A b s t r a c t s

International Seminar

on

Food Security, Biomass Energy and Livelihood Strategies

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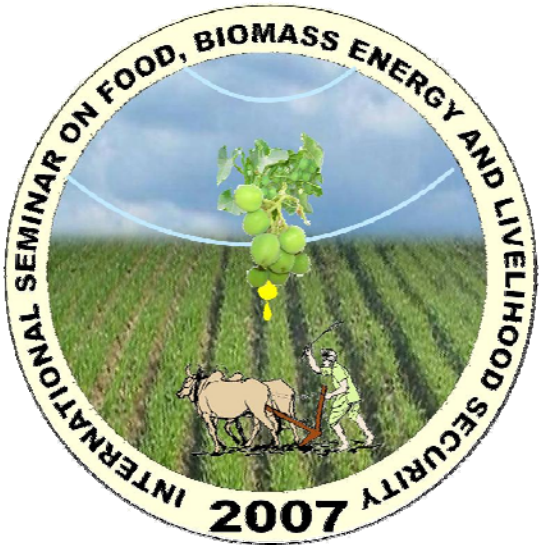

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Introduction

Welcome to Goettingen and thanks for attending the first **International Seminar** organized by **IFSDAA** (International Foundation for Sustainable Development in Africa and Asia) which was established in May 2007 under the umbrella of the AASF (African Asian Studies Promotion Association). Since its foundation we have been getting a positive echo which encouraged us to organize our first International Seminar. Our motivation has increased to follow the path we have embarked on and we wish to invite you to join IFSDAA, becoming part of the network of **global scouts** contributing to the challenges of sustainability and coping with the problems of climate change.

The main objectives of IFSDAA are:

1. To provide a common international platform for the exchange of scientific information, International conferences, workshops, group discussions on sustainable agriculture, food security, renewable energy, global climate change and sustainable development etc. and other topical local and global issues.

2. To carry out research and development work on sustainable agriculture for Food, Bio-energy, Rural Bio-Resources, Livelihood and Sustainable Development on behalf of government/non-government Agencies in developing countries.

3. To honour scientists / academics globally and in particular in Africa and Asia for their outstanding contribution in the area of sustainable agriculture, food security, resource management and sustainable development.

4. To publish periodically a newsletter on sustainable agriculture for food, bio-energy, livelihood security and sustainable development.

Issues of food, energy and livelihood are growing concerns of governments and the civil society in developing and developed countries. Food and energy security is determined by the availability of food and energy resources as well as people's access to them. They are closely interlinked with livelihood and economic power. In order to feed the ever increasing population of the world there is an urgent need to double crop production by the year 2050. This goal has to be achieved despite shrinking land, water and other natural resources.

To meet the UN Millennium Sustainable Development Goal of reducing the number of hungry people to half from its current number of about 825 million by 2015, there is a need to enhance crop production and crop productivity, especially in developing countries. However, climatic change, particularly global warming and green house gas emissions, further aggravate the problems of crop production and cause damage to the production environment. In addition, in order to cope with the emerging threats of dwindling earth oil sources, there is a need for improved technologies for the production of biomass-energy.

This would necessitate identifying and cultivating fast growing plants with high hydrocarbon content, adapted to tropical as well as temperate environs, and efficient bio-fuel production technologies.

It is therefore essential to concentrate on research and development efforts towards sustainable agriculture, natural resource management for food and biomass energy. This would ensure adequate agri-based employment and livelihood opportunities and thus contribute to the alleviation of poverty. Globalization and trade liberalization, in the face of inequities of the resource base among different states and inadequate social infrastructure, call for policy reforms, international dialogue and joint efforts for sustainable development, especially in Africa and Asia.

The main objective of this International Seminar is to deliberate on issues related to sustainable crop production for food and biomass energy, rural resource management and on enterprises for sustainable growth in agriculture and overall agrarian prosperity for food, biomass energy and livelihood security.

