and barks of these plants revealed the presence of five endophytic fungi belonging to five genera (*Aspergillus*, *Cladosporium*, *Fusarium*, *Glocladium* and *Trichoderma*).

33. Screening for high productive and good quality rice varieties and management for increase productivity for coastal saline belt of West Bengal

S.Kundu* , S.Paul* and S.Kundagrami#

Department of Genetics and Plant Breeding, Institute of Agricultural Science
Calcutta University, 35, Ballygange Circular Road, Kolkata 700019

Research student, Email: kundu.sritama@gmail.com

Assistant Professor and corresponding author, Email: skundagrami@gmail.com

Key words: Rice, Salinity, Herbal treatments, Hoagland solution, Quality aspects

Rice, the most important cereal of India, has the largest area under cultivation. In view of current situation, the main factors for decrease in productivity are biotic and abiotic stresses. Among the abiotic stresses salinity is one of the main cause for yield loss (20%). About 2

area of land in coastal regions are subjected to salt water inundation where average yield is about 1t/ha as against the National yield of 1.9t/ha. Against this backdrop, present study is carried out to screen high productive salinity tolerant lines from paddy genotypes in laboratory as well as field screening in saline prone areas of West Bengal. To uplift the productivity an appropriate management strategy was designed concerning application of Hoagland nutrient solution and herbal seed treatment. Furthermore high productive lines are selected in respect of good quality parameters.

34. Isolation and partial characterization of a free living nitrogen fixing, phosphate solubilizing and salt tolerant bacteria from the coastal area of West Bengal

Sandhimita Mondal¹, Biplab Kr.Chatterjee²

¹Department of Botany, Visva-Bharati University, Santiniketan 731235, West Bengal, India Email: sandhimita_mondal@yahoo.co.in; sandhimita@gmail.com; Mob: 09051788221

²Institute of Education, Vinaya Bhavana, Visva-Bharati University, Santiniketan-731235, West Bengal, India

Key words: *Biofertilizer, Nitrogen fixing bacteria, Phosphate solubilization, environmental hazards*

For sustainable agriculture, it is imperative to utilize renewable inputs, maximizing ecological benefits and minimizing environmental hazards. One way of achieving this is to decrease dependence on use of chemical fertilizer and harvest the potential of biological process, especially the biofertilizer. Isolation and identification of potential strains of growth promoting bacteria such as nitrogen fixers and phosphate solubilizer which can perform under stressed condition like salinity, could be beneficial to farmer of the saline tract and open up new options for them in the integrated plant nutrient management in an eco-friendly way. In our laboratory, several strains of free living nitrogen fixing bacteria with different growth promoting properties have been isolated. One such free living nitrogen fixing bacterial strain isolated from the soil collected from the riverside of Matla, South 24 parganas, West Bengal, has shown potent phosphate solubilizing as well as salt tolerant properties.

35. Quantitative assessment and mapping of plant resources of Eastern Ghats in Southern Orissa

Saujanendra Swain and Kartik Lenka

M. S. Swaminathan Research Foundation, Regional centre: Jeypore, Orissa
saujanendra@rediffmail.com

Eastern ghats region covering seven districts of southern part of Orissa state was explored for quantitative assessment and mapping of plant resources. The entire stretch was divided into 443 grids of 6.25 x 6.25 Km each. One belt transect of 5 m x 1000 m in each of the grid were made where trees of ≥ 30 cm GBH, Shrubs, climbers and herbs was enumerated. 641 plants were recorded with a composition of 174 trees, 154 shrubs, 186 herbs, 52 climbers and 75 others like orchids, grasses, ferns etc. The dominant families in these grids were *Fabaceae*, *Poaceae*, *Euphorbiaceae*, *Rubiaceae*, *Asteraceae*, *Verbinaceae* and *Convolvulaceae*. Three endemic ((*Stemona tuberosa*, *Selaginella nairii* and *Tragia gagei*) and three threatened species (*Stemona tuberosa*, *Gnetum ula* and *Albizia thompsonii*) were recorded and efforts are made to conserve them in their natural habitats.

36. Addressing the Agricultural crises by training and transforming Youth in Rural India

N. Parasuraman and S. Rajalakshmi

Principal Scientist, M. S. Swaminathan Research Foundation, Chennai
raman@mssrf.res.in

Key words: *Rural Youth, Sustainable Agriculture, Natural Resource Management, Modern Farming.*

It is increasingly becoming difficult to retain youth in agriculture. One of the major strategies for retaining youth in agricultural sector is empowering them with modern skill-sets that will make farming, a profitable enterprise. This calls for a continuous engagement with rural youth to train them in sustainable agriculture practices and NRM based services. While more rural youth are becoming literate, formal education system has made positive inroads, agricultural education has been lagging. Thus, rural youth miss out on formal and informal orientation to modern farming practices. Agriculture can be sustained only when farming becomes economically viable and profitable. MSSRF bridges this gap through training rural youth who have inclinations towards agriculture and farming. The training programme includes modules in leadership, grassroots institution building, economics, micro credit apart from training in scientific farming

37. Role of heat shock transcription factors and heat shock proteins in high temperature tolerance of wheat genotypes

Krishna Kumar G.¹, R. K. Sairam¹ and Lekshmy S.¹

¹Division of Plant Physiology, Indian Agricultural Research Institute
New Delhi 110012

Key words: *Temperature stress, Wheat, Tolerance, HSP, HSF.*

India is the second largest producer of wheat in the world. High temperature spells towards the end of the crop season are a major determinant of wheat yield, especially under Indian conditions. The present study was conducted with three wheat genotypes in terms of temperature tolerance viz. Halna, DBW 14 (Tolerant) and HD 2687 (Susceptible), sown on 25th November, 15th December and 10th January of 2010-11. Late sowing induced high temperature stress led to the reduction in relative water content, membrane stability index, chlorophyll content, carotenoid content and photosynthetic rate and an increase in lipid peroxidation in all the varieties. Comparatively greater changes were observed in susceptible genotype, HD 2687 as compared to Halna and DBW 14. Halna and DBW 14 maintained comparatively higher grain weight per ear, 1000 grain wt, grain yield per plant and yield stability index under high temperature stress. Expression analysis of heat shock transcription factor, *HSFA4a* and small heat shock proteins, *HSP16.9* and *HSP17.3* revealed that tolerant genotypes were having higher levels of gene expression than susceptible genotype. From the study, it can be concluded that the efficient up-regulation of *HSFs* and *HSPs* played a major role in imparting high temperature stress tolerance in wheat.

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VI

**ABSTRACT OF
POSTER PRESENTATION**

1. Geo-electrical Investigations for Shallow Ground Water at few Villages in a Canal Command of Orissa (India)

Shishir Raut

Directorate of Water Management, Bhubaneswar, Orissa 751023

Email: shi_wtcer@yahoo.com

Key words: Ground water, Vertical Electrical Soundings, Schlumberger, water quality

Vertical Electrical Soundings (VES) assuming Schlumberger configuration and profiling assuming Wenner configuration respectively were carried out in sixteen positions and along two traverses in three different villages covering an area of approximately 410 ha in Balipatna canal command of Orissa. Five geoelectric layers were found in the area within a depth of 40 m below ground level. VES data from two points were compared with bore hole data to assign resistivity values to different strata. Using resistivity fence diagram the quantity of ground water under shallow aquifer was computed to be around 12.2 ha-m. Chemical analysis of ground water samples showed that the quality of ground water was good with low salinity and low alkali hazard and could be grouped as C₁S₁ under USDA irrigation water quality classification.

2. Collection and Conservation of Large Cardamom (*Amomum Subulatum* Roxb.) Germplasm

U. Gupta

Indian Cardamom Research Institute

Regional research Station, Spices Board, Tadong 737102, Gangtok, Sikkim

Keywords: Germplasm, Collection, Conservation, Descriptor, Variability

Large cardamom (*Amomum subulatum* Roxb.) is the main cash crop of Sikkim having an area of 15587 hectares with an annual production of 3230 metric tons in India. NE India has largest concentration of Zingiberous flora especially in number and genera. Many of them have their origin in this region including *A. Subulatum*. Consequent to establishment of Indian Cardamom Research Institute, Regional station at Gangtok, efforts have been focused on conducting explorations and collection of genetic resources in large cardamom growing tracts of Sikkim, Darjeeling districts of West Bengal, Elam district of Nepal and border areas of Bhutan. A total of 212 accessions are collected and Conservation of these collected Germplasm are made in two established conservatory at Pangthang Research

farm in East Sikkim (2160M aMSL) and Kabi in North Sikkim (1630MaMSL).The accessions are collected based on specific characters and with passport descriptor.

During the year 2009-11 surveys were carried out in large cardamom growing areas of Dzongu, Sentam village and Singhik(North Sikkim),Namchipong,Raigaon and Bhusuk (East Sikkim),Soreng and Jawbari(West Sikkim),Sukhia Pokhri and Kalimpong Darjeeling district of West Bengal). Twelve germplasm accessions were collected and added to conservatory. The germplasm are collected belonged to cultivars of Varlangey, Ramsey and Golsey. Passport data of the germplasm was recorded as per prepared descriptor of large cardamom. Distinct variability was observed in the collected accessions. The accessions are under multiplication for further study of evaluation for useful traits.

3. Field Evaluation of Tissue Culture Plants and Open Pollinated Seedlings of Large Cardamom Selections in Sikkim and DARJEELING

Utpal Gupta

Indian Cardamom Research Institute, Regional Research Station, Spices Board,
Tadong 737 102, Gangtok, Sikkim, India

Key words: Tissue culture, Selection, OP seedling, Evaluation

Lack of high yielding selections, variation in seedling progenies and transmission of viral diseases through sucker propagation together contribute to the decline in the productivity of the large cardamom (*Ammomum subulatum* Roxb.). To increase the productivity of this crop, planting material raised through tissue culture techniques from six selections having higher productivity were field evaluated. The tissue culture plants of all the six cultivars performed better. Clone, SBLC 47A (Varlangey) and SBLC 5 (Sawney) were found superior as compared to other selections. Altitude wise, also these clones showed maximum yield in high and medium altitude. The capsule characters like size, weight and number of seeds were found better in SBLC 47A (Varlangey). From the study, it was observed that TC plant performed better as compared to conventionally propagated plants. TC plants had vigorous growth during initials years, precocity in the yield and higher productivity.

4. Effect of integrated weed management on growth and yield attributing Characters of drilled paddy under Konkan condition

A V Dahiphale, B D shinde, M G Palshetkar and N V dalvi

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli 415712 Dist-
Ratnagiri, India

Key words: Upland drilled rice, weed control, weed control efficiency.

An experiment was conducted to study the effect of various weed control measures on growth and yield of upland rice under lateritic soil conditions. The performance of rice was not influenced by introducing cowpea, as an intercrop in direct seeded upland rice for 30-35 days. It was also ineffective in controlling the weeds. For effective weed control and higher yields as well as higher net returns from the direct seeded *kharif* upland rice, Oxydiargyl @ 0.1 kg/ha should be sprayed 5-6 days after sowing of the crop and it should be followed by hand weeding 20-25 days after sowing.

5. Mapping Soil Fertility Management Zones for Precision Farming

Anil Sood, Deepak Mehra and Brijendra Pateria

Punjab Remote sensing Centre, Ludhiana 141004
Email: anilsood_prsc@rediffmail.com

Key words: Management Zones, Precision Farming, Micronutrient, Soil Fertility, Geographic Information System

Meeting the diverse and growing needs of the public within a limited environment is a challenging task for the future. Accurate and timely information is necessary to evolve strategies for sustainable management of natural resources. Soil resource plays a major role in determining the sustainable productivity of agro-ecosystem. One of the most important roles of soils is that it must supply those elements that are essential for plant growth. In all soils, replenishment of micronutrient elements takes place only from earth minerals. Thus, the role of the soil resource in supplying micronutrients is vital in an evaluation of food production sustainability. Increased removal of micronutrients as a consequence of adoption of High Yield Varieties and intensive cropping with high analysis NPK fertilizers has caused decline in the micronutrients constraint in soils below the required level for normal productivity of crops. The deficiencies of micronutrients have become major constraints to productivity, stability and sustainability in many soils. It is, therefore, essential to know the present nutrient status of soils in different soils which may limit crop production in near future. In the present study a systematic set of geo-referenced samples

were collected from the Fatehgarh Sahib district covering the entire area using GPS (Global Positioning System) and the maps showing the spatial variability of individual micronutrient cation (Zn, Cu, Mn and Fe) were generated using Arc Info GIS (Geographic Information System). The results of the study revealed that the Zn content in soils of the studied area ranged from 0.22 to 6.18 ppm with a mean value of 1.83 ppm, while the Cu content in these soils varied from 0.26 to 2.26 ppm averaging at 1.01 ppm. The average content of Fe was found to be 14.72 ppm with a range from 2.94 to 77.40 ppm, whereas the content of Mn ranged between 3.60 to 41.62 ppm with a mean value of 15.17 ppm.

Taking into consideration the critical limits of Zn, Cu, Fe and Mn as 0.6, 0.2, 4.5 and 3.5, respectively, the percent samples found to be deficient in Zn were 11 and that of Fe were 6, however none of the sample were found to be deficient in Cu and Mn. Spatially the deficiency of Zn and Fe were prevalent in 530 and 788 ha, respectively. The individual micronutrient cations maps were integrated in GIS through union of maps to generate soil fertility management zones. It can be concluded that the spatial maps generated under the study will be useful for generating homogenous units and guiding the farmers to decide the amount and kind of micronutrient to be applied for optimizing/ economic returns based on site specific nutrient management.

6. Effect of weather and application of primary nutrients and liming to ber (*Ziziphus mauritiana*) on winter season (aghani) kusmi lac production

S Ghosal

Senior Scientist, Indian Institute of Natural Resins and Gums, Namkum, Ranchi
Email: soumen66iinrg@gmail.com

Key words: *Kerria lacca*, *Ziziphus mauritiana*, yield ratio, primary nutrients, liming

An experiment was carried out during 2007-08 to 2009-10 at the research farm of Indian Institute of Natural Resins and Gums, Ranchi (23°23'N longitude, 85°23' E latitude and 650 m above MSL) to find out the effects of different primary nutrients (N, P₂O₅ and K₂O) and liming of established plantation of *ber* (*Ziziphus mauritiana*) on the production of winter season (*aghani*) kusmi crop of *Kerria lacca* (Kerr). Treatments comprised of four levels of N (0,100, 200 and 400 g/ tree), two levels each of P₂O₅ (0 and 150 g/ tree), K₂O (0 and 150 g/ tree) and liming (liming and no liming). Randomized Block Design was used in three replications and effect of years (weather variation) was estimated as the fifth factor. Potassium application led to reduction in male population by 3%. Significant interaction effect in between year and potassium application was noticed on lac yield ratio (output/

input). Potassium application with liming (higher pH) was found detrimental to lac production, while its application under low soil pH conditions increased lac yield ratio significantly. An increase in yield ratio to the tune of 97% was observed in potassium application on soil pH 4.5 as compared to that in pH 5.6. Higher adsorption of potassium in exchange complex under higher soil pH conditions due to liming might have decreased the potassium availability to the plant. Eventually, reduction in translocation of assimilate might have adversely affected the nutrition of lac insect and lac yield ratio.

7. Studies on varietal performance of turmeric under organic cultivation method

S. Satapathy and K.C. Samal

Biotechnology cum-Tissue Culture Centre, College of Agriculture,
Orissa University of Agriculture and Technology, Bhubaneswar, Orissa

Key words: Turmeric, Curcuma longa and Organic Cultivation.

The average of pooled data obtained from organic turmeric cultivation in Kandhamal district during the year 2009-10 & 2010-11 revealed that the variety 'Surama' recorded highest fresh yield (121.50 q/ha) followed by 'Lakdong' (116.26 q/ha), while 'Roma' has highest curing percentage is (29%) followed by 'Surama' (27%). With regard to rhizome size, 'Rajendra Sonia' produced maximum length (12.20 cm) followed by 'Roma' (11.59). The varieties 'PTS4', 'PTS43' and 'Rajendra Sonia', were found to be early duration types (210 to 230 days) compared to 'Surama', 'Ranga', 'Rasmi' and 'Lakdong', which matured relatively late (250 days). 'Lakdong' recorded significantly highest shoot dry weight (15.24 gm) followed by 'Surama' (12.96 gm) at maturity.

8. Effect of Drip Irrigation to Post-rainy Season Crops and Assessment of Crop Yields and Water Use Efficiency of Rice-based Systems

K.G. Mandal, A.K. Thakur and Ashwani Kumar

Directorate of Water Management (ICAR), Bhubaneswar 751 023, Odisha
Email: mandal98kg@yahoo.co.in

Key words: Drip irrigation; Crop yield; Water use efficiency; Rice-based systems

Field experiments were conducted for three years (2007-2010) at the DWM Research Farm at Deras Command, Odisha to study the effect of drip irrigation to post-rainy season crops and to assess crop yields, water use efficiency, land utilization efficiency and to

compare the economics of some rice-based cropping systems, viz. rice-maize-rice, rice-pulse-rice, rice-oilseed-rice, rice-vegetable-vegetable and rice-fallow-rice. Drip irrigation to rabi crops viz. maize, sunflower, tomato and cowpea was evaluated in terms of crop yields and water use efficiency. Results showed that though the crop yields under drip and furrow irrigation system were similar, water saving was more in drip irrigation system than furrow method. The irrigation water use and WUE of crops differed with the type of crops grown. By drip method water saving was to the tune of 29, 3, 13 and 30% in maize, cowpea, sunflower and tomato, respectively over the furrow irrigation method. The irrigation water use efficiency was increased with drip irrigation. Further, the crop yields, in terms of rice equivalent yield (REY) pooled over three years, increased by 273, 113, 106 & 58%, water use efficiency (WUE) by 414, 100, 87 & 49%, benefit/cost ratio by 77, 38, 43 & 20%, production efficiency by 201, 50, 50 & 14%, land utilization index (LUI) by 27, 45, 40 & 42% in rice-tomato-okra, rice-sunflower-rice, rice-maize-rice, rice-cowpea-rice, respectively when compared to rice-fallow-rice system. The irrigation WUE increased by about 36% when drip irrigation was used. The ordering of cropping systems based on gross return and benefit-cost ratio was: rice-tomato-okra > rice-maize-rice > rice-sunflower-rice > rice-cowpea-rice > rice-fallow- rice.

9. Effect of pruning on guava cv. Sardar under ultra high density orcharding system

**Sarita Mehta, Sanjay Kumar Singh, Bikash Das*,
B.R. Jana and Santosh Mali**

ICAR Research Complex for Eastern Region, Research Centre, Plandu, Ranchi,
Jharkhand 834010, India

Key words: *Guava, Ultra high density orcharding, yield, income*

An experiment was conducted during 2009-10 and 2010-11 at Ranchi to standardize time and level of pruning of guava plants planted under ultra high density orcharding. Treatments on time (pruning in May, Pruning in October and pruning in March, May and October) and different levels of pruning (pruning to 60% of canopy height, 80% of canopy height and pruning to 50% shoot length) were imposed on three year old guava plants of cultivar Sardar planted at a spacing of 1m x 2m. Pruning thrice a year to 50% of shoot length resulted in maximum yield of summer season, winter season crop and total yield per ha (34.88 t/ha and 37.24 t/ha during 2009-10 and 2010-11, respectively). With respect to gross income per ha, the maximum return was also obtained in case of pruning thrice a year to 50% of shoot length. Hence pruning of guava plants thrice a year viz. March, May and October to 50% of shoot length can be recommended for maximization of income from Ultra-high density guava orchard of cv. Sardar growing under Jharkhand conditions.

10. Hrti-silvi-pastoral agroforestry systems for rainfed uplands

P. J. Mishra, A. K. Patra, B. B. Behera, B. P. Gantayat, and S. Das

All India Coordinated Research Project on Agroforestry, College of Forestry,
Orissa University of Agriculture & Technology, Bhubaneswar 751003

Key words: Panicum maxicum, Stylosanthes hamata, Acacia mangium, Dalbergia sissoo, Gmelina arborea, Horti-silvi-pastoral agroforestry system

The demographic pressure and resulting higher livestock population to meet the demand for milk and milk products, meat, manures and animals for agricultural operations have necessitated for higher fodder requirement in our country. The fodder requirement is expected to reach 100 million tones by 2015. However, non-availability of natural pasture land and diversion of area under forage cultivation for other high value crops have created a huge gap between demand and availability of fodder in our country. Agroforestry systems with forage crops, particularly horti-silvi-pastoral systems are low input management systems which aim at providing food, fodder, fuel and timber to the farming community under rainfed upland situations on a sustainable basis. This also helps in ameliorating soil and microclimate through biological N₂-fixation and carbon sequestration. But selection of right tree and forage species is very important to get the maximum benefit from this system.

An experiment was conducted at OUAT, Bhubaneswar from 2008 to 2010 to study the performance of two fodder crops, guinea (*Panicum maxicum*) and stylo (*Stylosanthes hamata*) grown in the alley space of 8 year old trees of *Acacia mangium*, *Dalbergia sissoo* and *Gmelina arborea* planted in East-West direction at a spacing of 6 m x 6 m. The guava (*Psidium guajava*) grafts were planted at 6 m x 6 m spacing along the tree rows leaving 3 m distance on either side of a tree. The green fodder yield of guinea and stylo as intercrops differed significantly as compared to their yield as sole crops, yield recovery in intercrops being 86 and 79%, respectively. Guinea produced higher fodder yield (20.0 t/ha) than stylo (17.6 t/ha) irrespective of the tree species. The green fodder yield of guinea was highest in association with *Dalbergia sissoo* followed by *Acacia mangium*. Stylo registered higher net return and benefit: cost ratio as compared to guinea. Guava fruit yield was not much affected by the tree or forage species. There was a complementary effect on tree growth when fodder crops were grown in interspaces. The cumulative growth was more pronounced with *Acacia mangium* followed by *Gmelina arborea*. The soil fertility status increased due to addition of leaf litter to soil over the years and N₂ fixation by the tree species and stylo.

11. Effect of Applied Potassium and spike order on the Fatty Acid Composition of Castor, *Ricinus communis* L.

C. Sarangi¹, L.K. Das², P.K. Nayak³

¹AICRP on Castor, Regional Research and Technology Transfer Station,
Bhawanipatna-766001

Present Address: Residue Chemist, AICRP on Weed Control
Bhubaneswar.

² Associate Professor of Agronomy, College of Agriculture,
Bhawanipatna

³ Senior Scientist (PBG) SRS Nayagarh

Key words: *Castor oil: fatty acid profile, potassium*

Field experiments were conducted at Regional Research and Technology Transfer Station, Bhawanipatna, Orissa to study the effect of potassium levels on the fatty acid composition of castor, *Ricinus communis* L. taking one variety 48-1 and one hybrid DCH-32 grown with four levels of potassium (0, 20, 40, 60 kg K₂O ha⁻¹) applied as muriate of potash in 2006-07. The fatty acid profile of castor oil extracted from seeds of the primary, secondary and tertiary was analysed. Influence of increasing doses K₂O application up to 20 kg ha⁻¹ and 40 kg ha⁻¹ for a castor variety and hybrid, respectively was observed in improving and/or affecting the fatty acid profile of castor oil extracted from seeds at different picking intervals.

12. Effect of Packaging and Storage Environments on Shelf Life of Bell-pepper

NR Sahoo*, RK Patra, Kalpana Rayaguru, Dipika Sahoo

AICRP on Post Harvest Technology,
College of Agricultural Engineering and Technology
Orissa University of Agriculture and Technology, Bhubaneswar-751 003

*E-mail : nr_s2002@yahoo.co.in

Key words: *Bell pepper, modified atmospheric packaging, shelf life*

Bell pepper, a cultivar group of the species *Capsicum annuum* is rich in dietary fiber, vitamins and minerals. The present study was undertaken to find out the effect of packaging materials and storage environment on shelf life enhancement of bell pepper in terms of

different quality parameters. Different packaging techniques used for the experiment were modified atmospheric packaging (MAP) with Low density polyethylene (LDPE), Polypropylene (PP), perforated LDPE films, perforated PP films, shrink packaging with bi-axially oriented polypropylene (BOPP) film and Vacuum packaging with polypropylene film. The in-pack bell pepper created a suitable headspace environment with low O₂ and high CO₂ concentrations, which resulted in a better retention of freshness of the vegetable and its marketability. MAP with perforated PP film in refrigerated condition was found to be the best followed by vacuum pack with PP film in refrigerated condition and could be used to store bell pepper for 20 days for with maintenance of texture, colour, ascorbic acid and marketability. It is also inferred that under ambient conditions, bell pepper could be stored for 4 days using ventilated LDPE and PP as MAP storage.

13. Growth and yield behaviour of rejuvenated mango plants of cv. Amrapali with different canopy architecture planted at a closer spacing

Bikash Das and B.R. Jana

ICAR Research Complex for Eastern Region, Research Centre, Ranchi,
Plandu, Ranchi, Jharkhand 834010, India

Key words: Mango, rejuvenation, canopy architecture.

Investigations were undertaken at Ranchi, Jharkhand, to standardize canopy architecture of rejuvenated mango plants of cv. Amrapali planted at a closer spacing. 24 years old mango plants of cv. Amrapali planted at a spacing of 5.0 m x 5.0 m were headed back at three different heights viz. 1.0 m, 1.5 m and 2.0 m above ground during December, 2005. Treatments on length of primary shoot [60 cm, 120 cm), no control on length of primary shoot] and length of secondary shoots [60 cm and no control on length of secondary shoot] were imposed after one year of rejuvenation pruning in 18 different combinations. The treatments with rejuvenation pruning at 1.0 m resulted in lower plant height as compared to the treatments with rejuvenation pruning at other heights. Initiation of fruiting could be recorded during third year of rejuvenation pruning and a yield level of >60 kg per plant could be recorded during 2010. Keeping in view the yield, canopy size, shape, rejuvenation pruning at 1.0 m height, 60 cm length of primary shoot and no control on length of secondary shoot was found to be most appropriate canopy architecture.

14. Empowerment of forest dwellers through Tasar Culture with special reference to women

H. Chandra¹, K.R. Maueya¹, Madhu Mitra² D. Chakraborti³ & P.K. Singh¹

¹RSRS, Central Silk Board, Sahaspur- 248197, Dehradun, Uttarakhand State

²Residence Juyal Road, Majra- 248001, Dehradun, Uttarakhand State

³BTSSO, Central Silk Board, Bilaspur-495001, Chhattisgarh State

Email: drhc@rediffmail.com

Key words: Empowerment, Forest, Dwellers, Tasar, Culture, Women.

The term forest dwellers generally refer to those have lived around & in the forest for centuries. It is estimated that more than 140 million forest dwellers are dependent on forest for their livelihood. In the world, India occupied the second position having maximum tribals population after African sub-continent. The tropical forests (area 11.16 million hact. approx.) in India abundantly supported to be food plant for tasar silkworm rearing or collecting nature grown tasar cocoons is the most important occupation of tribe (12.89 million) and others living in & around forest. In Chhattisgarh more than 60% population is living in forest areas, their socio-economic system fully & partially depends on it. After introducing the national forest policy (Forest Act' 1988) they are in dilemma for their livelihood, but tasar culture a forest based industry keeping in view the problems of forest dwellers, taken up it very seriously and providing opportunities of employment and empowerment.

No doubt, tasar culture provide sustainable income to the farmers , but uncertainty due to various constraints i.e. improper handling, technical, managerial approaches, natural calamities and unsystematic exploitation of forest are the drawback, which affect the productivity and earning of beneficiaries. The applicable strategic approaches and efforts made in tasar sector for empowerment / upliftment of forest dwellers i.e. women such as training by group discussion & demonstration, technology transfer & skill development and increasing the earning etc. not only for their economical upliftment but also empowering them to take the decisions for their betterment are discussed.

The results revealed that the strategies applied, significantly enhanced the productivity , i.e. tasar silkworm egg production < 10.9% (2004-05), < 32.99 % (2005-06) and cocoons production < 219.04 % (2004-05), 101.04 % (2005-06) over the year 2003-04, while in earning it was recorded < 33.66 % (2004-05), < 21.16 % (2005-06) over the year 2003-04 (Base line). Where the personal involvement & contribution of women was appreciable. Which indicate that the approach & efforts made were effective & satisfactory. At the same time the farmers including women also learn the impact of a forestation / deforestation and to preserve the forest wealth for their future generation.

15. **Experimental Modelling of Modified Flours using Extrusion Technology**

Gurkirat Kaur, Savita Sharma and Baljit Singh

Department of Food Science and Technology, PAU, Ludhiana 141004

Email: keerat_25leo@yahoo.com

Key words: Modified flour, Extrusion, degree of gelatinization, viscosity, water absorption, solubility index.

Modified flour, a convenient ingredient for processed foods was prepared by extruding rice flour, wheat flour and rice + wheat Flour in combination in a co-rotating twin screw extruder. Response surface Methodology was used to assess the effect of extrusion conditions on different physical properties of modified flours. Extrusion variables were barrel temperature (125, 150 and 175°C), moisture content (14, 16 and 18%) and screw speed (300, 400 and 500 rpm). Barrel temperature had positive effect on WAI, WSI and DG; moisture content had on bulk density, WAI and DG and screw speed on WSI and viscosity. Significant regression models were established. The higher R² values showed that the model developed for the response variables appeared adequate for predictive purposes.

16. **Seed quality evaluation and pretreatments for enhanced germination in few high altitude medicinal plants**

Manisha Thapliyal and VRR Singh

Forest Tree Seed Laboratory, Silviculture Division

Forest Research Institute, Dehradun 248 006, Uttarakhand

Key words: high altitude medicinal plants, seed quality, germination, dormancy, pretreatments

The present study reports the seed germination behaviour of ten important medicinal plants (*Artemisia vulgaris*, *Berberis asiatica*, *Bergenia ligulata*, *Digitalis pupurea*, *Gentiana kurroo*, *Hippophae salicifolia*, *Myrica nagi*, *Punica granatum*, *Saussurea lappa* and *Zanthoxylum alatum*) from temperate areas, under various pretreatments with growth promoters over one year. Seeds were subjected to germination as per International Seed Testing Association rules for seed testing. The species depicted a requirement of constant temperature of 25/30°C for uniform and higher germination, in winter months seeds exhibited physical/physiological dormancy. Seeds responded to GA₃ and KNO₃ treatments with enhanced germination, these pretreatments should be used for uniform and increased seed germination.

17. Micropopagation studies of *Centella asiatica* Linn. - an important medicinal plant

Dharitri Behera, Meena Misra* and Amarendra Narayan Misra*

Department of Biosciences & Biotechnology, School of Biotechnology,
Fakir Mohan University, Vyasa Vihar, Balasore-756019, India.

*Present address and address for correspondence:

Central University of Jharkhand, School of Natural Sciences, Ratu-
Lohardaga Road, P.O. Brambe-835205, Ranchi, Jharkhand State, India
Email: meenamisra@yahoo.com

Key words: Centella asiatica, medicinal plant, multiple shoot, in vitro, clonal multiplication,

The study of micropopagation on *Centella asiatica* Linn., an important medicinal plant belonging to the family Apiaceae, is reported here. Single nodal explants isolated from field grown plants of *Centella asiatica*, when cultured on Murashige and Skoog's (MS) medium containing different concentrations and combinations of BAP and Kn produced multiple shoots. Maximum shooting was induced in the presence of 2.0mg/L BAP.

Multiple shoot induction was also, achieved through leaf-derived callus. Callus induction from leaf explants was achieved by inoculating the explants in MS medium supplemented with 2,4-D and BAP (6-Benzyle Amino Purine) Multiple shoot induction from leaf derived callus was initiated with 6 μ M of BAP in the MS media.

Individual shoots (2-5c.m), and rooting of these shoots were induced in full strength MS medium containing 2.0mg/L IBA.

18. Molecular analysis of F₁ hybrid between *Momordica dioica* × *M. subangulata* ssp. *Renigera* through cytological and DNA markers.

Seema Rana¹, L. K. Bharathi² and A. B. Das¹

¹Department of Agriculture Biotechnology, College of Agriculture,
Orissa University of Agriculture and Technology, Bhubaneswar -751003,
Orissa

²Central Horticultural Experiment Station (IIHR), Dumduma,
Bhubaneswar-751019, Orissa

email: rana.seema83@gmail.com; alkb@rediffmail.com;

a_b_das@hotmail.com

Key words: *Chromosome, Momordica, RAPD markers, F₁ hybrids, Spine gourd, Sweet gourd.*

Interspecific hybrid (F₁) between spine gourd (*Momordica dioica* Roxb.) and sweet gourd (*Momordica subangulata* Blume ssp. *renigera* (G.Don) de Wilde) were tested with chromosomes and RAPD analysis. Somatic chromosome analysis revealed 2n=28 in *M. dioica* – the female parent, 2n=52 in *M. subangulata* ssp. *renigera* - the male parent and 2n=42 in F₁ hybrid of *M. dioica* × *M. subangulata* ssp. *renigera*. RAPD analysis of both the parents and F₁ hybrid confirmed the more genetic affinity (60.95%) with female parent than the male parent (32.35%). Primer specific DNA markers confirmed the introgression of male genetic elements into the newly developed F₁ hybrids.

19. Capacity building of rural women through training and demonstrations for commercial cultivation of high value cash crops

Janardan Singh, D.R. Chaudhary and Anil Kumar

Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya
Highland Agricultural Research and Extension Centre
Kukumseri (Lahaul and Spiti)

Key words: *rugged areas, capacity building, rural women, high value cash crops*

Changar areas of Kangra district of Himachal Pradesh which fall in between low and mid hill zones and very close to the University headquarter, remained totally neglected so far as dissemination of improved agricultural technologies is concerned. Steep and undulating land topography subjected to high soil erosion coupled with fragmented land holdings and less/no irrigation sources are the characteristic features of these areas. Under Horticulture Technology Mission project (Mini Mission-1, Phase-II) which was in operation

in these areas (Aug., 2006 to Oct., 2009), exhaustive bench mark survey was conducted by the team of the scientists with the active involvement of the farmers to identify priority areas and the farmers/farmer groups interested in taking up vegetable cultivation on commercial scale. Except department of agriculture, no other agency has taken up agricultural technologies dissemination work in these areas. The farmers of the areas never visited any department or institute for seeking technological guidance. In order to upgrade the technological knowledge of the farmers for commercial cultivation of important vegetable crops in the area, various on and off-campus farmers training programs, exposure visits and demonstrations on improved vegetable production technologies were undertaken in a mission mode since August, 2006 to March, 2009. As many as twenty one off-campus farmers training programs of one day duration each and three on-campus farmers' training programs of two days duration each were organized in the selected villages of Changar area. During these training camps, 2294 farmers were educated about the scientific cultivation of vegetable crops in the region. More emphasis was given on the practical aspects of vegetable cultivation like nursery beds preparation, seed sowing, application of balanced fertilizers and preparation of various spray solutions for the control of diseases and insect pests in vegetable crops. Besides, two exposure visits of 10 days duration each of 50 farmers from the selected villages of Changar area were planned and executed with in Himachal Pradesh. The basic objective of the exposure visit was to educate the farmers regarding vegetable cultivation and to interact with the progressive vegetable growers in the different regions of the State. In addition, demonstrations on Rabi, Kharif and Autumn-winter season vegetable crops were laid out during Aug., 2006 to Oct., 2009 on selected farmer's fields covering an area of 18.12 hectares. As a result of these activities, the poor farm women of the area have started the commercial cultivation of potential off-season vegetable crops viz., tomato, cucumber, chilli, French bean, okra, pea, cauliflower, palak and broccoli and are earning a net profit of Rs. 60,000 – 80,000 per hectare per season.

20. Graphical analysis of genetic variation for pod yield and earliness in garden pea (*Pisum sativum* L.)

D.R. Chaudhary, Janardan Singh and Anil Kumar

Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishwavidyalaya
Highland Agricultural Research and Extension Centre
Kukumseri (Lahaul and Spiti)

Key words: Pod yield, genetic variation, graphical analysis

Seven diverse genotypes of garden pea were crossed in a diallel mating design (excluding reciprocals) to infer about the genetic architecture of pod yield and earliness following Haymans' approach. Both the GCA and SCA variances were found significant

for all the traits studied. The predictability ratio ($\sigma^2_{sca}/\sigma^2_{gca}$) was more than unity for all the traits studied except for days to 50% flowering. The values of observed regression coefficient 'b' were low in magnitude and deviated from unity for days to first picking, shelling percentage, pods per plant, plant height and pod yield per plant. The regression line intersected Wr-axis below the point of origin which indicated the presence of over-dominance. The scatter of array points along the regression line clearly indicated that the parental genotypes used in the present investigation were genetically diverse. The parental arrays, DPP 9418-06 and Pb-89 possessed most of the dominant genes with positive effect whereas, the parents DPP-3 and DPP LMR-41 had the recessive genes with increased effect on pod yield and its related traits. Both additive (D) and non-additive (H_1 , H_2) components were found significant for all the traits excepting additive component for pod yield per plant, shelling percentage and days to first picking. The mean degree of dominance revealed the presence of over dominance for all the traits which was probably due to the predominant role of non-additive genetic variation. The equal distribution of positive and negative genes in the parents was observed for days to 50% flowering, pods per plant and shelling percentage. Narrow sense heritability estimates were low for pod yield per plant, pods per plant, days to 50% flowering and days to first picking. Based upon the results obtained from combining ability variances, graphical and component analyses, a line of improvement of a particular trait for evolving an ideal plant type of garden pea has been suggested.

21. Studies on Genetic Diversity in *Oryza Rufipogon* and *Oryza Nivara* using Molecular Markers

D. Swain, S. Samantaray, H.N. Subudhi, Sunita Ojha, Saikrishna Repalli,
O.N. Singh, G.J.N.Rao

Central Rice Research Institute, Cuttack 753006, Odisha, India.

Key words: *Oryza rufipogon*, *Oryza nivara*, *Oryza sativa*, genetic diversity, SSR & ISSR molecular markers.

Oryza rufipogon Griff. and *Oryza nivara* (Sharma et Shastry) are the two wild rice species sexually compatible with the cultivated rice *Oryza sativa* L and are considered to be a rich source of important genes. The genetic diversity of twenty one accessions of these two species collected from Odisha and West Bengal was studied using SSR and ISSR markers. A total of 116 clear bands were amplified from 16 selected ISSR primers and 119 alleles were detected from 23 SSR primer pairs. The dendrogram constructed using UPGMA from a genetically similarity matrix based on SSR and ISSR analyses divided into two major clusters. Interestingly, only one accession (Ac. No. 1000027 of *O. nivara* collected from Kalahandi) falls in one cluster and other twenty accessions formed many minor, sub-minor, mini, sub-mini, micro and sub-micro clusters. The results clearly demonstrated the

richness of genetic diversity present in wild rice populations that constantly interact with various adversities of nature and thus serving as a great reservoir of genetic diversity which might be of use in rice genetic improvement program.

22. Effect of lime and organic matter, applied under different moisture regimes, on soil properties in some Alfisols of West Bengal

G.H. Santra* ; P. K. Das and D.K.De**

Department of Soil Science and Agricultural Chemistry,
Orissa University of Agriculture and Technology, Bhubaneswar-751003

*Email: santragh@yahoo.co.in

** Department of Agricultural Chemistry and Soil Science,
Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, Nadia, W.B.

Key words: Lime, Organic Matter, Submergence, Field Capacity, Soil Properties

The study was conducted in some Alfisols of West Bengal at two different moisture regimes viz. field capacity and continuous submergence. Application of lime and lime + organic matter increased soil pH in both the moisture regimes. Organic matter reduced pH under submergence but increased pH at field capacity. Application of organic matter and lime + organic matter increased organic carbon content in both the moisture regimes. Application of lime, organic matter and lime + organic matter increased the CEC in both the moisture regimes. Lime and organic matter reduced crystalline Fe₂O₃ content under submergence but increased amorphous Fe₂O₃ content in both the moisture regimes.

23. Role of hydrogel in improving water conservation and water use efficiency in pearl millet (*pennisetum glaucum*) production

Harphool Singh and M.P.Sahu

Agricultural Research Station, S.K.Rajasthan Agricultural University
Fatehpur-Shekhawati, Sikar (Raj.)-332001, India

Key words: Pearl millet, hydrogel and water use efficiency.

A field experiment was conducted at Agricultural Research Station, Fatehpur-Shekhawati in three consecutive rainy (*kharif*) seasons (2006-2008) to study the role of hydrogel in improving water conservation and water use efficiency in pearl millet production.

The soil of the experimental field was sandy loam, low in available nitrogen (168 kg/ha), medium in available phosphorus (21 kg/ha) and high in available potash (301 kg/ha) with 0.46 per cent organic carbon content and alkaline (pH 8.2) in reaction. The experiment consisting of 6 treatments was conducted in randomized block design with 4 replications. Study revealed that viz. effective tillers/plant, ear length, grain weight/earhead and test weight were significantly influenced by seed treatment with hydrogel. The grain, stover yield and WUE were also significantly influenced by the hydrogel application. The highest increase in grain yield was noted with seed coating 20 gm hydrogel + TU + DMSO followed by 20 gm hydrogel, 10 gm hydrogel + TU + DMSO and 10 gm hydrogel per kg over untreated control.

24. Evaluation of insecticide and biopesticide against sapota seed borer, *trymalitis margarius meyrice*

**B. D. Shinde, A. V. Dahiphale, A.Y. Munj, N. V. Dalvi and
M. G. Palshetkar**

Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli, Dist Ratnagiri 415712
M.S.

Field experiment on evaluation of insecticide and bio-pesticide against sapota seed borer was conducted during the year 2004-05 and 2005-06 with 10 treatments viz, Azadirachtin 1% @3ml/lit., Azadirachtin 0.03% @3ml/lit., *B. t* @1.5gm/lit., Phozalone 35 EC@1.5ml/lit., Emamectin benzoate 5 SG @0.45gm/lit., Novaluron 10EC @1ml/lit., Profenofos 40 EC @1ml/lit., Lambdacyhalothrin 5EC@1ml/lit., Deltamethrin 2.8 EC @1ml/lit and untreated control, two trees each treatment replicated thrice at the farm of Agriculture Research Station, Palghar, Dist-Thane (M.S.) . Four spraying was given to each treatment first spray at the end of monsoon, second spray one month after first spray, third spray one month after second spray and fourth spray one month after third spray. The pooled mean of two years experimental results revealed that the Emamectin benzoate 5 SG @0.45gm/lit was found most effective and significantly superior which was recorded 3.50 per cent sapota seed borer incidence. The treatment Lambda-cyhalothrin 5EC@1ml/lit was second best treatment recorded 6.42 per cent but it was at par with the treatment Deltamethrin 2.8 EC @1ml/lit and Profenofos 40EC @1ml/lit were recorded 6.50 per cent seed borer incidence, respectively.

25. Clutch size in *Cotesia glomerata*: response of hosts and consequences for parasitoids

Fazil Hasan and M. Shafiq Ansari

Department of Plant Protection, Faculty of Agricultural Sciences
Aligarh Muslim University, Aligarh 202002 (India)
Email: fazilento10@gmail.com; Cell: 09528432455

Key words: Cotesia glomerata; clutch size adjustment; sex ratio; superparasitism

The study investigates the ability of the gregarious larval endoparasitoid *Cotesia glomerata* L. (Hymenoptera: Braconidae) to adjust the progeny sex ratio and clutch size with repeated oviposition experience and the effect of honey based diet on the clutch size. In the field collected clusters many clusters were female-biased but some clusters (3.8%) produced only male wasps suggesting that low percentage of unmated females in the field. Superparasitism was common in the field, and females were believed to increase progeny sex ratio when attacking previously-parasitized hosts. In the laboratory, the number of eggs laid in a day tended to decrease with increasing female age. For females which were offered two hosts per day and for those offered three hosts per day, this value became nearly the same at 9th days after the start of oviposition. Old females which attacked many hosts tended to lay fewer eggs in a day than young ones. However, the degree of this tendency was not the same for all the parasitoid females of all three groups because sperm remained viable throughout a female's lifetime. The amount of sperm used in a single oviposition bout seemed fixed and was not dependent on the number of eggs laid. Over the 2 days of the clutch size response experiment, the number of hosts a female attacked per day was not affected by the presence or absence of honey.

26. Finger millet variety for high yield and non-lodging to suit the Coastal Areas

Dr. S.V.S. Gangadhara Rao

Senior Scientist (G&PB), ARS, Peddapuram, E.G.Dt., A.P.

Key words: Finger Millet, Non lodging, Coastal Belt

Among the six small millets, finger millet (Ragi) is an important one, grown where no other crop can give a reasonable yield. In view of its resistance to harsh environment and resilience for climate change and suitability for contingency planning, it is gaining importance in the National Food Security Schemes. Besides the above, it is known for

nutritional values and health benefits. It contains protein @ 6 -9%, carbohydrates @ 62-69%, fat 0.55-1.2% and calcium @ 285mg to 377mg/ 100g. It also possess soluble fibre up to 1.76%. Finger millet is mostly grown in Karnataka, Tamilnadu, Odisha, Madhya Pradesh, Jharkhand, Andhra Pradesh, Uttarakhand and Maharashtra. In spite of reduction in acreage, small millet production in the country has not come down proportionality due to significant increase in the productivity of Ragi from 731 kg/ha in 1960-62 to 1552kg/ha in 2008-09. In coastal areas often cyclonic gales have been causing damages to the finger millet crop leading to complete lodging. Therefore besides yield, a variety which can resist the lodging is quite essential for the coastal belt of Andhra Pradesh. Hence an attempt was made to identify/ evolve a finger millet variety to suit the areas. In this endeavor, selections were made from the segregating populations supplied by the Project Coordinator, Small Millets, ICAR, GKVK, Bangalore and Agricultural Research Station, Vizianagaram in Andhra Pradesh. Twenty eight selections were tested against two checks Godavari and Ratnagiri varieties, released from Agricultural Research Station, Peddapuram during Khari 2010 in an Observation Varietal Trial at Agricultural Research Station, Peddapuram during Khari 2010 in a randomized block design replicated thrice. Data was recorded on plant height in cm, number of productive tillers / plant, main ear length, number of fingers/ear, days to maturity, straw weight (Q/ha) and seed yield (kg/ha). Out of these 28 cultures tested, the culture PR 10-45 (GPU48 x GE4931) (3959kg/ha) is found significantly superior to the better check Godavari (2821kg/ha) in respect of seed yield . The culture is showing resistance to lodging in contrast to the check Godavari. It has recorded a plant height of 83cm, when compared to Godavari with 108cm. The number of finger/ear were 10 in PR 10-45 when compared to the check Godavari with 7 finger/ear. The culture came to maturity in 123 days while the check Godavari in 118 days. The straw yield in PR 10-45 (11.7 q/ha) is also high when compared to the check Godavari (7.4 q/ha). Therefore the culture is found suitable for coastal areas to with stand the frequent gales coupled with high yield.

27. Orissa Coastal Eco-System & Integrated Coastal Zone Management for Sustainable Development

S.R.Barik and R.S.Behera*

Post Graduate Department of Environment Management

*Post Graduate Department of Agroforestry, College of Forestry

Orissa University of Agriculture & Technology, Bhubaneswar –751003

swarupfo@gmail.com & radhe.shark@gmail.com

Key words: *Ecosystem, Coastal region, Conservation, Wetland & Sustainable development.*

Orissa is very rich in its natural resources. Its river resources, mineral resource, potential land resources, forest resources, long coastline and climate is the unique wealth and deserves special mention. India has about 7500 Km long coastline. The coastal areas

form a highly complex and dynamic ecosystem, sensitive to extreme development pressure. In Orissa the coastal zone spreads over an area of approximate 22,800 sq.kms. i.e. 15% of the total area of the State. It spreads over the districts of Balasore, Bhadrakh, Kendrapara, Jagatsinghpur, Puri, Khurda and Ganjam with 529 km of coastline. From North to South the six major rivers of India i.e. the Subarnarekha, the Burhabalanga the Baitarani the Brahmani the Mahanadi and the Rushikulya commanding huge catchments area in and outside the state are draining to the Bay of Bengal through this region.