The African Asian Studies Promotion Association (AASF) in Goettingen has for several decades, through its programme of reintegration of returnees from German Universities to their home countries, encouraged scientists and development functionaries from Africa and Asia to play an important role in this endeavour. It has been supported by the World University Service (WUS). The recently established International Foundation for Sustainable Development in Africa and Asia is an initiative to complement the efforts of AASF by facilitating the work of Global Scouts for the promotion of technology-transfer and participatory exchange of knowledge and experience.

Goettingen is a town renowned for its research infrastructure and expertise available at the Georg August University and other scientific institutions and is a centre of excellent studies for the international community.

The global network we wish to establish comprises in the first consolidating phase Africa, Asia and Europe. We are convinced that only a close cooperation of scholars leading to pragmatic actions in which the young generation is involved can produce tangible solutions to the different aspects of sustainability and poverty reduction.

Goettingen is, we believe, the most predestined town in Germany to take the lead. AASF has hosted over 4000 students coming from 51 African and 35 Asian countries who attended seminars related to reintegration. To these seminars 145 speakers from 34 African and Asian countries were invited to AASF to share their experiences with students preparing their return home after finishing their studies in Germany. AASF is the first association of its kind in Germany which has fostered the idea of alumni now practiced by nearly all German universities. Besides organizing seminars on reintegration, AASF publishes a quarterly review of its activities in a magazine called “Afrika-Asien Rundbrief” of which 500 are sent worldwide to returnees as well as institutions committed to sustainable development.

IFSDAA's aims are designed as an extension of the activities of AASF and its goals towards sustainable development through the concept of **global scouts.** It should also be mentioned that AASF has a students' hostel in Goettingen, the Mahatma Gandhi House, in which 120 students from Asia, Africa and Germany closely live together. Last but not least, the geographical central location of Goettingen is an important factor to develop this town as a meeting point for scholars coming to Germany, allowing virtual communication to turn into a real world by enabling accommodation and hospitality and organizing seminars in the fields of sustainable development.

What is the future of IFSDAA?

IFSDAA is about to establish a global network. The initiators of IFSDAA kindly ask you to discuss the goals and objectives with the aim of enriching them by your pledge for the success of IFSDAA. We request you to become active members of IFSDAA and to convey its message to those able and willing to contribute. Use this International Seminar to discuss with your colleagues what the future of IFSDAA could be, so that at the end of the seminar we can summarize your ideas and formulate an action plan.

Please use the form we have prepared to give your comments and suggestions concerning IFSDAA.

Dr. K. Wolde-Giorgis
Executive Secretary (IFSDAA)

Dr. A. Wais
For the Local Organizing Committee

Yield Enhancement in Pigeonpea [*Cajanus cajan* (L.) Millsp.] Through *Cajanus Scarabaeoides* A_2 Cytoplasm Based Male Sterility