The Coastal region has been formed by the deposition of silt and sediments brought down by these rivers. The deltaic and coastal tracts have been recognized to be of high potential value. The natural features of the land make a perfect system of irrigation and drainage possible and the soils are very fertile and are of very high agricultural value. This region is the most developed part of the State of Orissa supporting 36% of the total population and 43% of the total urban population. This region is best known as the “Rice Bowl” of the state of Orissa and this region is most thickly populated with population density of 300/ sq. km (1981) census. Cyclones with high wind velocities occur approximately four to six times per year (on an average) in this region whose effects on coastal process is very much prominent. All the ports, harbor, sea based industries are in the coastal zone which favour rapid population growth, natural calamities including cyclone, flood, storm surge etc. attack the coastal zone causing heavy damage to life and property. Coastal wetlands play a characteristic role in Orissa’s ecosystem. They constitute an unique eco-system which includes the colonization of mangals, marshis, swamps and mudflats. They act as barriers to storm surges, strong winds and cyclones and protect the hinterland. Wetlands also act as very good habitat for development of nursery grounds of shellfishes, crabs and other fauna. Stabilisation of sediments is also an inherent value of the coastal wetlands. The action of the littoral current from South to North along the coast of the Bay of Bengal and dumping of sand, silt and clay material by the Mahanadi-Brahmani-Baitarani system is responsible for creating the marine landscape of mangroves. Mangroves have manifold socio-economic importance. They check soil erosion encroachment of seashore and oceanic cyclone. Quite a good number of mangrove species such as *Cerbera manghas*, *Xylocarpus granatum*, *Sonneratia caseolaris*, *Lumnitzera racemosa* and *Acanthus ilicifolius* etc. have medicinal value. Further, tannin and flavonoids are extracted from mangrove taxa like *Rhizophora apiculata*, *Sonneratia caseolaris*, *Bruguiera gymnorrhiza* and *Kandelia candel* etc. Distraction of mangrove forest leads to various environmental hazards. Some mangrove species like *Cerbera manghas*, *Acanthus volubilis*, *Xylocarpus granatum* and *Heritiera kanikenxis* are found only in the Bhitarkanika wildlife sanctuary and are absent in the other mangrove forests of Orissa. Realizing the importance of potential coastal eco-system with a stretch of 529 Km protection and conservation are the need of hour for sustainable development which now needs to pay attention on comprehensive action plan of integrated coastal eco-system management prioritizing the issues such as conservation of wetlands

and natural depressions, ground water use and scientific expansion of new canal irrigation, land use planning & regulation in coastal zone, abolition of embankments, proper catchments management, conservation of mangroves diversity and conservation of aquatic life etc.

28. Evaluation and identification of sweet sorghum [*Sorghum bicolor* (L.) Moench] genotypes for biofuel and bioenergy production in the context of climatic change

SS Rao*, MV Madhavi Santhoshi, JV Patil, DCS Reddy, B Subbarayudu and G Vijaya Kumar

Directorate of Sorghum Research (ICAR), Rajendranagar, Hyderabad
500030, AP *e-mail: ssrao@sorghum.res.in

Key words: *sweet sorghum, bioenergy, rabi season, stalk yield, brix, total soluble sugars, grain yields*

Thirteen sweet sorghum genotypes were evaluated in a randomized complete block design with three replications at DSR Farm, Rajendranagar, Hyderabad during *rabi* 2010-11. The objective of the current study is to identify promising sweet sorghum genotypes that produce high stalk yield, biomass, sugar content and grain yield potential aimed at both first and second generation bio-fuels development. Significant genetic differences were observed for all stalk, biomass and juice quality traits at soft dough (SD), hard-dough (HD), physiological maturity (PM) stages. Stalk yield declined by 18% at PM than over HD and cv. SPSSV 30 produced 15% more stalk yield than hybrid CSH22SS. In varieties, SPSSV 30, SPSSV 11, SPSSV 20, SPSSV 40, SSV74, produced significantly higher yields (>150%) than variety check CSV19SS. In total biomass, both SPSSV 30 and SPSSV11 produced 196 and 209% higher biomass than check CSV 19SS. In varieties, SPSSV 20, SPV 422, SSV 74, SPV 913 produced significantly higher (100 – 126% more) grain yield than check CSV 19SS. Cv. SPSSV 30 showed significantly higher total chlorophyll content followed by SPSSV 5. Further, total chlorophyll content had shown significant positive relationship ($p < 0.05$) with stalk, sugar and ethanol yields. Sucrose content had shown high significant positive correlation with TSS ($r = 0.919$; $p < 0.01$). Mean sugar yield declined by 34% from 1.34 to 0.89 t/ha from SD to PM, respectively. At PM, ethanol yields ranged from 195 (SPSSV6) to 1391 L/ha (SPSSV 30). Mean computed ethanol yield was 716, 604, and 475L/ha at SD, HD, and PM, respectively. Cvs. SPSSV 30, SPSSV 11, SPSSV 20 and SSV 74 recorded 396%, 128%, 109% and 82% higher computed ethanol yield than check CSV19SS and these were distinctly superior across growth stages than check. The above entries will be ideal candidates for utilizing in production of both first and second generation biofuels in the context of current day climate change and climate variability.

29. Effect of pre-harvest calcium chloride treatments on storage life and quality of peach (*Prunus persica* batsch.) cv. Shan-i-Punjab

Raja Hadin Shafi, S. K. Jawandha, Z. A. Bhat*

Department of Horticulture, Punjab Agricultural University
Ludhiana, Punjab 141004

*Fruit Research Station Balopora, SKUAST (K)-Srinagar-191121

*Email:zahoornano@gmail.com.

Key words: Peach, Shan-i-Punjab, calcium chloride, storage life, fruit quality.

Peach being a highly perishable fruit crop cannot be stored for a longer period under ambient conditions. To prolong the storage life, the plants of peach cv. “Shan-i-Punjab” were sprayed with calcium chloride viz. 0.5%, 1.0% and 1.5%, at pit hardening stage, 10 and 20 days after pit hardening stage in three different groups. The first group of plants were given three sprays of calcium chloride at pit hardening stage, 10 and 20 days after pit hardening, in second group of plants, two sprays of calcium chloride were given at 10 and 20 days after pit hardening and in the third group of plants one spray of calcium chloride was given at 20 days after pit hardening. After harvesting the fruits were packed in CFB boxes and stored in cold store (temperature 0-1°C and 85-90% RH) for 30 days. Fruits samples were analyzed at the time of harvesting 10, 20 and 30 days after storage for various physico-chemical characteristics. Fruits treated with three sprays of calcium chloride @ 1.5% showed better results with minimum physiological loss in weight, TSS, TSS: acid ratio, total sugars and maximum pulp: stone ratio, sensory quality and acidity throughout the storage period.

30. Ambri - an Endangered Apple Cv., Its Revival and Conservation through Integrated Approaches

Z.A.Bhat*, G.M.Wani, G.I.Hassan, A.H.Pandith

Fruit Research Station Balapora, SKUAST-K (Srinagar)-191121

*Email: zahoornano@gmail.com

Key words: Ambri, long gestation period, alternate bearing, paclobutrazol, thinning

Extensive survey, selection and evaluation were conducted in the Ambri belts of Kashmir valley and four promising strains with better pomological traits selected and maintained for future breeding programme. Long gestation period (15-17 years) and alternate

bearing are the main reasons for extinction of Ambri apple – the only indigenous cultivar to Kashmir valley. In order to reduce to juvenility period interstocks of M9, MM106 and MM111, with different lengths were used. Interstocks reduced the gestation period to only 4-5 years. With 15 cm interstem piece earliness in first flowering (3rd year) and fruiting were observed. The average number of fruits after 4th year of planting was 55.63 and 48.32 fruits per plant with 15 cm and 20 cm interstem pieces, respectively. Alternatively, flower thinning, fruit thinning, girdling, ringing and application of paclobutrazol @ 2g and 4g /m² of canopy area were employed to overcome alternate bearing.. Data revealed that maximum flower intensity (16.53/ plant) during off year was observed in paclobutrazol (2g/m² of canopy area) which was highly significant over other treatments and was followed by flower thinning of alternate branches (12.45/ plant).

31. Elucidation of sole and pooled application of inorganic fertilizer (N, P and K) and organic manures (FYM and vermicompost) on yield, and nutrient accumulation in pepper mint (*Mentha piperita* L.).

V. K. Yadav*; Hari Baksh; D.D. Patra*****

*CSR&TI (Silk Board of India), Mysore-570008

Email: vinodkumarydv@gmail.com

**School of Life Sciences, JNU, New Delhi. 110067

***Central Institute of Medicinal and Aromatic Plants (CIMAP)

Lucknow, India

Key words: *Essential oil, growth, yield, peppermint and vermicompost.*

A field experiment was carried out at CIMAP research farm during 2008-09 to study the influence of sole and pooled application of inorganic fertilizer (NPK) and organic manures (FYM and vermicompost) on growth, yield and nutrient accumulation of peppermint (*Mentha piperita* L.) in a sandy loam soil. A significant increase in the growth parameters were recorded over control in all treatments. Combined application of vermicompost at @5 t ha⁻¹ with N, P and K, @ 75:37.5:37.5 kg ha⁻¹, increased the herb, dry matter, oil yield and uptake of nutrients by 57, 51, 51, 48% respectively over control. It was on par with application of 2.5 t vermicompost and even amount of N, P and K ha⁻¹ for all the parameters while analyzing for benefit cost ratio.

32. Heat Pump Drying of Onion (*Allium cepa* L.)

N. R. Sahoo*, U. S. Pal, C.K. Bakhara and S. K. Dash

Department of Agricultural Processing and Food Engineering
College of Agricultural Engineering and Technology
Orissa University of Agriculture and Technology, Bhubaneswar 751 003
*Email: nr_s2002@yahoo.co.in

Key words: *Onion, drying time, heat pump dryer, hot air dryer*

Onion, of pink variety were peeled, trimmed and sliced to 2 mm thickness. The onion slices were dried in the heat pump dryer at 35 (32 % R.H.), 40 (26 % R.H.), 45 (19 % R.H.) and 50° C (15 % R.H.) and were compared with samples dried in hot air dryer at 50°C (52 % R.H.). Drying rate increased with increase in drying air temperature and took place under falling rate period. The Page equation was found to be better than Lewis equation to describe the thin-layer drying of onion slices with higher co-efficient of determination and lower root mean square error. Drying air temperature of 50°C was recommended for drying of onion slices in heat pump dryer. Heat pump drying took less drying time and yielded better quality dried product as compared to hot air dryer at same drying air temperature of 50°C.

33. Leaves of *Lantana camara* Linn. (Verbenaceae) as a potent source for the management of stored grain pests

Y. Rajashekar*, K.V. Ravindra and N. Bakthavatsalam

National Bureau of Agriculturally Important Insects, P. Bag No: 2491,
H.A. Farm Post, Bellary Road, Bangalore - 560 024, Karnataka, India
Tel: 080-23511982; Fax: 080-23411961
Email: rajacftri@yahoo.co.in

Key words: *Lantana camara; adult mortality; Fumigant and contact toxicity; Sitophilus oryzae; Tribolium castaneum*

Insects cause extensive damage to stored grains and their value added products, which may account to 5-10% in the temperate zone and 20-30% in the tropical zone. Among stored grain pests, *Sitophilus oryzae* (L.) and *Tribolium castaneum* (Herbst) were considered

as destructive pests in India. Plants may provide alternatives to currently used insect control agents as they constitute rich source in bioactive molecules. *Lantana camara*, an erect shrub, which grows widely in the tropics, exhibits insecticidal activity against several insects. The efficacy of the extracts of leaves of *L. camara* as an insecticide was studied against *S. oryzae* and *T. castaneum* in the laboratory conditions. The methanol extract from leaves of *L. camara* has fumigant and contact toxicity against *S. oryzae* and *T. castaneum*. In fumigant assays, LC_{50} for *S. oryzae* was $128 \mu\text{l/L}^{-1}$ (66 μg), and *T. castaneum* $178.7 \mu\text{l/L}^{-1}$ (88.3 μg). The LD_{50} values for *S. oryzae* and *T. castaneum* in contact toxicity were 0.158 and 0.258 mg/cm^2 , respectively. Probit analysis showed that *S. oryzae* adults were more susceptible than *T. castaneum*. Gas chromatography-Electro antennogram detector (GC-EAD) studies for *S. oryzae* and *T. castaneum* indicated the presence of potent fumigant molecules in *L. camara*. Efforts are being made to isolate, and identify the active molecules for *L. camara* for the management of *S. oryzae* and *T. castaneum*.

34. Comparison of genetic parameters, correlations and path analysis of different maturity groups of paddy under coastal saline eco system

T. Anuradha & K. Nagendra Rao

Agricultural Research Station
Machilipatnam 521002, Andhra Pradesh

Key words: *Genetic parameters, correlations, path analysis, rice, coastal salinity.*

Studies on genetic variability, correlations and path analysis in three maturity groups viz., early, medium and late comprising forty eight promising cultures of rice under coastal saline eco system revealed that the phenotypic coefficients of variation were slightly higher than the genotypic coefficients of variation indicating little environmental influence. High values of heritability and genetic advance for grain yield, test weight and ear bearing tillers in all the three maturity groups indicate the predominance of additive gene action. High positive and significant correlation of plant height and ear bearing tillers with seed yield and their high positive direct and indirect effects indicate the importance of their special emphasis in selection in all the three maturity groups.

35. Effect of Nitrogen and Potassium level on yield and quality of Pikka tobacco (*Nicotiana tabacum*)

A.K.B. Mohapatra, A.K.Padhi, K.C. Pradhan & R.K. Panigrahi

AINRP on Tobacco, Centre for Pulses Research,
Orissa University of Agriculture and Technology, Berhampur, Orissa, 761001

Key words: Nitrogen, Potassium, Pikka tobacco, cured leaf yield, nutrient uptake.

Field experiment was conducted at CPR, OUAT, Berhampur, Orissa during 2009-10 on sandy loam soil to study the effect of 16 treatment combination of 4 levels of nitrogen (0,40,80 & 120 kg/ha) and 4 levels of potassium (0,30,60 & 90 kg/ha) fertilizer on the yield and quality of pikka tobacco. Application of 120-40-90 NPK kg/ha recorded the highest cured leaf yield (1420 kg/ha) highest net return of ₹ 23885/ha, uptake of 38.01 kg N/ha and 55.41 kg K/ha with leaf Nicotine (3.63 %) Reducing sugar (2.79 %) and Chloride (0.42 %) content which are within acceptable range for trade.

36. Evaluation of certain sapota (*Manilkara achras* Mill. Fosberg) genotypes for coastal region of Andhra Pradesh

Rajasekhar M¹, Rajyalakshmi R², Baburatan P³ and Purushottam K⁴

AICRP on Tropical Fruits, Dr. Y.S.R. Horticultural University
Venkataramannagudem-534101, West Godavari District, A.P., India

¹ marri.rajasekhar@gmail.com, Ph: 09490660670

² Scientist (Hort.), AICRP on Tropical Fruits, Venkataramannagudem

³ Professor (Hort.), HCRI, Anantharajupet, Railway Kodur (M), Kadapa Dist

⁴ Director of Research, DYSR Horticultural University, Venkataramannagudem

Ten varieties of sapota planted during 1996 were evaluated for growth and yield in coastal region of Andhra Pradesh. Maximum plant height was recorded in the variety DHS-1 (7.30 m) followed by PKM-3 (7.02 m), while the lowest was in PKM-1 (5.51 m). Canopy

volume was maximum in DHS-1 and DHS-2 (469.09 and 451.27 m³ respectively) and the minimum in PKM-1 (225.55 m³) while pollen fertility was maximum in Kalipatti (98.86%). The cv. Singapore produced the highest number of fruits per tree (4326) followed by PKM-3 (3967). Yield per tree and per ha was maximum in PKM-3 (288.63 kg and 28.86 t.ha⁻¹) followed by Singapore (228.62 kg) and PKM-1 (184.7 kg). The variety PKM-3 recorded maximum cumulative yield of 100.06 t/ha (1999 to 2011). Among the varieties, PKM-1 had dwarf stature, compact growth due to dense branching and may be more suitable for high density planting. Based on the overall performance the varieties PKM-3, PKM-1, Singapore and Kalipatti have been suggested for cultivation in coastal region of Andhra Pradesh.

37. Effect of N application in nutrient uptake and biomass production in *Sterculia villosa* Roxb. Seedlings in terai regions of West Bengal

A.N. Dey¹ B. Sharma¹, and D. Mukhopadhaya²

¹Department of Forestry, Faculty of Horticulture

²Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture
Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar 736165 W.B.

Email: amarendra_dey@rediffmail.com

Key words: *Sterculia villosa*, seedlings, biomass, nutrient content and uptake

A study was conducted to determine the influence of different levels of applied N on biomass production, nutrient content and their nutrient uptake in *Sterculia villosa* Roxb. seedlings during nursery stage. Seedlings were grown in poly bags for 90 days in combinations of four (4) levels of N (50, 75, 100 and 150 kg/ha in form of urea) with a fixed dose of P (100 kg/ha in form of SSP) and K (75 kg/ha in form of K₂O) as basal dose with a control. Seedlings were supplied four (4) varying levels of nitrogenous fertilizer (urea) in solution form. The N application significantly increased biomass in all parts of the plant and it was maximum at 100kg N/ha. The highest concentration (0.92%) and lowest concentration (0.53%) of N in root was observed at 150kg of N/ha and control respectively where as the total N uptake by plant root was followed the same trend. The maximum P concentration (0.15%) and uptake (44.77mg/plant) by root was noticed at 100 kg of N/ha where as the highest concentration of K (0.40%) and uptake (104.84mg/plant) in root was observed at control. Similar trend was followed in shoot and leaf of *Sterculia villosa* seedlings.

38. High Density Planting of Mango (*Mangifera indica* L.) under Mid-Western Plain Zone of Uttar Pradesh: a boon for orchardists

Yogesh Prasad Rajbhar, Mohan Lal, Gopal Singh, S. D. Singh and Vikrant Sirohi

Sardar Vallabh Bhai Patel University of Agriculture & Technology,
Meerut 250110, U.P.

An experiment was conducted at Zonal Research Centre – Nagina (Bijnor)-262502 U.P. during 2000 to evaluate the performance of High Density Planting of Mango (*Mangifera indica* L.). The grafted mango plants of Dashehari prepared on seedling rootstocks in July 1999 were planted at Horticulture Section in August, 2000 at two spacing viz; 10m x 10m (100 plants/ha-normal density) and 3.0m x 3.0 (1111plants/ha-high density). Five grafts were planted in normal density and 160 grafts were planted in high density employing about 0.1940 ha area. Grafts in normal density were planted at marked points prepared by pit digging (1x1x1m) and then by filling the pits with dug soil mixed with 100g N, 75 g P₂O₅ and 75 g K₂O fertilizer mixture, whereas grafts in high density were planted directly in soil mixed with fertilizers containing 100g N, 75 g P₂O₅ and 75 g K₂O fertilizer mixture.

The plant height (2.62m) was recorded under normal planting where it was found little difference in High density of mango. The Stem girth under normal density was noted as 67.7cm whereas; it was slightly reduced in High density of planting. The North –South and East-west direction length were 3.85m and 3.97m recorded in normal planting, respectively; however, they were slightly higher to HDP.

The fruit yield 21.7q/ha was noted under normal density of planting whereas it was 245.52q/ha on 5th year of planting under High Density Planting System. Again, 28.52q/ha fruit yield was noted under normal planting whereas it was recorded 300.08q/ha in HDP on 6th year. Fruit yield (34.72q/ha) was noted under normal density while it was recorded 364.87q/ha in HDP on 7th year. Again on 8th year, 38.44q/ha fruit yield was noted under normal planting whereas it was recorded 416.02q/ha in HDP during the 9th, 10th and 11th year it was noted similar increasing results. The observations showed that there were 1: 11.31, 1:10.52, 1:10.51 and 10.82, 10.36, 10.13 then 10.05 of normal to HDP system of planting from 5th year onward up to 11th year age. So, it is a very informative and need of the hour to plant HDP system of mango just to get 10 to 11 times more yield for increasing mango productivity and to reach the king of fruit to the common people.

39. Molecular characterization and purification of native landraces of rice

**P. Roy¹, S. Ara², A. Patnaik¹, S.S.C. Patnaik¹, S. Choudhury² and
G. J. N. Rao¹**

¹. Central Rice Research Institute, Cuttack

². M S Swaminathan Research Foundation, Jeypore

Key words: Land race, Purification, Characterization

The Jeypore tract of Orissa state is considered to be the secondary center of diversity of rice as it houses a rich genetic diversity. Rice is major crop of the district which occupies 39% and 18% of cropped area during *Kharif* & *Rabi*, respectively. Because of lack of purity in these landraces, farmers are unable to gain proper yields and appropriate market value for their produce. The present study reports on the efforts to purify three landraces (Kalajeera, Machhakanta & Haladichudi) which are popular among the tribal farmers of Koraput region. To achieve the objective, both morphological and molecular characterization was employed and the results will be presented.

40. Morphological characterization & purification of Aromatic Short Grain Rices of Orissa

P. Roy, A. Patnaik and G.J.N. Rao

Central Rice Research Institute, Cuttack – 753 006, Orissa, India

Key words: Aromatic Short Grain, Quality, Pure line, Breeding

Eastern India in general and Orissa in particular, is endowed with large number of short grain aromatic landraces. Unlike Basmati which has long slender grains, these varieties possess short and medium grains with different husk colours but endowed with the quality characters that are equal or better than Basmati like high HRR and excellent eating and cooking qualities. Purification of these varieties is a necessity for genetic improvement through pure line selection without losing their unique quality traits. The present study deals with morphological characterization and purification of some of these aromatic short grain rices of Orissa.

41. **Flavonoids as phytosomes**

Raghunath T. Mahajan* and Gunjan M. Chaudhari

Department of Biochemistry and Biotechnology, Moolji Jaitha College, Jalgaon

*Corresponding author: rt_mahajan@rediffmail.com

Key words: *Phytosomes, Asteraceae, flavonoids, drug delivery.*

An attempt has been made to review some flavonoids rich in some medicinal plants in Maharashtra with the intention of their use in herbal drug delivery system. In this direction a list of indigenous medicinal plants have been prepared with respect to the taxonomic name, vernacular names, family, parts used of these plants on the basis of literature. This article considers 181 medicinal plants of Maharashtra belonging to different 79 families. In the present review 27.07% trees, 17.13% shrubs, 48.07% herbs, few climbers, creepers and weeds are noted for the presence of flavonoids. Among the plant parts, mostly leaves contain more flavonoids than roots, stems, seeds, flowers, fruits and barks. The highest content of flavonoid as flavonol is present in Asteraceae family and expected chemotaxonomic markers of Asteraceae. Usually terpenes, edusmocoides, ginsenoside, flavonoids, epigallocatechi-3-o-gallate, procyanidins, flavones polyphenols are crucial candidates of phytosome. Relative lipophilicity and capacity constant K, hydroxylation pattern of C₂-C₃ are taken into consideration for final selection of most appropriate biomolecule as **phytosome**. These unique chemical characteristic and structure of flavonoids pose major challenge for the use of them in better absorption through tissues. The use of phytosomes is a novel formulation herbal technology which helps to reduce most of the problems arises in pharmacodynamics and bioavailability of drugs. This paper provides details of the selection of flavonoids and formulation methodology for phytosomal flavonoids.

42. **Community gene-seed-grain Bank; A community driven mechanism to achieve MDG1 in Koraput tribal region of Odisha.**

Tusar Ranjan Nayak

Senior Scientist, M.S.Swaminathan Research Foundation

Key words: *MDG- Millennium Development Goal*

Despite rapid economic growth in the last two decades through implementation of several schemes, India is likely to slip behind the MDG target of eradicating extreme poverty and hunger proportion of the people to half by 2015. Until and unless the prevailing grim situation of food and nutrition insecurity in the backward rural India is not addressed, the

goal may remain as a dream in the country. This paper highlights the hunger and malnutrition situation prevailing in a most backward tribal dominated district like Koraput in Odisha and the role of community driven gene-seed-grain banks in addressing the situation at the household level, particularly for marginalized groups, destitutes, women and children. The region Koraput has a very high percentage of scheduled tribe population, nearly 50 percent and most of them are primitive. The socio-economic indicators in these areas are comparable to the worst in the world with the percentage of people below the poverty line ranging from 72% to 83%. Although the area is endowed with rich natural resources and is bestowed with good annual rainfall, large percentage of households suffer from different forms food and nutrition insecurity during the year. Factors contribute to hunger are appear to be large number of land less people, lack of non - agricultural employment opportunities, low wages, undulating tableland scattered with hundreds of hills etc. Instances of malnutrition and anemia among the children and mothers are rampant in the villages with most of the newborn babies having low birth weight. In this scenario, establishment of the community driven gene-seed-grain banks in 26 tribal backward villages has been proved as a self reliant food security system and an appropriate mechanism to cater the food and nutritional needs of disadvantaged sections living in the most backward remote region like Koraput in Odisha.

43. Role of Bamboo Shoot in Functional Food and its Processing/Drying

Lalit M. Bal, Madhumita Patel, Santosh Satya

Centre for Rural Development and Technology
Indian Institute of Technology, Hauz Khas, New Delhi-110016, India
Fax: 011-26591121 Email: lalit.bal@gmail.com

Key words: *Bamboo shoot; Nutraceutical; Functional food; Drying*

The young shoot of bamboo is used as food that can be consumed fresh, fermented, canned, dried though its industrial uses is well known worldwide. The young shoots are rich source of nutrients but phytosterols and fiber in shoot attract the modern research as a new health food. In view of the booming nutraceutical & functional food industry and escalating demand for natural functional food additives due to the increasing trends of health consciousness among consumers, bamboo shoot could be further assessed and utilized for its health benefit effects. Bamboo shoot fiber is now a common ingredient in breakfast cereals, fruit juices, bakery and meat products, sauces, shredded cheeses, cookies, pastas, snacks, frozen desserts, and many other food products. The processing/drying of fresh shoot is important as it has high moisture content (~ 94% wb) to increase the shelf life for long storage keeping the nutritional properties intact. The use of hybrid technologies, such as solar-assisted heat pump dryer, solar dryer with thermal energy storage, microwave assisted drying may be more cost effective to get the desired quality products.

44. Bio-coagulant for Micro-algal Biomass Harvest

Narendra Kumar Sahoo, Sumedha Nanda Sahu

Centre for Rural Development and Technology, Indian Institute of Technology Delhi, New Delhi 110016, Email: nksahoo@gmail.com

Key words: Moringa oleifera, biofuel, adsorption, neutralization, protein

Owing to their promising qualities micro-algae are potential feedstocks for many products under food, fodder, pharmaceuticals, nutraceuticals, biofuels (second/third generation) etc. Although, many methods for efficient production of micro-algal biomass exist, efficient methods for harvesting of this biomass need more research inputs. On this backdrop, the authors have discussed the advantages of using *Moringa oleifera* seed extract for efficient (95-98%) and low cost harvesting of micro-algal biomass. This bio-coagulant is a mixture of cationic proteins and peptides and suggested to act by adsorption and charge neutralization due to high positive charge (PI above 10) on the small size molecules.

45. Genetics of quantitative characters associated with pods of Okra in different seasons

P.K.Panda

College of Horticulture, Chiplima, Orissa University of Agriculture and Technology, Chiplima, Sambalpur-768 025 (Odisha)
Email: hortpramod@yahoo.co.in

The gene effects for eight quantitative characters such as plant height, no. of branches, no. of pods, pod length, pod girth, no. of seeds/pod, 100 seed weight, pod yield/plant were studied in both summer and rainy seasons in six crosses of okra. The additive component was significant and present in sizeable proportion of the characters studied. Dominance was higher in magnitude than additivity. Additive X additive and dominance X dominance interactions were observed in most of the crosses for all characters. To exploit all the genetic effects, characters associated with pod can be improved through the use of recurrent selection to ultimately improve pod yield in okra.

46. Antifungal activities of some herbal plant extracts for the management of *Alternaria helianthi* on sunflower seeds causing blight diseases

Vikas V Patel and U.S. Mishra

Phytopathological Lab, Department of Botany, Bareilly college, Bareilly,
M.J.P.Rohilkhand University, Bareilly - 243001, India, E mail:
vikasbotany@gmail.com

Key words: *Alternaria helianthi*, herbal plants, sunflower, management.

The antifungal activities of ethanolic extracts of some selected herbal natural plants were evaluated against *Alternaria helianthi* causing blight diseases of sunflower. On screening the ethanolic extracts of different parts of 10 herbal plants for their antifungal activity evaluated by the zone of inhibition measurement. Among the tested plants, The Garlic bulbs (*Allium sativum*) extract was highly effective in inhibition the growth of as it produced 65.7%,72.6% and 84.2% growth inhibiting at 2%,5% and 10% concentrations , respectively. Neem leaf (*Azadiracta indica*) and Onion (*Allium cepa*) leaf extracts were found moderately as the average growth inhibition were between 36.1% to 63.1% and 51.1% to 83.9% growth similarly *Ageratum conyzoids* and *Vinca rosea* leaf extracts were not very promising as they produced only 2.9% and 6.2% inhibitions, respectively at 10% concentration. The disease was adequately managed by spraying of Garlic and Neem extract @ 5% in fields.

47. Seed Production of Tropical Tasar Silkworm (*Antheraea mylitta* D.) by Tribals – Scope for Effective Utilization of Tasar Host Flora

Sathyanarayana K. and Saratchandra B.

Central Silk Board, Ministry of Textiles, Govt. of India, BTM Layout,
Bangalore 560 068 Karnataka, India
Email: skutala@yahoo.com, (M): 09035022390

Key words: *Tasar culture*, Tribals, Central Silk Board, PRADAN, Silkworm Seed, Community Based Organizations

Tasar culture is the most prominent sector among vanya silks, is practiced by over 1.5 lakh tribals in India. Most of the tribals depend on the natural forests for rearing tasar silkworms (*Antheraea mylitta* D.) on its host plants *Terminalia tomentosa* (Asan) and *Terminalia arjuna* (Arjuna). In spite of several efforts of the Central Silk Board, Govt. of India through well defined seed multiplication system, due to various practical difficulties timely supply of quality silkworm seed still remains a major constraint. This warranted the entry of private sector to cater the needs of this important seri-input. Such an initiative for strengthening

tasar seed multiplication system under the Special Swarnajayanti Gram Swarojgar Yojana (SGSY) Projects in the states of Bihar and Jharkhand through an Professional Assistance for Development Action (PRADAN), an NGO in tasar seed sector is discussed. Genesis of the idea, methodology of conceptualizing and nurturing the model is also detailed. Role of Community Based Organizations, Infrastructure creation, capacity building and modalities of operating these tribal and rural entrepreneurial models are described with strategy for its replication. Various quality parameters adhered and steps taken to ensure the quality besides the benefits accrued through production of tasar silkworm seed locally are emphasized. Constraints and shortfalls faced while implementing this activity, areas of further intervention and future strategies to be adopted for sustaining the initiative are also discussed.

48. Nature friendly long term low cost storage practices of Rice and Pulse in Odisha

K. C. Samal, L. Behera*, P.K. Satapathy and B. K. Badu*****

Assistant Professor, Orissa University of Agriculture & Technology, Bhubaneswar, India, *Senior Scientist, Central Rice Research Institute, Cuttack, India, **Deputy General Manager, Food Corporation of India, Regional Office, Lucknow, India & *** Consultant, Pest Control Management, Bhubaneswar, Odisha, India

Agriculture is the oldest profession of human civilization. The knowledge on storage of agricultural produces particularly cereals and pulses for future use are as old as agriculture itself. Significant losses in quantity and quality of stored grains (Rice and pulses) generally occur through the activities of microorganisms, insects, mites and rodents. However, such losses can be reduced by controlling the storage conditions. The treatment of rice grains and pulses is important to reduce storage losses. Toxic chemicals used to protect these stocks against insects and seed borne pathogens are harmful to human beings. Health hazards associated with use of chemical pesticides for storage of pulses have emphasized the collection and testing of indigenous methods in which locally available low poisonous materials are used. The indigenous methods are cost effective as well as eco-friendly. In this investigation, an attempt had been made to compare these methods with other indigenous and standard chemical methods to improve the storage condition of grains and pulses with cost effective.

49. Value addition to mahua (*Madhuca indica*) flowers for Rural Livelihood Security

Madhumita Patel¹, Bindu Naik² and Lalit Bal³

¹ and ³: Centre for Rural Development and Technology, IIT, New Delhi 110016

Email: patelmadhumita@gmail.com, Ph: 011-26591162, Fax: 011-26591121

²: Centre for Food Science and Technology, Sambalpur University, Orissa

Key words: Madhuca indica, mahua, rural livelihood, flower juice

Madhuca indica commonly known as mahua is a tree of high economic importance providing with sugar rich flowers and oil bearing seeds. It is indigenous to the Indian subcontinent and abundantly distributed in the dry deciduous forests of central India. The annual collection of mahua flowers is more than one million tons. However due to lack of suitable post harvest processing, majority of this collection goes for liquor distillation. **Present paper is focused on a novel processing technology to prepare edible mahua juice concentrate, which may boost the economic return from mahua. It also reports the nutritional value of the concentrate and its utilization potential.**

50. Assessment of correlation between physicochemical characters and cooking qualities of aromatic rice varieties of Odisha

***L.Behera, **P.K. Satapathy and ***Priyadarsani Samal**

*Senior Scientist, Central Rice Research Institute, Cuttack, Odisha, India,

**Deputy General Manager, Food corporation of India, Regional Office, Lucknow,

India, ***Dept. of Chemistry, Gandhi Engineering College, Bhubaneswar, Orissa

Key words: aromatic rice, physicochemical characters, cooking qualities.

In the present investigation, physicochemical characters of rice grain and its association with cooking qualities was studied. A positive correlation was recorded between longer grain types and milling percentage. On cooking, rice grains containing higher amylose content exhibit higher volume expansion ratio and alkali spreading value. Hulling and milling recovery were not influenced by amylose content and alkali spreading value. The positive correlation of amylose content with water uptake, volume expansion ratio, and alkali spreading value indicates that high-amylose rice varieties that will absorb more water at low gelatinization temperature. It was also observed that long grains have reduced amylose content and require a higher gelatinization temperature than bold grains.

51. Characterisation of predominant farming systems in Malkanagiri district of Odisha

Dr. S.N. Mishra, Jr. Scientist (Agril. Economics)
Dr K.N. Mishra, Assoc. Prof.(Soil Science)
Dr. L.M. Garnayak, Chief Agronomist

AICRP on IFS, OUAT, Bhubaneswar, 751003

Key words: Farming system, cropping intensity

A field study was conducted in Malkanagiri district of Odisha during 2010-11 to characterize the existing farming systems adopted by different categories of farmers. Three dominant types of farming systems namely, cereal-based (Rice) farming system (82%), vegetable-based system (14%) and oilseed-based farming system (4%) were identified on the basis of maximum contribution to gross income. The average size of holding of the respective system was 2.6, 3.1 and 0.93 ha while the overall mean holding size was 2.03 ha. Out of 20 sub farming systems identified, maximum number were under cereal-based farming system (14) dominated by rice-oilseeds system. Vegetable + rice or vegetable + rice +oilseeds were the preferred one under vegetable based systems. Cereal based systems were practised by all groups of farmers whereas vegetable based systems were practised mostly by medium group of farmers. Considering all farm based farming systems, cereals contributed the highest share to gross income followed by vegetables, oilseeds and fishery. Fishery has a greater prospect for medium and large farmers. Dairy was adopted only by small and medium farmers. But pulses and dairy did not contribute much to the gross income of all farmers.

52. Effect of artificial diet impregnated with different sugarcane genotypes on post larval development of early shoot borer, *Chilo infuscatellus* Snellen

Bhavani B*, Dharma Reddy K, Venugopala Rao N and Bharatha lakshmi**

*Scientist (Entomology), Regional Agrl. Research Station, Anakapalle,
ANGRAU, Hyderabad

**Assoc. Director of Research, Regional Agrl. Research Station, Palem,
ANGRAU, Hyderabad

Studies on effect of artificial diet impregnated with four least susceptible (LS), four moderately susceptible (MS), four highly susceptible (HS) sugarcane genotypes and one susceptible check on post larval development of early shoot borer (ESB), Chilo infuscatellus Snellen indicated that larval period of ESB was longest on LS genotypes

while it was shortest on HS genotypes and the larvae took less time to pupate on HS than on LS genotypes. Moth emergence and longevity of male and female moths too were minimum on LS genotypes and maximum on HS genotypes. Biochemical assay revealed that shoot tissues of LS genotypes recorded low total sugars contents indicating positive correlation with susceptibility to ESB whereas high total phenol contents in LS genotypes indicating negative correlation with susceptibility to ESB and influenced the biology of the ESB by playing an important role in the antibiosis mechanism.

53. Studies on Physiological efficiency of bt cotton (*Gossypium hirsutum*) hybrids and their non-bt counterparts

Ghodke Pranjali Harischandra

Department of Plant Physiology, Marathwada Agricultural University,
Parbhani- 431402

Key words: Bt cotton, non-Bt cotton, leaf area, yield, dry matter

A field experiment was conducted at the farm of Cotton Research Scheme, Marathwada Agricultural University, Parbhani during kharif season, 2009-10. The experiment was sown in simple randomized block design with three replications and six Bt cotton hybrids along with their non-Bt counterparts. Observation on plant height, leaf area, leaf chlorophyll content, relative leaf water content, specific leaf weight, seed cotton yield and its components and length of root and shoot etc were recorded. The hybrid Ajeet-155 Bt out yielded other hybrids owing to moderate leaf area and highest number of bolls per plant, bigger boll size and high harvest index and biological yield was also high. The characters leaf area, number of bolls per plant, biological yield and harvest index showed highly significant positive correlation with seed cotton yield per plant. As a consequence of Bt gene, there was reduction in plant height and increase in leaf area and total dry matter produced per plant. Average of partly red leaves was more in Bt hybrids compared to their non-Bt counterparts.

54. Influence of methods of crop establishment and rice varieties on nutrient uptake and soil properties

**Priyanka Suryavanshi¹ and YV Singh², Radha Prasanna³,
Yashbir Singh Shivay⁴**

Division of Agronomy, Indian Agricultural Research Institute, New
Delhi, 110012, India

Corresponding author Priyanka Suryavanshi¹, priyankaagrios@gmail.com

Key words: *double transplanting; micronutrient uptake; N uptake; Rice varieties; soil microbial properties; system of rice intensification (SRI)*

A field experiment was undertaken to investigate the influence of methods of crop establishment and rice varieties on nutrient uptake and soil properties. The experiment was laid out in factorial randomized block design (FRBD) with nine treatments, comprising 3 methods of crop establishment viz., conventional transplanting (CT); system of rice intensification (SRI) and double transplanting (DT) and 3 rice varieties viz., 'Pusa Basmati 1401', 'Pusa 44' and 'PRH 10', during the Kharif season. The uptake of N, Fe and Zn was influenced significantly by the different methods of rice crop establishment. Fe concentration in rice grain was 25% higher in SRI than CT. Cultivation methods influenced MBC and FDA of soil significantly and SRI had significantly higher FDA. Available N in soil was significantly influenced by cultivation methods, and SRI recorded highest values, followed by DT. Grain yield was positively influenced by total N uptake. A significant and positive correlation between micronutrient uptake in grains, available N and soil microbial properties and was recorded. SRI was found to enhance microbial activity, micronutrient uptake and N significantly in grain and soil. PRH 10 and Pusa Basmati 1401 showed a superior performance in terms of the attributes evaluated, especially under SRI.

55. Study on the yield and nutrient content as affected by different Maize+ legume intercropping system in the lateritic soils of West Bengal

Dr. Mahua Banerjee and Malay Kumar Mondal

Department of Agronomy, Institute of Agriculture, Visva-Bharati
Sriniketan, Birbhum, West Bengal, 731236

Key words: *Nutrient content, yield, maize, groundnut, soybean, intercropping.*

A field experiment was carried out to study the effect of different row arrangements of maize + legume intercropping systems on the yield and nutrient content of maize and grain legumes (groundnut, soybean) under red and lateritic belt of Birbhum (West Bengal).

The experiment consisted of seven treatments with four replications and was laid out in randomized block design (RBD). The grain and stover yield of maize were significantly higher in case of pure stand of maize and the grain yield of legume was highest in maize + groundnut (1:2). Maize equivalent yields and protein content in maize grain was higher in maize + groundnut (1:2) treatment combinations.

56. Study of protein profile & other metabolites during germination of *Triticum aestivum*

Dr. Priti Mathur, Amit Singh, Ankitgaur, Ishan Khan, Piyuh Pandey

Plant Physiology and Biochemistry Division
Indian Institute of Sugercane Research, Lucknow 226002

Key words: *Triticum aestivum*, chlorophyll estimation, sugar content, protein content, amylase activity, SDS PAGE

Wheat (*Triticum aestivum*) is the second-most produced crop on earth, lagging behind only corn. It provides a large fraction of the dietary protein and total food supply, and is grown all throughout the world, in a wide variety of climates. Germination of seeds is an important event in the life cycle of plants and it initiates numerous physiological and biochemical activities when the apparent metabolic dormancy of desiccated seeds is disrupted. Data were taken on 1,2,3,4,5,6 & 7 day of germination stages. Data on germination index were recorded – Dry weight of seeds, fresh wt of seeds, plumule length and radical length % of germination. Biochemical data were taken for Protein estimation, Total sugar content, chlorophyll content, Amylase activity and protein profiling by SDS PAGE. The concentration of protein estimation varies from 79.4 to 238.2 µg/ gm of seeds. The concentration of total sugar varies from 0.023 to 1.486µg/gm of seeds. Activity of amylase varied from 0.024 to 0.418 µg/0.5 gm of seeds. Chlorophyll content varies from 0.801-7.325 µg/ gm starting from the 3day of germination. Similarly, when the total protein was analysed on SDS PAGE than, initially the bands were thin but at later stages the bands obtained were thick and protein separation were proper. Electrophoresis result showing different bands between 14.4 kDa to 94.0 kDa. in different stages of germination.

57. Strengthening Agricultural Community with Information Technology

P. S. Dharpal, M.R. Ingle, R.A. Hawa

Rural Institute, Pipri-Wardha (M.S.)

Key words: Information Technology, Processing, knowledge, Forecasting

Indian economy is agricultural based economy. A vast majority of rural population depends upon agriculture as primary occupation. But still, agriculture in India is in depression and it needs revolution although a good network of computers is implemented in India still these networks are not being used properly for the benefit of farmers. It is the most prudent to extend the benefit of IT to agriculture and allied industries. In future there is tremendous potential for growth in this sector. Efforts in this direction would help in extending the benefit of technological advances to the rural people:

To mobilize farmers, scientist, institution and organizations to promote agricultural IT. To encourage teaching, research and extension activities in all aspects of agricultural IT. To provide forum for information exchange and disseminations of agriculture information technology.

IT can be used as a great facilitator in agricultural marketing by providing connectivity between the market and exporter, growers, traders, consumers etc. Farmers ought to have the latest information with regard to new techniques and innovations of farming, new methods of cultivation, new crops etc. IT plays major role in updating the farming community by ensuring information through agri-websites, enabling the industry to take an updated. Along with this digital mandi is a unique e-trading platform having special features that enable the farmers to reap the most out of opportunity prices of major mandi are transparently provided on computer screen, giving the farmer the choice to sale his stock in more profitable market. Speed of decision making, empowerment of salesmen, faster and quality services to the dealer and even farmers shall form the key elements of winning approach.

58. Mannose selection system in *indica* rice transformation

Saikrishna Repalli, Chaitanya Kumar Geda, Rao G.J.N

Crop Improvement Division, CRRI, Cuttack

Key words: Positive selection, pmi, Callus, rice.

Plant genetic transformation technologies rely upon the selection and recovery of transformed cells for development of transgenics. Biosafety regulations have reservations on the use of selectable marker genes conferring resistance/tolerance to antibiotics or

herbicides in transgenic development. New classes of marker genes that can confer metabolic advantage to the transgenic cells over the non-transformed cells are now available and they can address the biosafety issue. This study presents our efforts with phosphomannose isomerase (*pmi*) gene in the transformation of Swarna, an elite *indica* rice. The results with this positive selection system will be presented and its biosafety aspects will be discussed.

59. Anther culture studies in *indica* rices

Rukmini Mishra, Bidyashree Kanungo, R.N.Rao and G.J.N.Rao

Division of Crop Improvement, Central Rice Research Institute
Cuttack 753006

Key words: Rice, Anther culture, hybrid

To feed the ever growing population and sustain self-sufficiency in rice, productivity has to be increased. Double haploid breeding through anther culture is the most viable option and a convenient alternative to conventional breeding not only because it shortens the breeding cycle by immediate fixation of homozygosity but also increases selection efficiency. The present study was aimed to generate a large number of doubled haploid plants from four popular heterotic hybrids (JKRH405, JKRH401, CRHR5 and CRHR7) through antherculture. The derivatives were screened for their ploidy levels in A_0 generation under green house conditions. The fertile doubled haploid recombinants obtained from each hybrid are being evaluated under field conditions for morpho-agonomic characterization and yield evaluation.

60. Molecular characterization of rice germplasm from Koraput

Amit kumar Dash¹, D.Prasad², H.N.Subudhi¹ and G.J.N.Rao¹

¹Central Rice Research Institute, Cuttack-753006

²NRCPB, New Delhi -110012

Key words: Rice, genetic diversity, germ plasm

Koraput region of Orissa is rich in rice genetic diversity. The recent advances in molecular markers has made it possible to estimate such diversity effectively through the use of by microsatellites (simple sequence repeats, SSRs). The marker based analysis was carried out to study the diversity of 96 rice accessions collected from the Koraput region of Orissa. A total of 72 reproducible bands were obtained from twenty four rice microsatellite markers and 69 alleles from 21 markers were found to be polymorphic while one marker was found to the monomorphic. The genetic distance and relationship analysis reveal that

some genotypes were distinctly diverse and can be exploited in the breeding programs. The data obtained can be used for the protection of plant genetic resources and has further implications in genotype identification and plant variety protection.

61. Flaxseed: A Source for Functional Foods

Rama Chandra Pradhan¹; Satya Narayan Naik²; Venkatesh Meda³

¹Dept. of Farm Engineering, Institute of Agricultural Sciences
Banaras Hindu University, Varanasi, U.P., India

Email: ramapradhan@rediffmail.com; rcpradhan@bhu.ac.in

²Centre for Rural Development & Technology
Indian Institute of Technology, Delhi

³Dept. of Ag & Bioresource Engineering, University of Saskatchewan, Saskatoon,
Canada

Key words: *Physical properties; Flaxseed; Moisture content*

Flaxseed is an important raw material to obtain functional foods due to its special characteristics, and it offers advantages over other available sources. Thus, in view of its considerable economic potential in foods and chemical industries, it is important to determine the physical properties of flaxseeds. The study was conducted to investigate the physical properties of flaxseed namely, dimensions, 1000 unit mass, arithmetic mean diameter, geometric mean diameter, sphericity, aspect ratio, surface area, bulk density, true density, porosity, angle of repose, terminal velocity and static coefficient of friction on six different surfaces. These properties are often essential to develop equipment for handling, transportation, drying, storage and other processes, such as oil extraction. The flaxseed has an average of 6.85% (d.b) moisture and 39.05% oil content. The average seed length, width, thickness and 1000 seed mass were 4.64 mm, 2.37 mm, 1.0 mm and 5.77 g respectively. The average surface area of flaxseed was 15.49 mm² while the sphericity and aspect ratio were 0.48 and 51.04% respectively. The average bulk density of seed was 652.16 kg/m³ while the true density was 784.36 kg/m³, and the corresponding porosity was 16.83%. The angle of repose for flaxseed was 24.4° while the terminal velocity was 2.9 m/s. The static coefficient of friction on six different contacting materials has been found out and the results showed that the mean value of static coefficient friction was least in case of plastic sheet while it is highest for rubber sheet.