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Abstract

Pigeonpea is an important crop of Asian and African sub-continent under subsistence agriculture. Despite the fact that this crop has multi-utilities, the productivity of pigeonpea has been stagnant around 6-7 quintals per hectare. Recently, heterosis breeding has been exploited for breaking the yield plateau. Among the different types of wild cytoplasm that have been used for male sterility in pigeonpea, A_2 cytoplasm of wild *Cajanus scarabaeoides* has attained a commercially viable status. Efforts were made to diverse the genetic background of A_2 cytoplasm. Among the extensive conversion and fertility restoration identification programme, 53 stable A lines and 55 stable R lines were identified. Among these, 14 A and 5 R lines were short listed to make crosses among them to ascertain the extent of heterosis for five important characters: grain yield per plant, harvest index, protein content, rate of photosynthesis at 60 and 80 DAS. The resultant 70 hybrids along with their parents and standard checks were grown in a randomized block design with three replications during *kharif* 2006. The analysis of variance exhibited significant differences among genotypes and existence of enormous heterosis for the character studied. The magnitude of heterosis was high for all the characters but harvest index and protein content for which it was medium. CMSGT 311A x GTR 29, CMSGT 301A x GTR 29 and CMSGT 100A x GTR 30 were the best three heterotic cross combinations for seed yield per plant, exhibiting 52.5 to 78.6 per cent superiority over best check (56.03 g/plant of GTH 1). Among these, CMSGT 311A x GTR 29 recorded the highest and significant standard heterosis for harvest index too. Combining ability analysis evinced predominance of non-additive gene effects for all the characters suggesting relevance of hybrid programme in pigeonpea. CMSGT 33A, CMSGT 100A, CMSGT 288A and CMSGT 311A among A lines and GTR 27 and GTR 29 among R lines were good general combiners for seed yield per plant and harvest index. The superiority of the crosses viz. CMSGT 311A x GTR 29, CMSGT 100A x GTR 28 and CMSGT 33A x GTR 26 for seed yield per plant was confirmed by significant SCA effects. The individual best specific crosses for each character were also identified. Taking the holistic view, the predominance of non-additive gene action suggest the relevance of hybrids for busting yield plateau in pigeonpea for which the above specific combinations having desired sca effects may be targeted.

Ectomycorrhiza Development: The Functional Role of a Fungal Aldehyde Dehydrogenase

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Abstract

Enhancement of plant growth by mychorrhiza, a symbiotic relationship between a plant and a fungus, is now a widely accepted phenomenon. However, the mechanisms underlying this association, especially at the molecular level, remain not thoroughly elucidated. The symbiotic association between a basidiomycete ectomycorrhizal fungus (*Tricholoma vaccinum)* and its compatible host plant spruce (*Picea abies*) is characterized by morphologic and metabolic changes that are beneficial to both organisms. These changes are largely due to fungal and plant compounds interacting during ectomycorrhizal development. Among the fungal compounds that are believed to play a role in ectomycorrhiza development are aldehyde dehydrogenase (ALDH) and alcohol dehydrogenase enzymes. These two enzymes are, specifically, believed to be involved in detoxification of aldehydes and alcohols, respectively, which accumulate when plants are exposed to stress. The detoxification of acetaldehyde and ethanol by the enzymes is interlinked in a common pathway called ethanol catabolism. Apart from being involved in ethanol catabolism, ALDH is also believed to supply the phytohormone indole-3-acetic acid (IAA), whose involvement in ectomycorrhizal formation has been controversially discussed in the literature.

Our studies are aimed at investigating the role of ALDH in *T.vaccinum*-spruce ectomycorrhizal development. The results indicate that the gene encoding this enzyme (*aldh*) is 30-fold induced in ectomycorrhiza, compared to the fungus alone, confirming its role in ectomycorrhiza development. Substrate induction tests show that ethanol, indole-3-acetaldehyde and spruce leaf oil are strong inducers of the gene, especially ethanol and spruce leaf oil. We also observed highly branched fungal hyphae in the medium containing indole-3-acetaldehyde (IAA direct precursor), which correlated well with IAA concentration in the medium; ALDH catalyses production of IAA from indole-3-acetic acid. We believe that increased fungal branching increases mycorrhization speed as well as efficiency. Currently, we are trying to amplify, and clone *aldh* by PCR and hybridization methods. The sequences of fragments generated indicate that we are close to getting a full length sequence of the gene, after which we shall functionally analyze it.