62. Evaluation of bioactive compounds of *Bixa orellana* L. (Kum Kum) a natural dye yielding plant of Odisha and test of its toxicity against *Artemia salina*

Sanjeet Kumar and Padan Kumar Jena

Department of Botany, Ravenshaw University, Cuttack, Email:
sanjeet.biotech@gmail.com

Key words: *Bixa orellana* L., *Phytochemical screening*, *Toxicity*, *Artemia salina* L.

Bixa orellana L. (Kum Kum) is a natural occurring plant in Odisha and also cultivated at some places. The plant belonging to the family Bixaceae. The leaves and fruits of the plant are used as dye and as natural lipstick among the rural and some peripheral tribal community of Odisha, such as those residing in Simlipal Biosphere Reserve Forest. The leaves and fruits of the plant are also used as dye for colouring the vegetables and other food dishes. Experiments were designed to study the bioactive compounds presents in the plant or its leaves and whether the leaf extract posses any toxic effect. The results revealed the potent bioactive componunds in the leaves of *Bixa orellana* L. The study further exhibited that the leaf extract posses no toxic action against *Artemia salina* L., an arthropod. Thus the studies emphasize upon the potent bioactive compounds present in the leaves of *Bixa orellana* L without any toxic effect.

63. Removal of Aflatoxin in Groundnut Meal and its Incorporation in Selected Products

Shashi Jain, Dashrath Bhati and Neha Saxena

Department of Food and Nutrition, College of Home Science,
Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan
bhati.dashrath1@gmail.com

Key words: *Aflatoxin*, *Groundnut meal*, *Malnutrition*, *Noval Protein source*.

Groundnut meal has been reported to contain good quality of protein but at the same time aflatoxin growth in this meal make it unutilizable for human consumption. Hence, in present study technology was developed to prepared protein rich powder from an oil extracted groundnut. For this purpose the ground nut meal was obtained from an oil extracting industry and analysed for its protein and aflatoxin content. It was containing 34.17 percent of protein and 0.527 ppm of aflatoxin. In order to make the meal free from aflatoxin four treatments were employed. viz. Eather treatment, heat treatment, acid-alkali treatment and home stead acid-alkali treatment. After each treatment the powder was subjected to analysis

of protein and aflatoxin and acceptability for sensory characteristics. A reduction in aflatoxin was observed with each treatment along with the loss of protein. A reduction ranged from 17.86 to 100 percent of aflatoxin and 29.17 to 70.47 percent of protein. The mean acceptability for physical characteristics observed were between 5.2 and 6.9 at 9 point hedonic rating scale revealing that all the powder were liked by panel members. A comparative evaluation of four powders indicated that organic acid alkali treatment is free from aflatoxin and containing 10.09gm of protein. This powder was incorporated in three products i.e. *baati*, *basen laddu*, and sweet biscuits at 35 percent and 50 percent level. Acceptability was assessed at 9 point hedonic rating scale. The mean scores of standard, 35 percent and 50 percent incorporated *basen laddu* were 8, 7.1, 6.6 *batti* 8, 7.2, 6.4 sweet biscuits 7.5, 7.2, 6.3 respectively, revealing that the developed powder is acceptable at moderate level in various products. No significant difference ($P>0.05$) was found between standard and 35 percent incorporated product and between 35 and 50 percent incorporated products. However the 50 percent incorporated product scored significantly lower than the standard, specifically for colour and appearance. Study concluded that groundnut meal can serve as a source of protein after removal of aflatoxin.

64. A comparison of efficiency of molecular markers in assessing genetic variation of rice (*Oryza sativa* L.) varieties

**S. Samantaray, H.N. Subudhi, A.R. Sahoo, R. Saikrishna, G.J.N. Rao
and O.N. Singh**

Central Rice Research Institute, Cuttack-6, Orissa

Key words: Rice, SSR, ISSR, polymorphic markers

Microsatellite markers (SSR and ISSR) were used in order to assess the genetic variation in 48 CRRI released rice varieties. Twenty five SSR primers produced a total of 65 bands of which 44 bands (67.69%) were polymorphic and the amplicons resolved were in the range of 50-1500 bp. A total of 45 clear bands were amplified from 8 selected ISSR primers; the fragment size ranged from 275 to 1600bp. The dendrogram constructed using UPGMA similarity matrix based on SSR analysis divided in to two major clusters. Only one variety Vandana falls in one cluster whereas another cluster contains other 47 varieties. Similarly, the dendrogram, based on ISSR showed two major clusters out of which one cluster contains 47 varieties while the other one consists of only one variety (Savitri). The combined dendrogram of SSR and ISSR is more or less similar to SSR. It could be demonstrated from this study that both SSR and ISSR analysis are powerful methods for detecting polymorphisms among the 48 CRRI released rice varieties. However, the SSR marker provides a more informative result in terms of the genetic variation at the varieties level compared to the ISSR analysis.

65. Aromatic rices in Orissa and necessity for conservation

H.N. Subudhi, D.Swain and O.N. Singh

Central Rice Research Institute, Cuttack-753006

Key words: *aromatic rice, Orissa, conservation*

Orissa is very rich in rice genetic resources in general and aromatic short grain in particular. Due to spread of high yielding varieties, population pressure and environmental degradation, the genetic wealth of rice is almost extinct. Like other states of India, Orissa had more than hundreds of indigenous aromatic rice varieties spread in different districts. Being aware of the importance, exploration and collection were undertaken in the state of Orissa. A total 85 aromatic rice cultivars were collected. The passport information were documented. All the accessions were evaluated for their morphological and agronomic characters to find some good varieties for the farmers and donors for different traits. The common varieties are Kalajeera, Dubraj, Bishnubhog, Jabaphool, Dhusura, Krushnabhog, Chinikamini. Dhusara is popular in coastal districts of Orissa. The range, mean value, coefficient of variation and standard deviation of different quantitative characters are recorded. The culm height varied from 90.5 (Bindli) to 184.4 (Jabaphool). All the varieties are tall. Culm number is also high and ranged from 8.9 (Dhusara) to 20.0 (Vasumati). Panicle length varied from 22.2 (Bansapatri) to 32.06 (Kalajeera). Both *In-situ* and *Ex-situ* conservation methods should be taken up to conserve these valuable germplasm.

66. Home-based vegetable garden to overcome hidden hunger in Koraput district of Odisha

Akshaya Kumar Panda ¹ & Rama Narayanan ²

1. Scientist, Biju Patanaik Medicinal Plants Garden & Research Centre,
M.S. Swaminathan Research Foundation, Jeypore Odisha, India.

2. Ford Foundation Chair for Women and Sustainable Food Security,
M.S. Swaminathan Research Foundation, Chennai, Tamilnadu, India.

Email: akshaya74@rediffmail.com

Although the tribal people in Jeypore are used to consuming vegetables, the micronutrient requirement is not fulfilled due to the narrow diversity of the vegetables cultivated. M.S. Swaminathan Research Foundation has been promoting home garden in 15 villages to increase the production and consumption of vegetables and fruits along with nutrition education need for a wider food basket. Awareness has been created through “Seven Plants Campaign” which focuses on planting seven crops in home gardens. Encouraging planting and increasing consumption of diverse vegetables and fruits rich in micronutrients like: calcium, phosphorus, iron, vitamin ‘A’ & ‘C’ and folic acid round the year would play a vital role in alleviating nutritional deficiencies.

67. Some soil chemical properties as affected by fencing and slope position in the foot hills of Shiwaliks

MS Hadda¹, KB Thapa² and M Vashistha¹

¹Department of Soils, Punjab Agricultural University, Ludhiana-141004

²Nepal Agricultural Research Council, Nepal

Email: ms_hadda@yahoo.com

Keywords: Watershed, slope position, soil quality, anthropogenic activities

The information on soil properties is crucial to the understanding of productivity of soils undergoing erosion overall as the latter can result in decline in soil quality and crop production in the whole landscape. On the complex topographies and sloping landscapes where soil redistribution not only depends on erosion and /or deposition by water, but is also influenced by anthropogenic activities. Thus, the present study was initiated to examine the variation of some soil chemical properties as affected by fencing and slope position in the area. In order to meet the above objective, the study was conducted at Zonal Research Station for Kandi Area, Ballawal-Saunkhri in district NawanShar. The treatment comprises fenced and without fencing, the sub-treatments comprises upper, middle and lower slope position. The factorial randomized block design was employed with three replications. The fencing has helped in improving the organic C, total N, available and citric acid soluble phosphorous, available and citric acid soluble potassium, Ca and Mg contents etc. The major changes in soil chemical properties occurred on upper slope position compared to lower slope position. The soil redistribution occurred more on longer slope where fine particles are selectively removed on down slope by water erosion.

68. Micronutrients Status in Soils of Tribal District - Sheopur of Madhya Pradesh

S.K. Dubey and Ramdeen Dhakad

Department of Soil Science & Agricultural Chemistry,
College of Agriculture, RVSKVV, Gwalior, M.P. 474001

The study on micronutrient status in soils of Sheopur district of Madhya Pradesh was carried out during 2006-07 at Gwalior. For this study, Three tehsils (Karahal, Sheopur and Vijaypur) of Sheopur districts were selected for collecting the surface soil samples. Over all 120 surface soils samples (0-20 cm) were collected from thirty eight villages. Results indicated that texture of these soils varied from sandy, sandy clam loam to clay loam. Maximum sand (mean 35.67%) was found in Vijaypur tehsil while maximum clay (mean 36.15%) was found in Karahal tehsil. pH and EC varied from 6.4 - 9.0 and 0.1 to 0.8 dSm respectively. Maximum pH (9.0) and EC (0.8 dSm⁻¹) were observed in Sheopur and Vijaypur tehsils, which showed alkaline nature of soil with more total soluble salts. Organic carbon ranged from 0.201 to 0.580 per cent which indicates low to medium organic carbon

content in these soils. Calcium carbonate varied from 0.5 -12.0 per cent. About 10% samples have more than 12 per cent CaCO_3 , shows calcareous nature of the soil. Average content of Zn in Karahal, Sheopur and Vijaypur tehsils was 0.569, 0.696 and 1.075 mg kg^{-1} , respectively and 37.5%, 72.5% and 100% samples were above critical limit (0.6 mg kg^{-1}) in these tehsils. Available Mn content was 0.765, 0.575 and 0.895 mg kg^{-1} in Karahal, Sheopur and Vijaypur tehsils and 2.5%, 0.00% and 7.5% samples were above critical limit (1.0 mg kg^{-1}) in these tehsils. In Sheopur tehsil all the samples were below critical level shows deficiency of this mineral. The average content of Fe was 6.544, 6.200 and 9.520 mg kg^{-1} in Karahal, Sheopur and Vijaypur tehsils respectively and it was above critical level (4.5 mg kg^{-1}) in all the tehsils of Sheopur district except Sheopur tehsil where 97.5% samples were above critical level. The mean level of available Cu was 0.526, 0.554 and 0.183 mg kg^{-1} and it was 90%, 85% and 12.5% above critical limit (0.5 mg kg^{-1}) in Katahal, Sheopur and Vijaypur tehsils respectively.

Among the four micronutrient cations, deficiency of Mn was found to be widespread in Sheopur district. Available Fe and Cu were negatively correlated with pH, Clay and positively with organic carbon and sand. Available Zn showed positive correlation with pH, EC, OC, CaCO_3 , sand and silt. Available Mn showed positive correlation with pH, EC, silt and clay and negatively correlated with OC, CaCO_3 and sand. It indicates that availability of Zn, Fe and Cu is dominantly controlled by organic carbon whereas Mn by pH, EC and clay content of these soils.

Micronutrient status showed that average content of Zn and Mn in Karahal, Sheopur and Vijaypur tehsils was 0.569, 0.696, 1.075 mg kg^{-1} for Zn and 0.765, 0.575 and 0.895 mg kg^{-1} for Mn. In Zn content 37.5, 72.5 and 100% soil samples were above critical limit (0.6 mg kg^{-1}) in Karahal, Sheopur and Vijaypur tehsils, respectively. In Mn content 2.5, 0.00 and 7.5% samples were above critical (1.0 mg kg^{-1}) level in the soils of Kamhal, Sheopur and Vijaypur tehsils. Iron was found 100% above critical level (4.5 mg kg^{-1}) in Karahal and Vijaypur tehsils while 97.5% samples were high in the content in Sheopur tehsil. In copper content 90, 85 and 12.5% samples were found above critical limit (0.5 mg kg^{-1}) in Karahal, Sheopur and Vijaypur tehsils respectively.

69. Total and Extractable Manganese and Iron in Cultivated Acid Soils of India - Status, Distribution and Relationship with Some Soil Properties

Sanjib Kumar Behera and Arvind Kumar Shukla

Indian Institute of Soil Science
Nabibagh, Berasia Road, Bhopal, MP 462 038, India

Key words: Acid soil, micronutrient, availability, extractants, geostatistics, spatial variability, soil property

The present study was conducted to assess the distribution pattern and variability of total and extractable Mn and Fe in cultivated acid soils of India. A total of 400 representative surface (0-15 cm) soil samples were collected from cultivated soils

representing four (100 each) soil series namely Hariharapur, Debatoli, Rajpora and Neeleswaram situated in Orissa, Jharkhand, Himachal Pradesh and Kerala state of India respectively. The status of total and extractable Mn and Fe in soils and other soil properties like pH, electrical conductivity (EC), organic carbon (OC) content, neutral normal ammonium acetate extractable potassium (K), calcium (Ca) and magnesium (Mg) were assessed. Results revealed that concentrations of total as well as extractable Mn and Fe varied widely among the acids soils and the amount of Mn and Fe extracted by different extractants also differed. Mn deficiency was observed in 7 to 23 per cent soil samples and 1 to 3 per cent soil samples were Fe deficient. The deficiency is based on DTPA extraction and critical values published in the literature. Correlation analysis revealed that the extracted Mn and Fe by DTPA, Mehlich 1, Mehlich 3, 0.1 N HCl and ammonium bicarbonate DTPA (ABDTPA) extractants was significantly correlated. Contribution of soil organic carbon (OC) content towards total and DTPA- Fe was higher as compared to soil pH. Geostatistical analysis revealed that total and DTPA extractable Mn and Fe concentrations in acid soils of India were influenced by different sets of environmental factors. Spatial distribution maps of total and DTPA extractable Mn and Fe in soil indicated their differential distribution pattern.

70. Agrobacterium-mediated genetic transformation with rd29A::DREB1A gene for moisture stress tolerance in Brinjal (*Solanum melongena* L. cv.Utkal Anushree)

Deepti B. Sagare, I.C.Mohanty

Department of Agricultural Biotechnology, College of Agriculture,
OUAT, Bhubaneswar

High frequency regeneration of shoot buds from Shoot-tip was achieved with MS medium + BAP (2.0 mg/l) in brinjal. Rooting was obtained on MS medium+ NAA (0.01 mg/l). The *Agrobacterium tumefaciens* strain GV3107 containing a binary vector pCAMBIA2300 carrying rd29A::DREB1A gene has been used for transformation. The shoot-tip from *in vitro* grown seedling was precultured and co-cultivated for 2 days. Shoot buds were produced on the regeneration medium containing kanamycin (100 Mg/l) and cefotaxime (250 mg/l). A transformation frequency of 6.40% was achieved after PCR analysis with gene specific primer. The gene expression was confirmed through morpho-physiological analysis.

71. Long-term effects of manures and fertilizers on chemical fractions of Fe and Mn and their uptake under rice-wheat cropping system in NorthWest India

S. S. Dhaliwal, U. S. Sadana and T. S. Manchanda

Soil Chemist, Department of Soil Science, Punjab Agricultural University
Ludhiana, Punjab, India 141004, Email: drdhaliwalss@yahoo.co.in

Key words: Chemical fractions; green manure, farm yard manure, wheat cut straw, NPK fertilizers

In India the deficiencies of Fe and Mn are becoming very common as rice-wheat system (one of the predominant cropping systems of the country) is extended on light textured soils to feed the burgeoning population. Farm yard manure (FYM), green manure (GM) and wheat cut straw (WCS) help in release of different fractions of iron (Fe) and manganese (Mn) in the soil, when these are applied in combination with chemical fertilizers. Therefore, the present research study was conducted with a prime objective to investigate the long term effect of chemical fertilizers (NPK) alone and in combination with FYM, GM and WCS on different fractions of Fe and Mn and their interactions with each other. For this, a field experiment was in progress since 1983 with rice-wheat cropping system at Research Farm, Department of Agronomy, Punjab Agricultural University, Ludhiana. In different treatments, 50% recommended dose of N was applied through chemical fertilizers (urea fertilizer with 46.4% N) whereas, the remaining 50% N was substituted through FYM, WCS and GM (*Sesbania aculeata*) and their biomass was added to soil on dry weight basis. Surface soil samples were collected and analyzed for basic soil parameters using standard procedures. These soil samples were also subjected to estimation of different fractions of Fe and Mn using atomic absorption spectrometer (Varian AAS-FS Model). Rice grains samples were analyzed for their Fe and Mn concentrations with Varian AAS-FS Model. The results of our study revealed that these three organic manures lowered the soil pH and EC as well as increased the organic carbon (OC) content and available NPK in soil with the application of FYM, WCS and GM in conjunction with N fertilizers as compared to alone NPK fertilizers. Significant changes were observed in the different fractions of Fe and Mn when FYM, WCS and GM were applied in conjunction with different combinations of chemical fertilizers. The broad view of results revealed that the GM, FYM and WCS applied before transplantation of rice increased the concentrations of water soluble plus exchangeable (WS+EX), amorphous iron oxide (AFeOX), crystalline iron oxide (CFeOX) and organic matter (OM) bound fractions of Fe and Mn whereas, their fractions held on specifically absorbed (SPAD) on inorganic sites and manganese surfaces (MnOX) decreased with the incorporation of GM, FYM and WCS. Among these manures, GM (T₅) reported higher concentrations and uptake of WS+EX, SPAD, MnOX, AFeOX, CFeOX and OM bound fractions of Fe and Mn followed by FYM (T₆) whereas, higher concentrations of Fe and Mn in case of total micronutrient (TM) were reported by FYM (T₄). The increase in the WS+EX, AFeOX, CFeOX and OM bound fractions were indicative of the enhanced

availability of Fe and Mn with the application of GM, FYM and WCS. The micronutrient fractions were activated differentially and the dynamics of their inter conversion from one fraction to other was accelerated due to decomposition of GM, FYM and WCS. The results further concluded that after 27 years of rice-wheat cropping system, the application of FYM, WCS and GM resulted in significantly higher content of the WS+EX- Fe and Mn in the soil with GM followed by FYM and WCS (GM>FYM>WCS) which may be ascribed to the higher supply of Fe and Mn through decomposition of organic manures.

72. Effect of size of the sett, seed rate and sett treatment on yield and quality of sugarcane

**T. Chitkala Devi, M. Bharathalakshmi, V. Gouri. M.B.G.S. Kumari,
N.V. Naidu and K. Prasada Rao**

Regional Agricultural Research Station, Anakapalle
Acharya N.G. Ranga Agricultural University
Rajendranagar, Hyderabad, Andhra Pradesh

Key words: *Sugarcane. Sett size, Carbendazim, Gibberellic acid, Sucrose, Cane yield.*

A field experiment was conducted for three consecutive years (2008-09 to 2010-11) to study the effect of size of the sett, seed rate and sett treatment on yield and quality of sugarcane at Regional Agricultural Research Station, Anakapalle (A.P.). The results of the experiment indicated that, planting of sugarcane with 2 budded setts, (86.3 t/ha) or 3 budded setts (84.9 t/ha) proved significantly superior in increasing cane yield as compared to single budded setts (77.9 t/ha) during all the three years of experimentation. The increase in cane yield was 10.8 % and 8.9% in 3 budded setts and 2 budded setts respectively over single budded setts. Similar increase in cane yield was observed with normal seed rate of 1,20,000 buds/ha (86.2 t/ha) as compared to lower seed rate of 80,000 buds/ha (80.2 t/ha). Significant differences in cane yield were not observed due to sett treatment either with Carbendazim alone @ 0.1% (83.0 t/ha) or Carbendazim @ 0.1% + Gibberellic acid @ 100 ppm for 15 minules 84.0 t/ba). Sucrose content in juice did not vary with sett size or seed rate or sett treatment. In respect of sugar yield, higher sugar yield was obtained with 2 budded or three budded setts at normal seed rate of 1,20,000 buds/ha.

73. Need for food security and sustainable agriculture

R.S. Sengar and Reshu Chaudhary

Tissue Culture Lab, College of Biotechnology, Sardar Vallabhbhai Patel
University of Agriculture & Technology, Meerut – 250110

Key words: *Food Security, sustainable agriculture, sustainability, future generation.*

There are two sides of the same coin. We have to shine in both the sides in a sustainable manner for proving our claim of a developed nation. It is often said that food is peace. Without food, peace and freedom cannot be achieved. Food security can be defined as “all the people at all the times should have access to safe and nutritious food to maintains a healthy and active life”. This definition indicates the availability of food, its access to the people and its stability at various levels such as individual, household, national and at global levels. Though food security at individual level is important, yet to achieve it food security at all levels is necessary. In India we are losing 5000 million tonnes of top soil of every year. Out of this, 30% are being lost to the sea every year. In India, more than 50% of the children are stunted and under weight. Percentage of mothers with body mass index value less than 18.5 varied from 31.1% for age group of 35-49 to 42 % for age group of 20-24 indicating chronic under nutrition among mothers. In a study conducted by National Nutrition Monitoring Bureau reported that in India about 78 and 75 % anemia were found in lactating women and pregnant women, respectively. The sustainability which can be defined as “meeting the present needs without compromising the future generation to meet their own needs”. So the sustainability of agriculture has direct implication on food security. Until and unless we provide food security to all, we cannot achieve peace and prosperity and dream of making India a developed nation cannot be full filled by 2020.

74. Jeypore tract as the Globally Important Agricultural Heritage Site

Saujanendra Swain, Ajay Parida and K.U.K. Nampoothiri

M. S. Swaminathan Research Foundation, Regional centre: Jeypore, Orissa
saujanendra@rediffmail.com

The Jeypore tract of Orissa state is well known for its agrobiodiversity, which includes 372 landraces, out of which many are still under cultivation. It is especially known for the genetic diversity of Asian cultivated rice and has been considered as the center of origin of *aus* ecotype of rice (*Oryza sativa*). The tribal farm families inhabiting this area have been responsible for the domestication and conservation of rice genetic resources for several generations. Traditional cultivation practices suitable for diverse agro-ecological zones are still carried out by the tribal communities based on their indigenous technical knowledge and there is a unique bond of cultural diversity with agrobiodiversity. Recently the area is in the limelight for being recognized as a candidate system in FAO's Globally Important Agricultural Heritage Systems.

75. *Ex-situ* conservation of ethno-medicinal plants by tribes of Koraput district, Orissa

Saujanendra Swain and Nihar Parida

M. S. Swaminathan Research Foundation, Regional centre: Jeypore, Orissa
saujanendra@rediffmail.com

In every ethnic group of Koraput, Orissa, there exists a traditional healthcare system and for many rural people this represents the frontline of health defense. An ethno-medicinal plant conservation garden with 347 ethno-medicinal plants used in traditional healthcare of nine major tribal groups of the region viz: Bhatra, Bhumia, Bonda, Gadaba, Gond, Kandha, Koya, Paroja and Saora are conserved and maintained with the participation of traditional healthcare practitioners and traditional birth attendants of the above tribes. The species diversity of these ethno-medicinal plants includes 109 trees, 91 shrubs, 39 climbers, 104 herbs, 2 orchids and 2 ferns. The garden functions as a conservation centre, providing a living gene bank for the tribal families and giving them a sense of ownership.

76. Enhancing small farm income of tribal people through long pepper cultivation

Saujanendra Swain, Bhaskar Adhikari and R.K. Anantha Krishnan

M. S. Swaminathan Research Foundation, Regional centre: Jeypore, Orissa
saujanendra@rediffmail.com

Long pepper (*Piper longum*), is a high value medicinal plant naturally found in forests of Koraput, Orissa. Uplands are utilized for commercial cultivation of long pepper for their roots by tribal families. It is propagated through vegetative means or tillers. The gestation period of this crop is three years. The gross income per acre is Rs. 2, 40,000 against an investment of Rs.90,000 with a net profit of Rs.1,50,000 obtainable from third year to 15 years. The price per kg of roots varies from Rs. 370 -500 based on quality. Long pepper can be intercropped with papaya, chilli and runner-beans providing an additional income of Rs.20,000. The crop gives high returns compared to other crops grown in uplands of the tract.

77. Integrated Approaches for Agriculture Productivity and Sustainable Livelihood Enhancement in Coastal Region of Nagapattinam District

T. Selvarasu, and L. Krishnan

Scientist, M S Swaminathan Research Foundation
Fish for All Research and Training centre, Poompuhar 609 105, Sirkali Taluk
Nagapattinam District, Email: selvarasut@yahoo.co.in

Farmers' participatory development and demonstration of Integrated Farming System models for livelihood enhancement of small and marginal farmers of the coastal region of Nagapattinam District is the main theme of this paper. MSSRF adopted disaster relief to pre- disaster pro- active, preparedness method to promote disaster resilient farming communities. Social mobilisation and promoting area specific Integrated Farming System (IFS) have been adopted as the approach. IFS would help to spread the risk across the different components; hence the farmers would equip better to encounter any future disaster. MSSRF has been directly working with twenty six inland fish farmers and have facilitated them to convert the existing fish farms in to IFS models at Nagapattinam district. As part of strengthening IFS, components including dairy, goat and poultry farming, fodder, tree and vegetable crops and freshwater aquaculture and effective utilization of organic wastes by recycling have also been incorporated with integrated farming systems which would prove to be economically rewarding for the farmers. The success of IFS depends upon a holistic approach with suitable forward and backward linkage with Agriculture department, Horticulture department, Agriculture Engineering department, NABARD and banks.

The main objective of IFS model is to reduce the risk through diversification, increase the farmers' income and reduce cost of production through more output per unit of land area, efficient use of natural resources, internal recycling of resources and generating year round employment opportunities. The poor farming community would thus be enabled for sustainable livelihood improvement and identify and demonstrate suitable agro technologies and promote crop diversification.

78. A Case Study of Water management through low cost pedal pump

T. Selvarasu, and Dr. L. Krishnan

Scientist, M S Swaminathan Research Foundation
Fish for All Research and Training centre, Poompuhar – 609 105, Sirkali Taluk
Nagappattinam District. Email:selvarasut@yahoo.co.in

Nagappattinam district is located in the tail end delta region of Cauvery River in Tamil Nadu. Water management in agriculture is an increasingly important matter in the present days, as rain is scanty. The Agro-Climatic conditions have been altered due to climate change. The deltaic farmers have to depend on the water harvested during nonseasonal rains, as the water flow in the River Cauvery is almost a questionable affair every year. Hence, the farmers in this area rely on the farm ponds, which play a vital role in providing irrigation source to the first crop of paddy in the main crop season in the wet land and second crop of vegetable cultivation of the small and marginal farmers. The irrigation practices in the traditional methods is manual lifting of water using small earthen pots, a time consuming activity which involves drudgery or using oil engines or motors, which again is a burden to the farmers towards the purchase of diesel and oil for engines and/or paying the electricity bill for running the electric motors for lifting the water.

A field survey was carried out in the field of Mr. Pavadai, a small farmer on 20th January, 2011, who cultivated Chilli plants in a 20 cents of land area, in which 150 Seedling was planted. The planting was done using pit method system and watering of the Chillies plants were done every alternate day by manual lifting of water using earthen pots. He could complete the watering of all plants in about one hour and he continued the watering for two months. After two months, he fitted an oil engine of 1.5 hp capacity and the oil engine was energized with diesel @Rs.43/- per liter. This cultivated area of 20 cents could be thus irrigated in one hour and done every alternate day. Thus he had to continue the watering of plants for almost four months. By doing so with the diesel, he had to spend an approximate amount of Rs.860/- towards the cost of diesel, which is a loss of revenue from the income generated through chillies. The chillies crop harvested was 45 kg @Rs.85 per kg.

After receiving the Concrete Pedal Pump (CPP), Mr. S.Pavadai used the CPP for irrigating the chilli plants and he could complete the watering the entire area in 30 minutes. The working principle of the device (CPP) is almost same as the working principle of the hand pump. The difference lies in the fact that a hand pump has a single barrel/cylinder/piston, wherein CPP has two cylinders, which could be operated by the feet, and hence called a Concrete Pedal Pump. It is so simple to use that even a women can operate the

pump. In the hand operated pumps the strain on the shoulder is much and whereas, in a CPP the stress level on the feet is almost nil or negligible.

In field levels:

- Area wise easily irrigated and significant increase in irrigated land
- Timely irrigation of the crop; need not depend on the electric power or fuel for engine.
- To reduce the frequency of irrigation
- Easily operated by men and women
- Horticulture crop can be grown including short maturing crops
- Irrigation is easier
- Water table increased

Social Levels:

- Irrigation work is now enjoyable
- Health has been improved due to increased access to nutritious food
- Farmers are provided exercise at free of cost
- The spouse of farmer and community like it

Economic Levels:

- To improve farm income per season per capita
- Crop income increase
- Crop yield increase.

Economics of chilli crop cultivation

Crop	Total Expenditure	Gross income	Net income
Chillies	2060 (1200+860diesel)	3825	1765

79. Micropropagation of two rare orchids, *Acampe praemorsa* and *Vanda testacea*, from Similipal Biosphere Reserve, Orissa

Debashish Behera, Laxmipriya Ranjit and Umaballava Mohapatra*

Department of Botany, North Orissa University, Baripada, Odisha-757003

*Email- ubmbotnou@gmail.com

Key words: *Orchids, Similipal Biosphere Reserve, Micropropagation*

Similipal Biosphere (SBR) is the richest orchid habitat of Orissa, which contains 94 species of orchids. Although SBR is the treasure house of many spectacular orchids with excellent potential in cut flower trade, these have not received proper attention hitherto. *Acampe praemorsa* and *Vanda testacea* seeds were allowed to germinate on MS Mitra, and Kundson C medium. All the media were equally responsive for seed germination for both the species and growth regulators were not essential. Protocorm-Like Bodies (PLBs)

were seen after 30-40 days of inoculation. PLBs were transferred to above media containing both auxin and cytokinin. The most effective medium for shoot regeneration was found to be full strength MS medium supplemented with 1.0 mg/l IAA and 0.5 mg/l BAP. Shoots regenerated on the 5th week of transfer of PLBs. Roots were also observed in the same medium containing 1.0 mg/l IAA and 1.0 mg/l BAP.

80. Effect of naphthalene acetic acid on chromosomes of shoot derived callus tissues of Jute (*Corchorus olitorius* L. variety JRO-632)

P.K. Ghosh¹ and A. Chatterjee

CSB, CSR&TI, Berhampore 742101, Murshidabad, West Bengal
Centre of Advanced Study in Cell and Chromosome Research,
Department of Botany, University of Calcutta, 35, Ballygunge Circular
Road, Calcutta-700047

¹Communication Address: Milan Appartment, Ground Floor, 41/1A,
Durga Prasanna Paramhansa Road (D.P.P.Road), P.O.Naktala, Calcutta-
700047, West Bengal, Email: paritush.ghosh@rediffmail.com

Key words: *Corchorus oUtodus* L., Shoot Explant, Chromosome, Napthalene Acetic Acid.

Jute seeds (*Corchorus olitorius* L. Variety JRO-632) were grown in in vitro in White's medium. The shoot explants were collected from in vitro growing seedlings and were cultured aseptically in both Murashige and Skoog's (MS) and Schenk and Hildebrandt's (SH) media with different combinations and concentrations of auxins and cytiokinins whereas in other cases no auxins was utilized. Callus tissues were obtained from the epicotyls explants in MS basal medium supplemented with Napthalene Acetic Acid (NAA) and coconut milk. When the concentration of Napthaloene Acetic Acid (NAA) were gradually increased vigorous growth of the callus tissues was observed. Napthalene Acetic Acid (NAA) also enhanced rapid growth of the callus tissues. Cytological analysis revealed that the callus tissues are mixoploid, diploid, polyploidy in nature. The present investigation indicates that Napthalene Acetic Acid (NAA) plays an important role in in vitro culture of shoot derived callus tissues and its role in chromosomal change during in vitro growth of callus tissues.

81. A Case Study on Integrated Organic Farming System Approach for Sustainable Agricultural Development in Coastal Belts of West Bengal

Dr A. K. Mandal¹ and Dr. A. Datta ²

¹Assistant Director of Agriculture (Sisal & Ramie), Head Quarters, Govt. of West Bengal, Writers' Buildings, Kolkata-1

²Bidhan Chandra Krishi Viswavidyalaya, Mohonpur, West Bengal

Key words: *Sustainable Agriculture, Organic Farming, Farming System Approach (FSA), Land Shaping, Coastal Belts.*

The magical word sustainable Agriculture is used by United Nations has become a buzz word meaning development of agriculture without hampering future ecology. This includes off course organic farming and Integrated Farming System Approach. Farming system represent an appropriate combination of farm enterprises viz., cropping system, horticulture, forestry, livestock, fishery, poultry and the means available to the farmer to raise them profitably. In West Bengal we found some of the diversified organic practices in Agriculture.

Codex Alimentarius Commission, a joint body of WHO/FAO, defines “organic agriculture as a holistic food production management systems, which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity. The role of organic farming in India as well as in West Bengal is leveraged to mitigate the problems of over exploitations.

Land shaping is modification of low land with rain - water harvesting facility in judicious way. And hence shifting from traditional risky and unsustainable Coastal farming system approach to Land shaping farming System Approach. It was observed in a case study that one marginal farmer from his 0.2 ha of land can earn 4 times more (Rs 40,000/- per annum) than that of earlier (Rs 10,000/-) income following the models of land shaping and integrated farming system approach.

Major impacts observed in FSA (Farming System Approach) are better nutrition, security of income, efficient use of resources, reduction in migration, higher economy and sustainability in production.

82. Comparative Evaluation of Different Composting Method in terms of End Product Quality, Process Convenience and Cost of Product for Large Scale Adoption - A Case Study from FAO-CFC-TBI Project at Maud T.E., Assam, India.

R.K. Sarkar¹, S.K. Bera ¹ and A.K. Das²

¹ Khaira Professor, Dept. of Agronomy, Ballygunge Science College,
Calcutta University, India

² Dept. of Horticulture, Calcutta University, India

Key words: *Composting method, Microbial population, Cost of production*

In the pretext of growing need for organic soil management, the present study at Maud tea estate (Assam), India under FAO-CFC-TBI Project 2008-2011 was aimed for comparative qualitative evaluation and potential for large scale adoption of different available and practiced composting methods viz. Vermi, Indigenous (FYM), Biodynamic and Novcom composting using on- farm resources.

Study revealed that though comparable values were obtained in all the composts in terms of physical properties, organic carbon, C:N ratio, stability, maturity and phytotoxicity status but compost under Novcom method was superior than other composts in terms of total NPK and significantly higher self generated microbial population (in order of 10¹⁶ cfu). Study of convenience factor and cost of production for large scale adoption also indicated advantage of Novcom method over others.

83. Organic Agriculture: A Perspective for Better Agro Ecosystem

R.S. Sengar and Reshu Chaudhary

Tissue Culture Lab, College of Biotechnology
Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut
Email: rs.svbpату@gmail.com; reshuchaudhary55@gmail.com

Key words: *Organic farming, sustainable environment, ecosystem, soil productivity.*

Organic farming is a production system that avoids or largely excludes the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent organic farming systems rely on crop rotations, crop residues, animal manures, legumes, green manures, off-farm organic wastes, and aspects of

biological pest control to maintain soil productivity and tilt, to support plant nutrients and to control insects, weeds and other pests. Organic farming practices keep's pests and diseases at a level, which does not cause economic damage. The focus is supporting the health and resistance of the crop. Beneficial flora and fauna are promoted by offering them a habitat and food. If pests reach critical levels, natural enemies and herbal preparations are used. India has converted over 2.5 million hectares including 1.1 million ha of cultivable lands into organic. There has been consistent increase in the number of farmers adopting organic practices in the country every year. According to National Centre for Organic Farming (NCOF) – a body under the Union Ministry of Agriculture the area under organic cultivation is likely to cross 2 million hectare up to 2012. In India, the domestic market for organic products is estimated at Rs 560 crore last year; the exports were in excess of Rs 250 crore. Organic farming aims at following the laws of nature. Within the organic movement one will find farmers who focus on natural farming, and others who take a purely commercial approach. The majority of organic farmers probably lies somewhere in between these two extremes. Most farmers expect sufficient production from the farm to make a healthy living.

84. Evaluation of mango based agri-horti-silvicultural agroforestry system

**A. K. Patra, P. J. Mishra, B B Behera, B. P. Gantayat, S. Das and
A. K. Mohapatra**

All India Coordinated Research Project on Agroforestry
Orissa University of Agriculture & Technology, Bhubaneswar, Orissa 751 003
Email: alokpatra2000@yahoo.co.in

Key words: Agri-horti-silvicultural system, Acacia mangium, Dalbergia sissoo, Gmelina arborea, Mangifera indica, Andrographis paniculata, Curcuma amda, Aloe vera and Ananas comosus

The enormous population growth during the last few decades has caused considerable reduction in the landholdings and the requirement of basic needs seems to be inadequately met through the existing land use system. There are reports that diversification of the cropping systems, consisting of commercial timber trees, have provided higher net returns as compared to the sole crop. So, it is necessary to develop economically viable, farmers' friendly, diversified and sustainable cropping systems integrating tree component which would ensure enhanced production through efficient utilization of resources. Agroforestry systems are now considered to be the most ideal strategy that requires low input management systems and aims at providing food, fruit, fodder, fuel and timber to the farming community on a sustainable basis besides ameliorating soil and microclimate through biological N₂-fixation and carbon sequestration. Therefore, agri-horti-silvicultural agroforestry system where annual agricultural crops and perennial fruit crops grown with

multipurpose tree species could be one such promising and viable option to achieve diversification as well as assured income from the system.

A field experiment was conducted at Bhubaneswar during 2009-10 and 2010-11 to study the performance of three medicinal crops kalmegh (*Andrographis paniculata*), ghee kuanri (*Aloe vera*) and mango ginger (*Curcuma amda*) and one short duration fruit crop pine apple (*Ananas comosus*) in the alley space of nine year old trees *Acacia mangium*, *Dalbergia sissoo* or *Gmelina arborea* planted in east-west direction at a spacing of 6 m x 6 m. The mango (*Mangifera indica*) grafts were planted during 2000 at 6 m x 6 m spacing along the tree rows leaving 3 m on either side of a tree. Pine apple as an intercrop recorded maximum yield recovery as compared to sole crop in association with *Gmelina arborea*. Among the tree species, yield recovery for all the crops were higher with *Gmelina arborea* followed by *Acacia mangium* and *Dalbergia sissoo*. Highest fruit yield in mango was recorded with *Gmelina arborea* + kalmegh. Pine apple in association with *Gmelina arborea* gave the highest net return closely followed by pine apple in association with *Acacia mangium*. *Acacia mangium* had the maximum plant height and diameter at breast height as compared to other two tree species.

85. Impact of Insecticides and mixtures on insect pests of Brinjal

Vishwa Nath and S.R. Sinha

Division of Entomology, Indian Agricultural Research Institute
New Delhi 110012

Key words: *Insecticides, mixture, leafhopper, whitefly, shoot and fruit borer.*

Field investigations were undertaken to evaluate six insecticides viz., deltamethrin/fipronil, bifenthrin, indoxacarb, carbosulfan, endosulfan and three mixtures viz., triazophos + deltamethrin, profenphos + cypermethrin and chlorpyrifos + cypermethrin against insect pests of brinjal var. *Pusa Purple Round*. Two foliar sprays were given at fortnightly interval. Study revealed that bifenthrin @25g a.i. /ha, fipronil @50g a.i. /ha, indoxacarb @70g a.i. /ha and endosulfan @700g a.i. /ha and insecticide mixture, profenophos + cypermethrin@440 g a.i. /ha were effective in managing the population of sucking pests viz., leafhopper and whitefly. As far as shoot and fruit borer is concerned, treatments with deltamethrin @15g / fipronil @50g a.i. /ha or indoxacarb @ 70g a.i. /ha gave minimum damages in brinjal fruits.

86. Effect of nutrient management and spacing on the growth and yield of Sweet corn (*Zea mays saccharata*) under rabi hot weather condition of Konkan

A.V.Dahiphale, B D Shinde, N V Dalvi and M G Palshetkar

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli 415712, Dist
Ratnagiri, India

Key words: Planting geometry, nitrogen, micronutrients, growth, yield, sweet corn

The values of growth attributes except plant height and yield attributes were significantly higher under broader spacing of 75 x 20 cm than the narrow spacing of 45 x 20 cm. However, plant height, green cob and green biomass yield were significantly higher under 45 x 20 cm spacing than the broader spacing. Application of 150 and 225 Kg nitrogen ha⁻¹ recorded significantly higher values of all the growth and yield attributes than 75 Kg N ha⁻¹ and control. However, application of 225 Kg N ha⁻¹ recorded significantly higher yield of green cobs and biomass than the lower levels. Further, application of micronutrient spray produced significantly more dry matter per plant and green biomass ha⁻¹ than control.

87. Genetic Analysis for Quantitative Traits in Early Season Bottle gourd [*Lagenaria siceraria* (Mol.) Stand L.]

AK Singh, RS Pan and P Bhavana

ICAR-Research Complex for Eastern Region, Research Center,
Plandu, Ranchi-834010, Jharkhand, Email: aksingh171162@rediffmail.com

Key words: Correlation, Coefficient of variation, Genetic advance, Heritability, Path coefficient

Fourteen diverse genotypes of bottle gourd grown under plastic mulching with three replications were evaluated for genetic variability, correlation and path coefficients for yield and yield components. Yield per plant, number of fruits per plant, fruit weight, fruit length and fruit breadth exhibited additive gene action where as node at which first female flower appears and days to 50 percent flowering showed non additive gene action. Number of fruits per plant showed significant positive association with yield per plant and also highest direct effect. Days to 50 percent flowering and fruit weight recorded next highest direct effects on yield per plant.

88. Development of variety baked products incorporating Cereal bran

Bhupinder jit Kaur, Savita Sharma and Baljit Singh

Department of Food science & Technology, PAU, Ludhiana Punjab
Email: savitasharmans@yahoo.co.in

Key words: Baked products, cereal bran, texture, colour, acceptability.

Baked products are considered as an excellent vehicle for fortification and value addition in present scenario of health concern. Variety baked products (buns, pizza base and flat bread) were prepared with incorporation of cereal bran (wheat, oat and rice), singly and in combination as dietary supplement at 0-15 percent. Addition of bran had significant impact on the physico-chemical, rheological and baking properties of flour. Significant variation was assessed among different brans and their levels with regard to color, and texture profile. The overall quality of fibre enriched buns; pizza base and flat bread was excellent, which was reflected from mass consumer acceptability.

89. Indices of drought tolerance in Sorghum (*Sorghum bicolor* L. Moench) genotypes at early stages of plant growth

R. Ambika Rajendran* and Dhandapani Raju**

* Corresponding author-Scientist (Plant Breeding), Directorate of Maize Research, New Delhi, India; Email: rambikarajendran@gmail .com

** Scientist (Plant physiology), Directorate of Seed Research, Mau

Key words: Sorghum, PEG, Drought Tolerance

A laboratory experiment was carried out to evaluate the responses among nineteen Sorghum (*Sorghum bicolor* L. Moench) genotypes under drought stress. Seeds were placed between filter paper soaked with the appropriate PEG 6000 solution to create osmotic stress conditions of control (0.0MPa) and -0.7MPa. The plants were studied after ten days, for germination percentage, root length, shoot length, seed vigour index, coleoptile length, root to shoot length ratio and membrane stability. Genotypes showed significant difference for germination percentage, root, shoot and coleoptile lengths and root to shoot length ratio. The data obtained allowed to identify ICS213A and CO26 as poor genotypes at low water supply. CO1, Tenkasi1, CO21, CO22, B35, K3 and K8 showed the best behaviour in terms of germination percentage, seed vigour index, root to shoot length ratio and membrane stability.

90. Using bryophytes as a tool to cure European foulbrood disease of honey bee: an eco-friendly novel approach

Dheeraj Gahtori* and Preeti Chaturvedi

Department of Biological Sciences, College of Basic Sciences and Humanities, G. B. Pant University of Agriculture and Technology, Pantnagar 263 145, India Email: dgahtori@gmail.com

Key words: Activity index, bryophytes, European foulbrood, honey bees.

Melissococcus plutonius, causal agent of European foul brood disease in honey bee is one of the most dangerous honey bee parasites. By now, various herbal and chemical drugs have been tried to control it. In the present study, the effects of different organic extracts of three different bryophytes and a standard drug (positive control) have been tried to control the bacterium *in vitro* by using agar disc diffusion and micro broth dilution method. All the tested extracts showed good antibacterial activities against the test pathogen. Acetone extract of *M. polymorpha* and chloroform extract of *D. undulatum* exhibited maximum activity (AI 15.51 and 15.56 mm respectively) comparable to that of standard drug.

91. Formulations and evaluation of ricebean based ready to eat convenience foods

YS Dhaliwal, Ranjana Verma DC Bhandari and CP Awasthi

Department of Food Science and Nutrition
CSK Himachal Pradesh Agricultural University
Palampur-176062 (HP)

Key words: Ricebean, formulations, nutritional profile, convenience foods.

Ricebean is an underutilized crop and gaining attention because of its rich nutritional profile. Four varieties of rice bean PRR-1, PRR-2, RBL-1 and RBL-6 were analyzed for physico-chemical and nutritional characteristics. Attempts were made to standardize methodologies for preparation of calorie and protein rich ricebean based convenience foods like *pinni*, *mathri* and *laddos*. The prepared products were stored in different packaging materials. The ricebean *pinni*, *mathri* and *laddos* remained acceptable for 3 months of storage. Results of the study revealed that there is wide potential for utilization of ricebean in preparation of ready to eat nutritionally rich convenience foods.

92. An Insight into the Agricultural Sustainability of Birbhum District

Swapan Kumar Maity¹ and Jayashree Saha²

¹Institute of Agriculture, Visva-Bharati, Sriniketan – 731236

Email: swapankumar.maity@visva-bharati.ac.in

²Siksha Satra, Visva-Bharati, Sriniketan – 731236

Key words: agricultural sustainability, Birbhum district

The agriculture of Birbhum district in West Bengal is characterized by mostly rice dominated rainfed monocropping and cereals dominated irrigated intensive cropping. Major concerns in agricultural sustainability of the district are decline in productivity of rice particularly winter and summer rice, less crop diversity, less production of pulse and oilseeds than the requirement of the district, decline in soil fertility with emerging deficiency of micronutrients, vagaries of monsoon rain making crop production an uncertain affairs in rainfed areas and excessive exploitation of underground water in tube well irrigated areas in the absence of sound rain water management systems. High market fluctuations of conventional agricultural produce and increasing input costs further worsen the economic sustainability of agriculture as the livelihood of major group of the people of the district.

93. Comparison of populus clones under different levels of water stress

Aradhna Kumari¹ and Santosh Kumar Singh²

¹Division of Plant Physiology, Indian Agriculture Research Institute,
New Delhi 110012

²Department of Soil Science, RAU, Pusa, Samastipur, Bihar 848125

Key words: Poplar plant, water stress, field capacity, membrane stability, drought tolerance

Poplar plantations have acquired a considerable economic importance in many regions of the world. Wide natural distribution, considerable genetic variation, rapid early growth and vegetative propagation have made poplars attractive for genetic improvement and plantation programs. Poplar is very sensitive against water stress during seedling establishment period. A pot culture experiment was conducted to study the effect of different levels of water stress on yield component in two Populus clones during seedling establishment period. Four sets of pots were arranged; eight replication for each set for both the clones. One set maintained at field capacity, while others are maintained at 25, 50 and 75% of field capacity respectively. Different levels of water stress were maintained on IW/CPE ratio, which is the standard method of maintaining water stress both in field and

pot experiments. The variety G-48 showed better growth characteristics and lesser cytotoxic damage under stress, as assessed through better plant height, more number of leaves, higher biomass accumulation, more proline accumulation and lesser membrane permeability, ion leakage and damage to photosynthetic pigment. The results obtained clearly indicate that the clone G-48 has higher drought tolerance potential than the clone Kranti. It was also shown in our investigation that Poplar seedlings can withstand drought up to 25% of the field capacity. But beyond this level of drought, plant growth and biomass severely decreased to an extent that plant cannot withstand their further better growth.