Utilizing Solid Wastes to Improve Land Productivity for Sustainable Production

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Abstract

Sustainable agriculture from rain fed areas is more difficult than the irrigated one. Farmers, due to poor income and lack of resource, keep their lands fallow, resulting into creation of wastelands. The restoration and rehabilitation of these degraded soils to an acceptable level of productivity can be enhanced by introducing suitable crops with proper nutrient management systems. Sabai grass, a perennial plan, can be successfully grown on such lands. An experiment was conducted for three years (2003-2006) with a sabai grass - peanut intercropping system to evaluate the relative efficacy of different organic and industrial wastes like farmyard manure (FYM), water hyacinth (WH) and paper factory sludge (PFS), along with chemical fertilizer (CF) and soil ammendments like lime or rice husk ash (RHA). Results revealed that the integrated plant nutrient management system comprising organic or industrial wastes and CF maintaining a nutrient level of approx. 50 kg N, 25 kg P and 25 kg K ha^{-1}, in conjunction with soil amendments, increased the grass and pod yield to the extent of 37.1% (average of sabai grass and peanut over three years) over sole application of CF. Among three organic sources, the PFS based integrated plant nutrient management system recorded higher grass and pod yield to the extent of 4% and 10% (average of sabai grass and peanut) against the FYM and WH based treatments respectively. Therefore, this industrial waste can be effectively used as a substitute for FYM. Another industrial waste, RHA, along with organic wastes and CF, improves the soil's physical, chemical and biological properties after three years of sabai grass cultivation. Lime, in similar combination, had almost a comparable effect as that of RHA. Hence, RHA could be used as a substitute of lime for the amelioration of acid lateritic soils.

Key words: Acid soil, farmyard manure, water hyacinth, paper factory sludge, lime, rice husk ash

Heat Tolerance in Wheat

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Abstract

The Inter-governmental Panel on Climate Change (IPCC) has recognized that global mean temperatures will rise 0.3°C per decade during the next century with an uncertainty of 0.2 to 0.5%. Thus global mean temperatures should be 1°C above the present values by 2025 and 3°C above the present value by 2100. Moreover, global warming effects will vary diurnally, seasonally and with altitude. Being immobile, crop plants must adapt to prevalent soil and weather conditions. Plants can adjust their tissue temperature to some extent mainly through transpiration cooling. That would necessitate an adequate water in soil profile and efficient root hydraulic system for effective water uptake. However, plants have developed several mechanisms that enable them to tolerate higher temperatures. These adaptive thermo tolerant mechanisms reflect the environment in which a species has evolved and they largely determine the environment where that species may be grown.

Wheat is grown as a winter season crop in the tropics and subtropics despite the relatively high temperatures that occur during the growth cycle. Heat stress is also a common constraint during vegetative growth stages in early sown crops in water deficit / rainfed areas as well as at anthesis and grain filling stages in many countries including South and West Asia, North Africa, Australia, Mediterranean Europe, and the central and southern Great Plains of the USA

High temperature severely limits wheat yield, accelerates plant development and specifically affects the floral organs, fruit formation and functioning of the photosynthesis apparatus. At 45°C leaf photosynthesis may be halved, decrease totally above ground biomass and grain yield. Temperature has differential effect on each phase. Plant response to heat stress differs from one phenological stage to another. The most thermo sensitive stage is GS_2 (double ridge to anthesis stage). Wheat breeders are seeking for new heat-tolerant germplasm suited to these stressed areas. Also, the complex physiological-genetic relationships conditioning heat tolerance must be combined with genes necessary for superior agronomic performance. Therefore, breeders use an empirical selection with visual screening traits such as biomass, tillering ability, and leaf senescence. Genes governing different mechanisms for heat tolerance are scattered over a multitude of germplasm lines. Therefore, wheat breeders should evaluate many lines during selection for heat tolerance because identification of a plant with all the required genes is difficult. Yield selection is difficult in large breeding programs, with thousands of segregating lines. In fact, wheat varieties are developed with heat stress tolerance without a complete understanding of the selective effects of the environments in which selection took place. Yet, physiological, and molecular techniques could complement empirical methods to increase selection efficiency.

On the basis of mean performance and gene effects for grain growth rate (mg/day), 1000-grain weight(g), number of seeds/spike, flag leaf area (cm^2) and grain yield (g)/plant, wheat crosses MP 3091 x Raj 3765 appeared promising under terminal heat stress conditions. The parent MP 3091 (38.4g), Raj 4012 (37.2g), Raj 3765 (37.8 g) and F1's, MP 3091 x