94. Synthesis of pyrazoles for discovering a new nematicide

**Madhuban Gopal^a, Archana Upadhyay^a, Rajesh Kumar^a,
Gautam Chawla^b and Ram Niwas^a**

Division of Agricultural Chemicals^a and Nematology^b
Indian Agricultural Research Institute, New Delhi- 110012, India

The prevalence of pyrazole cores in biologically active molecules has stimulated the need for elegant and efficient ways to make these heterocyclic lead. Mixture of appropriate chalcone and hydrazine hydrate were refluxed for 5-6 h. The precipitate was filtered off and recrystallized. The reactions were also done by using microwave method to save energy and time.

Nematicidal testing of the compounds was carried out *in vitro* against the two nematodes, namely *Meloidogne incognita* and *Rotylenchulus reniformis*. One mL of nematode suspension containing about 25-30 freshly hatched J₂ (juvenile second stage) of *Meloidogne incognita* and about same number of pre--adults of *R. reniformis* were taken in vials. Test compounds were added to the vials, kept at 30°C± 1° for 72 h. A control solution or DMSO containing Tween-80 was similarly prepared and stored along with the compounds and also a standard nematicide, triazophos at the same concentration. After the exposure, the number of live and dead nematodes was counted under stereoscopic binocular microscope. The nematicidal activity data of pyrazole derivatives against *Rotylenchulus reniformis* revealed that 6 compounds exhibited more than 80% mortality at 31.25 ppm and 4 compounds showed 100% mortality at 62.50 ppm. Compounds namely **63**, **71**, **77** and **78** were competitive with triazophos as they showed good nematicidal activity.

95. Influence of different boron levels on growth and yield of Sunflower (*Helianthus annuus*)

Jajati Mandal*, Ayon Alipatra, Kallol Bhattacharyya and HIRAK BANERJEE

Directorate of Research, Bidhan Chandra Krishi Viswavidyalaya
Kalyani-741235, Nadia, West Bengal
Corresponding author: jajati.bckv@gmail.com

Key words: Sunflower, boron, growth, productivity

Field experiments were conducted at Central Research Farm of B.C.K. V., West Bengal during winter season of 2009-10 and 2010-11 to observe the efficacy of boron on growth and seed yield of sunflower (variety 'Aditya'). The experiment was laid out in a randomized block design with 6 treatments combinations and 4 replications. Results showed that growth characters like plant height, basal girth, dry matter accumulation, capitulum diameter and seed yield were greatly influenced by different levels of boron. Highest seed yield (2.27 t/ha) were obtained with RDF + foliar application (0.2%) of boron at 30, 40 and 50 days after sowing.

96. A New Approach for Effective Road Map of Municipality Solid Waste Management through Novcom Composting Method Ensuring Economically Useful End product - A Case study from West Bengal, India

A.K. Mandal¹, A.K. Das², S.K. Bera³ and R.K. Salim

¹ Assistant Director, Dept. of Agriculture, Writers building, Govt. of West Bengal

² Dept. of Horticulture, Calcutta University, India

³ Dept. of Agronomy, Calcutta University, India

Key words: Novcom composting method, Municipality solid waste, Stability, Phytotoxicity.

An effective method for successful management of MSW at large scale into a quality compost is still in search. A study was conducted in 2011 at Garulia & North Barrackpore municipality, West Bengal to evaluate 'Novcom composting method' for management of municipality solid waste (MSW). Novcom solution (Research of Inhana Biosciences, Kolkata) was used for the biodegradation process which completed in just 30 days with two turning on 10th and 20th day.

Analytical results of the compost samples as stable, mature, free from any phytotoxic effect with moderately high nutrient content and significantly high microbial population (in the order of 10^{12} to 10^{16} cfu) indicated the method as an effective & economic pathway for MSW management.

97. Importance of women for control of Silkworm (*Bombyxmori L*), diseases at Mothabari area of Malda district of West Bengal

T.Ghosh, D.Ghosh and P.K.Ghosh¹

Milan Apartment, Ground Floor, Flat No.001, 41/1A, Durga Prasanna
Paramhansha Road, P.O.Naktla, Calcutta 700047, West Bengal
¹CSB, CSR&TI, Berhampore-742101, Dist.Murshidabad, West Bengal
Email:paritush.ghosh@rediffmail.com

Key words: *Silkworm (Bombyx mori L.), Mulberry (Morus sp.), Silk, Cocoon, Pebrine, Bacterial Diseases, Virus Diseases, Fungal Diseases*

An intensive investigation showed that most of the farmers of Mothabari area of Malda District of West Bengal, India, are practicing sericulture at their house regularly. It has been observed that the women in every farmer's house are undertaking major responsibilities in the development of sericulture by controlling different kinds of diseases of silkworm at young and late age of their development. The womenfolk in every house hold carry out the job of feeding young age silkworms (*Bombyx mari L*) with mulberry leaves (*Morus sp.*) four time a day and also maintaining optimum temperature and humidity. After end of young age silkworm rearing they devoted most of their time for late age silkworm rearing with mulberry leaves again with four time feeding per day maintaining optimum temperature and humidity during entire rearing period. They take care of worms from infection of Pebrine, Bacterial, Virus and Fungal diseases. To control all these diseases they use disinfectants after each rearing is over are formalin and bleaching powder, however, clean, hygienic rearing, careful handling of silkworms without causing injury, isolation and destruction of diseased individuals, will help to control all- kinds of diseases. The object of the present investigation was to train the womenfolk to develop healthy worms in their young age and late age by controlling different kinds of diseases so that they can produce more superior quality cocoons for International market and by sailing them they can earn more money and easily can uplift their socio-economic staus.

98. Role of women for silkworm (*Bombyx mori* L.) rearing at Mothabari area of Malda district of west Bengal

T.Ghosh, D.Ghosh and P.K.Ghosh¹

Milan Apartment, Ground Floor, Flat No.001, 41/1A, Durga Prasanna
Paramhansa Road, P.O.Naktla, Calcutta-700047, West Bengal
¹CSB, CSR&TI, Berhampore-742101, Dist.Murshidabad, West Bengal
Email:paritush.ghosh@rediffmail.com

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An intensive investigation shows that most of the farmers of Mothabari area of Malda District of West Bengal, India, are practicing sericulture at their house regularly. It has been observed that the women in every farmer's house are undertaking major responsibilities in the development of sericulture. The womenfolk in every house hold carry out the job of feeding young age silkworms (*Bombyx mori* L.) with mulberry leaves (*Morus sp.*) four time a day and also maintaining optimum temperature and humidity. After end of young age silkworm rearing they devoted most of their time for late age silkworm rearing with mulberry leaves again with four time feeding per day maintaining optimum temperature and humidity during entire rearing period. The object of the present investigation was to train the womenfolk to develop healthy worms in their young age and late age so that they can produce more superior quality cocoons with superior quality for International market from which they can earn more money and easily can uplift their socio-economic status.

99. Dimethyl sulfoxide induced early maturing mutant in Jute (*Corchorus olitorius* L.)

P.K.Ghosh¹ and A.Chatterjee

1. CSB, CSR&TI, Berhampore-742101, Murshidabad, W.B.
Centre of Advanced Study in Cell and Chromosome Research
Department of Botany, University of Calcutta
35, Ballygunge Circular Road, Calcutta-700047, West Bengal

Key words: *Dimethyl sulfoxide, Corchorus olitorius L., Early maturing mutant, 24 hours, chromosome, concentration 2%.*

Presoaked seeds of jute (*Corchorus olitorius* L. Variety JRO-632) were treated with 2% Dimethyl sulfoxide for 24 hours. Early maturing mutants were screened in M3 in contrast to the normal plants. Palmate leaf mutants otherwise looked normal excepting the nature of palmate leaf habit. A number of yield component growth parameters were recorded

like plant height, basal diameter, plant spread, root length, pod per plant, seeds per pod, pod length/ breadth ratio, number of primary branches per plant, number of secondary branches per plant, leaf angle, branching angle, first flowering date, 100% flowering date, total duration, % of pollen sterility and weight of 100 seeds which were found to vary from the control plant. Chromosome analysis revealed a number of aberrations like stickiness, fragmentation, clumping, polyploidy, and laggard and bridge formation etc. at very low frequency. This early maturing mutant plant gives more fiber yield than the control plants with superior quality.

100. Studies on Physio-chemical composition of Mango (*Mangifera indica* L.) pulp stored at different temperature in Unit containers

Dr. Kiran Singh, Rajeev Kumar¹ and S. Arya²

Pt. D.D.U. M.M.Rajajipuram, Lucknow
¹N.B.R.I., Lucknow (U.P.), ²D.G.College, Civil Lines, Kanpur

Key words: Mango, Pulp, Dshehari, Containers.

Mango fruits are famous in taste, quality, sweetness, colour and attraction in India and abroad. In glut period of the season, mango pulp storage has got a lot scope for making industrial products which can be sold through out the year in markets. Present study deals with the quality parameters of pulp of Dashehari mango, a most famous variety of North India. Experiments were conducted in ripe fruits during 1997 and 1998. It was found that stored pulp contained ascorbic acid ranging from 8.1 to 9.2mg/100gm of pulp in Aluminium pouches and glass containers, respectively. Protein content was in reduced condition ranged from 0.25 to 0.87 per cent, in poly-propylene and H.D.P.E. containers after 3 months stored pulp at room temperature. Containers after 6 months storage at room temperature. Similarly oil, pH, total sugars, contents values gave important information which can be utilized by research workers, scientists and industrialists.

101. Response of Nitrogen and Phosphorus to Flower Quality of Tuberose

Man Bihari, Ajay Singh¹ and Preeti Pandey²

K.A.P.G. College, Allahabad, ¹L.G.H.S.S.Pawarkhera
²D.G.P.G. College, Civil Lines, Kanpur, (U.P.) India

Key words: Tuberose, Flowers, Nitrogen, Phosphorus.

Field experiment was conducted in varieties of tuberose during 2003. Nitrogen at 0.40 and 80g/m² and phosphorus at 0.150 and 300 g/m² levels were applied in Tuberose trials. The data were recorded on the observations of flowers size and weight parameters.

The analysed data revealed significant results in applications of nutrients as individual and combined treatment of 40 and 80 G/N. Treatment gave positive response with 150g phosphorus. In other parameters, results were found significantly increased due to $V_4 \times N_3 \times P_3$ interaction. Tuberos growth in general was found for better in different treatments than the plants under control treatment. Overall best response of N and P was found in different levels of nutrients to tuberos.

102. Studies on Heritability and Genetic Advance in Potato Genotypes

L.K. Mishra¹, Preeti Pandy, S.S. Singh² and Singh³

C.S.A.U.A.T., Kanpur, U.P., India, ¹Nehru M.V.Lalitpur
²M.G.G.V.V. Chitrakoot, Satna, ³G.H.S.S. Pawarkhera

Key words: *Heritability, Potato, Varieties.*

Investigation on heritability and genetic advances in Potato varieties were carried out in C.S.A. University of Agriculture & Technology, Kanpur. In outstand Twenty varieties were studied for thirteen characters during 1998-99 and 1999-2000. A considerable range of variation in heritability was found in different characters which ranged from 28.05935 to 99.06258 and 32.93102 to 98.89147 in 1998-99 and 1999-2000, respectively. The great range of variation and results in heritability inferred the chances for making improvement in potato varieties. Similarly genetic advance was also found variable ranging maximum 126.06316 and 126.1677 in first and second year, respectively. Promising characters leading to increase in yield have the possibility to produce the material for obtaining quality crop of potato yield. Further cv (geno.) and cv (Pheno.) were also observed variable indicating the chances for making improvement. In fact potato being main crop in vegetables has major roll in food security in agriculture.

103. Biochemical responses of native tree species to elevated CO_2

Janani, G.R., Priyadharshini, P., Jayaraj, R.S.C., Buvaneshwaran, C. and Rekha R. Warriar

Institute of Forest Genetics and Tree Breeding
(Indian Council of Forestry Research and Education)
P.B.No.1061, R.S.Puram, Coimbatore-641002 (Tamil Nadu).

Key words: *Elevated CO_2 , Biochemical, enzymes, antioxidant activity, native trees*

A study was conducted to provide an insight into the response of important tropical tree species to elevated levels of CO_2 under simulated temperature and moisture regimes, in terms of biochemical changes, antioxidant property and photosynthetic activity. Seedlings of four species namely, *Azadirachta indica*, *Pongamia pinnata*, *Melia dubia* and *Gmelina*

arborea were exposed to two levels of CO₂ concentrations i.e. 600 and 900 ppm in Automated Open Top Chambers. Two controls, one under open conditions and the other inside a chamber under ambient CO₂, were maintained. Statistical analysis on the data revealed significant variations in biochemical parameters in all the species except *Pongamia pinnata* for chlorophyll a and total chlorophyll. The results revealed *Azadirachta indica* as a species sensitive to elevated CO₂ concentrations, affecting the photosynthetic machinery. However, an associated increase in temperature facilitated its growth. The study emphasizes the need to assess all important tropical tree species individually and not to generalize the response of tree species to elevated CO₂. In addition, multiple environmental factors must be considered and their interactive effects on predicted climate change is needed to be studied and understood. Immediate and significant increase in photosynthesis can be exploited as a major strategic adaptation to mitigate the global rise in atmospheric CO₂. The veracity of information on morphological, physiological, biochemical and molecular responses of different plants to elevated CO₂ suggests that photosynthetic acclimation and the resulting down-regulation of plant metabolism is due to imbalances between the source–sink capacity.

104. Growth, dry matter production and nutrient accumulation in indigenous tree species under elevated Co₂ levels

**Vimalkumar, K., Buvaneswaran, C, Lalitha, S., Rekha R. Warriar
and R.S.C. Jayaraj**

Institute of Forest Genetics and Tree Breeding
(Indian Council of Forestry Research and Education)
P.B.No.1061, R.S.Puram, Coimbatore-641002 (Tamil Nadu).

Key words: Elevated CO₂, Growth, Dry matter production, Nutrient accumulation, Indigenous trees

The present study was conducted to understand the effect of elevated CO₂ on growth and nutrient accumulation of four indigenous tree species viz. *Azadirachta indica*, *Pongamia pinnata*, *Melia dubia* and *Gmelina arborea*. The seedlings of these four species were maintained inside an Automated Open Top Chambers, a facility available at Institute of Forest Genetics and Tree Breeding, Coimbatore with fully automated control and monitoring system. After a period of three months exposure to various levels of CO₂, the seedlings were measured for growth parameters and nutrient accumulation in biomass components – leaf, shoot and root.

It is observed that there exist statistically significant difference for mean shoot length, root length and dry weight for all the species. The shoot height growth of seedlings exposed to elevated CO₂ was greater than that grown under ambient conditions in all the species studied. The gain in shoot growth due to chamber environment and CO₂ elevation was highest for Neem recording 60% more height growth under chamber environments than seedlings grown under ambient conditions. Contrary to the observations on shoot

length, the root growth highly varied under elevated CO₂ exposures. Neem and *Gmelina arborea* responded positively and gained root length and *Pongamia pinnata* and *Melia dubia* registered lesser root length under elevated CO₂ environments than the ambient grown seedlings.

With regard to dry matter accumulation, it can be concluded that though there are differences among species, dry matter accumulation in all the biomass components were greater in seedlings grown under elevated levels of CO₂ than that are grown under ambient environment.

Studies on effect of elevated CO₂ on nutrient accumulation in plants revealed that nitrogen accumulation was greater with CO₂ enrichment when compared to seedlings grown under ambient conditions. However, the least values of N accumulation in all the three biomass components was observed in seedlings grown under CO₂ concentration of 600 ppm without temperature control. Though there existed little differences in phosphorous content among different treatment, statistical analysis showed that the differences were not significant in all the three plant components. With regard to potassium, there is greater accumulation of potassium under elevated levels of CO₂, more particularly in leaf component, excepting in *Gmelina arborea*.

105. Evaluation of Critical Areas in Upper Kasai Watershed of Puruliya District, West Bengal for Optimizing Land Use

A. K. Sahoo and Dipak Sarkar*

National Bureau of Soil Survey and Land Use Planning (ICAR)
Regional Centre, Block-DK, Sector-II, Salt Lake, Kolkata – 700 091, West Bengal
sahooak2007@gmail.com / sahooak2007@rediffmail.com

*National Bureau of Soil Survey and Land Use Planning (ICAR)
Amravati Road, P.O.-Shankarnagar, Nagpur – 440033
director@nbsslup.ernet.in

Key words: *Critical areas, watershed, prioritization, action plan, land use*

Upper Kasai watershed in Chottanagpur Plateau region of Puruliya district, West Bengal were grouped into seven critical areas based on six most important parameters viz. slope, drainage, soil depth, surface texture, erosion and soil acidity. Area having moderately shallow to very shallow and moderate to severe erosion hazards with gravelly sandy loam surface texture occupied 18.7 % area of the watershed. According to the severity of the problems, the identified critical classes were again grouped under three priority zones i.e., high (severe limitations), medium (moderate limitations) and low (minimum limitations /

normal soils). High and medium zones require immediate attention regarding suitable protection / amelioration. Area under high, medium and low priority zones were 14.5, 10.6 and 72.7 % respectively. Considering the priority zones and the need of the farmers an action plan of the watershed was prepared for overall development.

106. Erodibility characteristics of soils of Badajorenala micro watershed, Khurda, Orissa and their inter-relationship with different soil properties

Krishnendu Das, S. K. Singh, T. Bannerjee and Dipak Sarkar

National Bureau of Soil Survey and Land Use Planning (ICAR),
Regional Centre, Block- DK, Sector-II, Salt Lake, Kolkata-700091

Key words: Badajorenala microwatershed. soil mapping units, erodibility, physico-chemical properties, soil correlation etc.

Surface and subsurface soils of nine soil mapping units in a representative Badajorenala Microwatershed, Khurda Block of Khurda district, Orissa representing the three physiographic units viz., upper, middle and lowland plains with three land use types, viz mixed forest, pasture and grazing lands and rainfed paddy cultivation were studied for the assessment of soil erodibility characteristics. Perusal of the data shows that in the both the surface and subsurface soils the mean K factor was highest ($K=0.41$ and 0.37) in rainfed agricultural system and lowest ($K=0.25$ and 0.22) under forest systems. Significant positive correlation has been found between K with silt % ($r=0.87^{**}$) and silt % + very fine sand % ($r=0.91^{**}$) and negative correlation with the clay fraction ($r=0.45^*$) indicating that soils with higher content of the intermediate particle size fractions erode more. It was also revealed from the study that tillage especially in the rainfed agriculture and soil texture are the most important and crucial factors governing soil erodibility in the watershed.

107. Antioxidant properties of cereal brans

B.N.Dar and Savita Sharma

Department of Food science & Technology, PAU, Ludhiana Punjab

Email: darnabi@gmail.com

Key words: Antioxidant activity, DPPH, Folin-Ciocalteu assay, TEAC, Cereal brans

Cereal brans, a potential by product of milling industry are identified as dietary fibre supplements. These were evaluated as alternative source in exploring the food functionality as dietary antioxidant. Antioxidant assay was measured by DPPH, Folin-Ciocalteu assay and TEAC. Among all cereal brans, wheat bran exhibited higher free radical scavenging ability. Rice, oat and combination of all three brans also reported good scavenging activity. The Trolox equivalent antioxidant assay (TEAC) was used to provide ranking order of antioxidant activity. The data for antioxidants in cereal brans by TEAC(μ mol/g D.W) ranking was in order of wheat bran >Oat bran >Rice bran.

108. Climate Change and Indian Agriculture: Role and plight of women

Anupma Rai

Alternative Futures, B-177, East of Kailash, Delhi -110065

Phone: 011-26847668, 098103068200, www.alternativefutures.org

Key words: Climate change, agriculture, women, natural resources, food security

Indian Agriculture, the mainstay of India's economy and social development, is now faced with a new set of challenges due to erratic rainfall and weather patterns, increase in intensity and frequency of unpredictable droughts, floods and cyclones and declining natural resources triggered by climate change. The recent trends observed during my study on climate change and its impact on Indian agriculture show a bleak future for agriculture and India's food security issues. The quality of environment directly affects women; India's National Action Plan on Climate Change (NAPCC) has also noted that women are particularly vulnerable to climatic variability. The adaptation and mitigation strategies to fight climate change need to be engendered, making them sensitive towards the needs of women farmers and empowering them to be the change agents to save our forests and other natural resources.

109. Ethyl Amine induced Tall mutant in Jute (*Corchorus olitorius* L.)

P.K. Ghosh¹ and A. Chatterjee

1. CSB, CSR&TI, Berhampore-742101, Murshidabad, W.B.
Centre of Advanced Study in Cell and Chromosome Research,
Department of Botany, University of Calcutta
35, Ballygunge Circular Road, Calcutta 700019

Key words: *Corchorus olitorius* L., chromosome, Tall mutants, Ethyl amine, 6 hours.

Presoaked seeds of jute (*Corchorus olitorius* L. Variety JRO-632) were treated with 0.5% Ethyl amine (EA) for 6 hours. Tall mutants were screened in M3 in contrast to the normal looking fruit plants. A number of yield component parameters were recorded including plant height, basal diameter, plant spread, root length, pod per plant, seeds per pod, pod length/breadth ratio, number of primary branches, number of secondary branches, leaf angle, branching angle, first flowering date, 100% flowering date, total duration, percentage of pollen sterility, and weight of 100 seeds which were found to vary from the control plant. Chromosome analysis revealed aberrations like stickiness, fragmentation, polyploidy, clumping, laggard and bridge formation etc.

110. Hydrazine hydrate induced 7-locular fruit Mutant in Jute (*Corchorus olitorius* L.)

P.K.Ghosh¹ and A.Chatterjee

1. CSB, CSR&TI, Berhampore-742101, Murshidabad, W.B.
Centre of Advanced Study in Cell and Chromosome Research
Department of Botany, University of Calcutta
35, Ballygunge Circular Road, Calcutta-700019

Key words: *Corchorus olitorius* L., chromosome, 7-locular Fruit, Hydrazine hydrate, 6 hours.

Presoaked seeds of jute (*Corchorus olitorius* L. Variety JRO-632) were treated with 0.5% Hydrazine Hydrate (HH) for 6 hours. 7-locular fruit mutants were screened in M3 in contrast to the normal looking fruit plants. A number of yield component parameters were recorded including plant height, basal diameter, plant spread, root length, pod per plant, seeds per pod, pod length/breadth ratio, number of primary branches, number of secondary branches, leaf angle, branching angle, first flowering date, 100% flowering date, total duration, percentage of pollen sterility, and weight of 100 seeds which were found to vary

from the control plant. Chromosome analysis revealed aberrations like stickiness, fragmentation, polyploidy, clumping, laggard and bridge formation etc.

111. Women empowerment in poverty eradication through training in agro-based rural activity

K.R.Maurya, R.C.Kimoty and H.Chandra

Scientist-C, Regional Sericultural Research Station
Central Silk Board, Govt. of India, Sahaspur, Dehradun 248197, (U.K.)
Email: mourya08@gmail.com

Keywords: *Women empowerment, Poverty, Eradication, Sericulture, Extension, Technology transfer, Population, Agriculture.*

The purpose of this paper is to provide an overall assessment of how women empowerment helps in poverty eradication through training in agro-based rural industry i.e. "Sericulture." The paper contains detail account of woman literacy rate which is 64.46% and how the government of India has provided facilities for their empowerment. More specifically, the paper attempts to trace how these policies have impacted on women's access to employment at their home. Among them sericultural activities constitute major employment opportunities for poverty eradication. Each woman may have different activities so that agro-based industry sustains on infrastructure, resources and knowledge available with them. Therefore, motivation is required for development of Sericulture as one of agro-based activity, which requires good extension support and timely transfer the technology for making the industry sustainable India, whose current silk production is about 20,410 MT, is the major silk producing country in the world and stands second in the raw silk production. However, the raw silk quality produced in the country is far inferior as compared with that of China producing 1,15,000 MT and Brazil 60 MT, because the major share of silk produced in India is comprised of multivoltine silk, which is considered to be qualitatively inferior. Sericulture farmers must build up their capacity through theory and practical training programme for agro-based activity on transfer of improved technology through well- structured training programme. It is also required to enable the extension workers to develop positive attitude and to improve self-confidence resulting in better job performance to meet the aim and objectives of the programme.

112. Enhancing Crop Productivity: Role of wide Hybridization in Rice

L.K. Bose and D. Swain

Central Rice Research Institute, Cuttack 753006 (Odisha), Email:
lotankbose@yahoo.com

Keywords: *Oryza sativa*, *Oryza glaberrima*, *Oryza brachyantha*, wide hybridization, MAALs.

Breeding programs aiming at transferring desirable genes from one species to another through interspecific hybridization and back crossings often produce monosomic and disomic additions as intermediate crossing products. The genus *Oryza* has two cultivated and 22 wild species. Of the two cultivated species, *O. sativa* ($2n=24$ AA), commonly referred to as Asian rice, is grown worldwide, whereas *O. glaberrima* ($2n=24$ AA), “African rice”, is cultivated in a limited area in West Africa. The wild species have $2n=24$ or 48 chromosomes representing 10 genomic types (AA, BB, BBCC, CC, CCDD, EE, FF, GG, HHJJ, and HHKK). Several incompatibility barriers, such as low crossability, increased sterility, and limited recombination between chromosomes of wild and cultivated species, limit the transfer of useful genes. Recent advances in tissue culture and genomics have enabled the production of wide hybrids among distantly related species. Eight MAALs of *O. brachyantha* (RN1086) having tolerance to & yellow stem borer) have been produced. These MAALs had diploid chromosome complement of *O. sativa* and a single chromosome of *O. brachyantha*. These MAALs had a striking resemblance to the primary trisomics of *O. sativa*. Like primary trisomics they differed from each other as well as from the normal disomics in several morphological and reproductive features. All had a slower growth rate. MAAL1 had narrow, light green, droopy leaves and MAAL8 had narrow, dark green, rolled leaves. The modal chromosome pairing in MAALs was 12II+1I. Rarely 11III+1III were observed in a few pollen mother cells of MAAL.

113. Effect of different doses of soil and foliar applied $ZnSO_4$ on yield and quality of wheat varieties

Shiva Dhar, Anju M. Singh and G. P. Singh

Division of Agronomy, Indian Agricultural Research Institute
New Delhi – 110 012

Key words: *Wheat*, $ZnSO_4$ application, varieties, yield, grain quality

An experiment was conducted during 2007-09 at IARI, New Delhi to find out response of wheat to dose and methods of $ZnSO_4$ application in split plot design with three replications. Grain and straw yields, Zn concentration and protein content in grain were

significantly superior in Zn applied treatments over control. Higher grain and straw yields, Zn concentration and protein content in grain were obtained when 25 or 50 kg ZnSO₄/ha was applied with or without foliar spray or only two foliar spray of 0.2 % ZnSO₄ making plant totally wet, at boot and one week after anthesis. Significantly lower protein content was obtained with soil application of 25 kg ZnSO₄/ha. 'DBW 17' registered significantly higher grain and straw yields, over 'PBW343' while Zn concentration and protein content in grain showed no difference in both the varieties.

114. Genetically improved *Melia composita* Willd. for rehabilitation of wastelands

Ashok Kumar, Shivani Dobhal, Nafeesh Ahmed and Shruti Sharma

Division of Genetics Tree Propagation
P.O. I.P.E. Kaulagarh, Forest Research Institute, Dehradun 248 195,
Uttarakhand, India Email: ashok@icfre.org, ak_meena@yahoo.com

Key words: *Melia composita* (Willd.), plus trees, index value, arid and semi arid regions, carbon sequestration

Melia composita (Willd.) is an important multipurpose tree species grown commercially under various afforestation programmes for fodder, timber and industrial woods. However, the availability of genetically improved planting stock is almost non-existent and was a serious challenge for the researchers. It was therefore selection and characterization of genetically divergent genotypes adopting selection and breeding was initiated to select 230 candidate plus trees using index method based on height, diameter at breast height, straightness, clear bole height, crown diameter and knots. The trees with index value of more than 75 (58 trees) were selected as plus trees and the average index value of plus trees was 81.81. Genetic evaluation of 21 most suitable progenies was carried out in six geographical locations to analyze stability and adaptability and screening of suitability of genotypes for arid and semi-arid regions. The progenies / genotypes, which survive and sustain in toughest of the conditions of more than 48°C of temperature and very little rains are expected to play a crucial role in rehabilitation of arid and semi-arid zones. The programme would essentially ensure development of suitable ideotypes with sustainable water use for such degraded regions and contribute substantially in carbon sequestration when deployed commercially.

115. Integrated Nutrient Management on yield maximization of irrigated groundnut

H. Patro, S.S. Nanda, D. Parida, Md. A. Alim and A.K. Behura

Senior Scientist (Agronomy), All India Coordinated Research Project on
Groundnut, OUAT, Bhubaneswar 751003
Email: pranati_hkp@hotmail.com

Key words: Nutrient yield maximization, irrigated groundnut and farm yard manure (FYM)

A field experiment was conducted during rabi-summer season of 2009-10 and 2010-11 at Agronomy Main Research Farm, Orissa University of Agriculture and Technology, Odisha to study the effect of integrated nutrient management on maximizing the yield of groundnut crop under irrigated condition. The result of pooled analysis of two years data revealed that application of 100% recommended dose of fertilizer as basal plus 50% recommended dose of fertilizer nitrogen at 30 DAS along with FYM @ 7.5t/ha recorded the maximum pod yield of 2200 kg/ha which was comparable with 75% recommended dose of fertilizer as basal and 75% recommended dose of fertilizer nitrogen at 30 DAS with or without FYM @ 7.5t/ha and 100% recommended dose of fertilizer as basal plus 50% recommended dose of fertilizer nitrogen at 30 DAS without FYM@7.5t/ha. The yield maximization was due to improvement in growth parameters and yield attributes. Similar trend was also observed in respect of maximum gross return (Rs.48629/ha), net return (Rs.23274/ha) and benefit- cost ratio (1.935) with the same treatment.

116. Effect of Salinity on Yield, Quality and Nutrient Uptake of Sweet Potato in Coastal Saline Soils

K. Laxminarayana¹, D. Burman², D.P. Singh³ and S.K. Naskar⁴

Regional Centre of Central Tuber Crops Research Institute,
Bhubaneswar, Orissa - 751019, India Email:
klnarayana69@rediffmail.com

Key words: Coastal saline soils, sweet potato, yield parameters, quality traits, nutrient uptake

Field experiments were conducted for three consecutive *rabi* seasons during 2006 to 2009 at three locations in Orissa and West Bengal in a participatory mode to find out the tolerance of sweet potato under varied soil textural groups in coastal saline soils in order to find out the effect of native soil salinity on yield, quality and nutrient uptake of sweet

potato. Out of 15 varieties of sweet potato, CIP-440127 found superior and produced significantly highest mean tuber yield (12.69 & 15.12 t ha⁻¹) and highest mean vine yield (13.23 & 13.70 t ha⁻¹) in saline sandy loam soils of Orissa. The variety Samrat performed better with highest mean tuber and vine yields of 16.51 and 16.55 t ha⁻¹, respectively in saline silty loam soils at Canning, West Bengal. However, the varieties like Gouri, Sankar, and Sourin found susceptible to salinity in all the locations and showed lowest tuber and vine yields. Significantly highest mean starch content (22.90 & 23.82 %) was recorded by Kishan in both the locations of Orissa, whereas Kalinga has recorded highest starch (21.39 %) at West Bengal. Highest amount of total sugars (3.93 & 3.84 %) were observed in CIP-SWA-2 at both the locations of Orissa, while CIP-187017-1 at West Bengal (4.02 %). Among the genotypes, Kishan and Kalinga recorded highest dry matter (29 - 34%). Significantly highest total uptake of N, P, and K was observed in Pusa Safed, Kishan, CIP-440127 and Samrat. Thus, the results revealed that the genotypes Samrat, Pusa Safed, CIP-440127, Kishan and CIP-440038 of sweet potato were found tolerant to moderate salinity up to 6 - 10 dS m⁻¹ by producing sustainable crop yields, quality and uptake of nutrients and it offers good scope for food and nutritional security in the coastal saline soils of eastern India.

117. Formulation and quality evaluation of sand pear (*Pyrus pyrifolia*) based RTS beverage blended with seabuckthorn pulp

Ranjana Verma, Shilpa Sharma, YS Dhaliwal and Rajni Modgil

Department of Food Science and Nutrition,
College of Home Science,
CSK Himachal Pradesh Agricultural University, Palampur-176062

Key words: *Sand pear, Seabuckthorn, Quality evaluation, RTS beverage*

Attempts were made to formulate sand pear based ready to serve beverage with 12 per cent juice, 17°B TSS and 0.3 per cent acidity. To improve the nutritional and sensory quality of the RTS blending with seabuckthorn pulp was done in various proportions i.e. 100:00, 75:25, 50:50 & 25:75. Incorporation of seabuckthorn pulp significantly increased the ascorbic acid contents of sand pear RTS beverage from 1.52 to 13.97 mg/ 100 ml. The sensory scores of the sand pear based RTS beverage also increased significantly with addition of seabuckthorn pulp. Storage of RTS beverage for six months had a significant (Pd^{0.05}) effect on various chemical and sensory parameters.

118. Efficacy of *Heterorhabditis* sp. to fruit borer *Leucinodes orbanalis* and termites *Odontotermes feae* under Lab condition

P. Subramani and Dr. L. Sujatha

PG and Research Department of Zoology
Government Arts College (Autonomous), Coimbatore 641018, Tamil Nadu, India

Key words: *Heterorhabditis*, *Steinernema*, *Xenorhabdus*, *Photorhabdus*,
Leucinodes orbanalis, *Odontotermes feae*, *Biopesticide*.

The soil samples surveyed for Entomopathogenic nematodes (EPN) in areas like Coimbatore, Dharapuram, Manapparai, Mettupalayam and Gudalur. Out of these, three samples harboured EPN. Out of the three, two belonged to the genus *Steinernema*. Since it harboured *Xenorhabdus* bacteria. But the sample from Manapparai was *Heterorhabditis* since it harboured *Photorhabdus* bacteria. Among this only Manapparai sample with *Heterorhabditis* was used to study the pathogenicity, it was carried out to find the efficacy of the EPN to the pest of Brinjal *Leucinodes orbanalis* and termite *Odontotermes feae* isolated from Eucalyptus tree under lab condition of temperature $25\pm^{\circ}\text{C}$. The treatments were with five larvae of *Leucinodes orbanalis* with three treatments of 15 nematode for each treatments. The kill was observed after sixty hours. The termite *Odontotermes feae* was taken as two treatments of 15 each termite and was sprayed with nematodes of *Heterorhabditis* for each treatment the kill was observed after 12 hours. Thus *Heterorhabditis* can be used as Biopesticide as it is an effective agent against these economically important pests under lab condition.

119. Field evaluation of neem oil with endosulfan against sesame shoot webber and capsule borer

P.K. Behera

AICRP on Seed Technology Research, OUAT, Bhubaneswar 751003

Key words: *sesame*, *Antigastra catalaunalis*, *endosulfan*, *neem oil*.

Alternate use of synthetic chemicals and botanicals resulted in effective pest management and maintain the ecological equilibrium. Considering this fact, a field experiment was carried out at OUAT, Bhubaneswar. Spraying of endosulfan and neem oil was done either in single or in alternation at 30 DAS / 45 DAS/both. Twice application of endosulfan (30, 45 DAS) found at par with endosulfan (30 DAS) and neem oil (45 DAS) combination. However benefit: cost ratio was 7.08 : 1 in endosulfan application (30 DAS only) and 5.33 : 1 in case of alternate application of endosulfan (30 DAS) and neem oil (45 DAS).

120. Production potential, Technology gap and economic analysis of cultivated mushrooms in Kangra district of Himachal Pradesh

Deepika Sud and K D Sharma

CSK Himachal Pradesh Krishi Vishvavidyalay- Krishi Vigyan Kendra,
Kangra (H.P.)

Key words: mushroom, economic analysis, technology gap

Diversification in any farming system imparts sustainability. Mushroom cultivation plays an important role in economic and social spheres for enhancing income and nutritional status of people in developing countries. India is a good producer of mushrooms in world however, the production is not sufficient to meet essential requirement to feed current population. The study was carried out in most thickly populated district of Himachal Pradesh where farmers' are shifting from traditional farming system to modern high value crops like cultivated mushrooms where returns are more and early. The present investigations were focused on both primary and secondary data, examines the cost concepts, net returns, input-output relationship and technological gap of selected cultivated mushrooms i.e. white button (*Agaricus* spp.) and oyster (*Pleurotus* spp.). Study revealed that button mushroom was more capital intensive than oyster mushroom whereas oyster mushroom gave higher net returns than button mushroom. The Cobb-Douglas production function used to examine the input-output relation indicated that factors like spawn, compost, labour, growing rooms etc. in the analysis significantly affected the yield of both the mushrooms. The study revealed that critical inputs like spawn and compost were not available in sufficient amount and spawn being used at more than recommended levels, where use of chemicals for disinfection and disease control showed positive technological gap in cultivation of both the mushrooms.

121. Status of Plant Protection Mechanism under Protected Cultivation in Himachal Pradesh

**A K Sood, P K Mehta, K S Verma, K D Sharma, D K Banyal and
Y S Chandel**

Entomologist, Department of Entomology
CSK Himachal Pradesh Krishi Vishvavidyalay, Palampur 176062 (H.P.)
Email: sood_hpau@yahoo.co.in

Key words: protected cultivation, insect-pests, diseases, nematodes

For protected cultivation, exclusion and early detection of pest problems forms the foundation to mitigate them. In Himachal Pradesh, guided surveys conducted revealed the insect-pests, diseases and nematodes to be one of the major constraints for the production

of healthy crop under protected structures. Insect and non-insect pests namely whiteflies (*Trialeurodes vaporariorum* and *Bemisia tabacci*), aphids (*Myzus persicae*), serpentine leaf miner (*Liriomyza trifoli*), mites (*Tetranychus ludeni*, *Polyphagotarsonemus laetus* and *Aceria lycopersici*), tobacco caterpillar (*Spodoptera litura*) were most abundant. Apart from these, thrips and mealy bugs were also encountered at few places inflicting losses to the crops. The major plant pathogens found associated were bacterial wilt, early blight and powdery mildew in tomato, collar rot of capsicum, downy mildew of cucurbits and phytophthora blight in capsicum. Apart from this, septoria blight of tomato and cercospora leaf blight of capsicum were of minor importance. Amongst the nematodes, root-knot nematode, *Meloidogyne incognita* was the most important with wide spread infestation in the state. The others namely, spiral nematode (*Helicotylenchus* spp.), reniform nematode, (*Rotylenchus reniformis*) and lesion nematode (*Pratylenchus* spp.) were of low abundance. The possible routes of entry of pest species in the polyhouse are through doors, side/ top ventilators (flying insect), alongwith planting material (insects, pathogens and nematodes) and from the infested plants growing within the polyhouse (insects and pathogens). The findings of the sample survey conducted in five districts of Himachal Pradesh namely, Bilaspur, Kangra, Kullu, Mandi and Sirmour revealed the lack of double doors in the polyhouses to be one of the important exclusion parameter for insect abundance. The provision of double door varied from 14.3-34% in different districts with an average proportion of 21.5%. Though more than 85% polyhouses had the insect-proof net covering on the side and top vents, however, the provision of appropriate mesh net was the constraint. It was observed that in majority of the polyhouses (78.1%) the mesh size ranged from 21-30 openings per linear inch and only in 4.2% polyhouses, it was between 31-40 mesh, due to which small flying insects got easy entry inside the polyhouse. The infested planting material was also found to be the major source of pest infestation as 55.7% of the growers were raising the nursery in the same polyhouse along with main crop. Majority of growers (60.9%) were not inspecting the planting material before transplanting for the presence of associated pests. Moreover, the awareness among the farmers for recognizing the pest problems and safe use of pesticides was also low to moderate, and can be designated as one of the reason for increased level of pest problems under protected cultivation situations.

122. An Effort of-Application of Embellishment Techniques on Durrie Material

Saini, P., Punia, P., Pruthi, N., Singh, V.

Department of Textiles and Apparel Designing College of Home Science
CCS Haryana Agricultural University, Hisar – 125004
Cell: 09896942273, Email: pushpatomer@yahoo.in

Key words: *Durrie material, Diversified, Embellishment*

Man is born with a capacity to think, imagine, and power to construct. Even primitive people recreated their surroundings by beautifying and decorating which gradually took the form of art and craft. This served various psycho-social needs of a person as it brought

recognition and appreciations along with the opportunity to express one's potentialities satisfying the need of self- actualization (Punia, 2004). *Durrie*-weaving being a traditional art of rural Haryana has a seal of social approval, and can be effectively used as a tool to improve the socio-economic status of women. This art will get a new face if woven *durrie* designs are complemented with various decorative techniques like embroidery and painting for which the villagers are already skilled. Therefore, a study was conducted to prepare diversified products of *durrie* material using three preferred embellishment techniques i.e. painting, machine embroidery and hand embroidery. The preferred embellishment material was sequins. A total of fifteen products were made. Though the products made by using all the three-embellishment techniques i.e. printing, machine embroidery and hand embroidery were accepted by the consumer, however the products embellished with machine embroidery were the most preferred. Consumers had high opinion about preparation of embellished designs on the products as according to them 'it helps in breaking monotony of woven products.

123. Impact of tropospheric ozone on productivity of major cereals in India

**Ritu Tomer*, Arti Bhatia*, V.Kumar*, Tripti Agarwal*,
Bhupinder Singh** and S.D.Singh***

*Division of Environmental Sciences, IARI, New Delhi, INDIA

**Nuclear Research Laboratory, IARI, New Delhi, INDIA

Key words: Tropospheric ozone; rice; maize; wheat; growth; yield)

Tropospheric Ozone (O_3) is an important air pollutant in our environment which affects agriculture by plummeting yields and degrading the quality of agricultural products. There are reports that there may be sufficient losses in yield of cereal crops in South Asia region. In this study we evaluated the impact of increased surface ozone levels on major cereal crops (viz. rice, wheat and maize) in India. Experiments were conducted in open-top chambers (OTCs) under ambient control (AC), charcoal-filtered air (CF), non-filtered air (NF), elevated ozone (EO), elevated ozone (25-35ppb) + elevated carbon dioxide (500 ± 50 ppm) (EO+ CO_2) and non filtered air+ elevated carbon dioxide (NF+ CO_2) in the farms of Indian Agricultural Research Institute (IARI), New Delhi, India. The average 7-h daily mean O_3 concentration in ambient air ranged from 11 to 82 ppb during the crop growth period. The charcoal filters reduced the ozone levels in the ambient atmosphere by ~ 80-85%. In the elevated ozone treatments, 25-35 ppb additional ozone over the ambient concentrations was maintained. Elevated ozone concentrations significantly reduced most of the growth and yield parameters in these crops. Plants grown under elevated ozone showed reductions in net photosynthetic rate of 25-27% in rice, 55% in maize and 31-56% in wheat at flowering stage compared with the control. Grain yield recorded at harvest was reduced under elevated ozone by 10-13% in rice, 13% in maize and 15-19% in wheat. The

presence of elevated CO₂ concentrations along with elevated O₃ was able to counter some of the negative impacts of elevated O₃ concentrations in these crops. The reduction in different yield and growth parameters in combined elevated O₃ and CO₂ treatment was statistically at par with the non-filtered air control. The results indicate that there may be significant decline in yields of cereal crops in future as ozone concentrations are increasing rapidly.

124. Effect of Dadri coal based thermal power plant on agriculture

R. Singh*, **B. Chakrabarti**, **A. Bhatia**, **S. D. Singh**, and **B. Singh**¹

Division of Environmental Sciences
Indian Agricultural Research Institute, New Delhi, India.

¹Nuclear Research Laboratory
Indian Agricultural Research Institute, New Delhi, India.

*Corresponding author- renu_icar@yahoo.com

Key words: *Thermal power plant, suspended particulate matter, wheat, photosynthesis*

Thermal power plants are considered major air emission sources, which can affect local and regional air quality. SO₂, NO_x, CO, CO₂ and Suspended Particulate Matter (SPM) (which may contain trace metals) are emitted from the combustion of coal. Dadri thermal power plant (TPP) situated in NTPC Dadri in Uttar Pradesh was selected for the current study. Nine different locations situated in different villages at a distance of 1-10 km were selected. The study for the impact of SPM on the quality of soil and wheat crop was carried out in the adjoining agricultural areas of the Dadri thermal power plant. During the kharif season, soil and water samples were collected from those villages. Soils were found to be alkaline with pH ranging from 7.7-9.0. Nitrogen content was high, while phosphorus content of the soils was in the lower range. Wheat variety PBW 343 grown in those villages was selected for the study. Measurement of photosynthesis rate in wheat crop showed that in villages located near to the thermal power plant has lower photosynthesis rate as compared to others. Photosynthesis rate was least ($16 \pm 2 \mu \text{ mol m}^{-2} \text{ s}^{-1}$) in Salarpur village which is located at 1 km distance from the TPP. This was due to the deposition of SPM on the leaves of wheat plants which has reduced the photosynthesis rate. Yield as well as biomass of wheat plants was less in villages located at a shorter distance from the TPP as compared to far off villages.

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99th Indian Science Congress

January 3-7, 2012, Bhubaneswar

VII

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PAST SECTIONAL PRESIDENTS**

**PAST SECTIONAL PRESIDENTS
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Biswapati Mandal	(2008)	Sankar Mukhopadhyay	(1985)
M S Sachdev	(2007)	Abrar M Khan	(1984)
Dipak Sarkar	(2006)	D K Sengupta	(1983)
Saroj Kumar Sanyal	(2005)	R S Murthy	(1982)
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Panjib Singh	(2003)	N K Chakrabarti	(1980)
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S Gangopadhyay	(1993)	Usha Nath Chatterji	(1969)
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Dilip Kumar Das	(1991)	Biswanath Sahu	(1967)
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Section I : Agriculture and Forestry Sciences

S C Sen	(1963)	Rao Bahadur B Viswanath	(1937)
P K Sen	(1962)	A K Yegna Narayan Aiyer	(1936)
B L Chona	(1961)	F J F Shaw	(1935)
B N Singh	(1960)	S S Nehru	(1934)
B K Kar	(1959)	M Afzal Mosain	(1933)
P N Bhaduri	(1958)	G N Rangaswamy Ayyangar	(1932)
E S Narayanan	(1957)	Dewan Bahadur Sir T Vijaya	
S P Raychaudhuri	(1956)	Raghavacharya	(1931)
R J Kalamkar	(1955)	George Clarke	(1930)
B P Pal	(1954)	Gabrielle L C Howard	(1929)
N Parthasarathy	(1953)	Rao Sahib T S Venkatraman	(1928)
K L Khanna	(1952)	F J Warth	(1927)
J K Basu	(1951)	G S Henderson	(1926)
R L Sethi	(1950)	R S Finlow	(1925)
R S Vasudeva	(1949)	B C Burt	(1924)
Rai Bahadur Kali Das Sawhney	(1948)		(1923)
N L Dutt	(1947)	Rao Sahib M R Ramaswami Sivan	(1922)
Rao Bahadur V Ramanatha Ayyar	(1946)	S Milligan	(1921)
N V Joshi	(1945)	Agriculture & Applied Botany	
Rao Bahadur D V Bal	(1944)	D Clouston	(1920)
Rao Bahadur Y Ramachandra Rao	(1943)	G F Keatinge	(1919)
R J Kalamkar	(1942)	L C Coleman	(1918)
K Ramiah	(1941)	Agriculture	
Jai Chand Luthra	(1940)	J Mackenna	(1917)
Rao Sahib T V Ramakrishna Ayyar	(1939)	B Coventry	(1916)
Rao Bahadur T S Venkatraman	(1938)	Agriculture & Applied Science	
		H M Mann	(1915)

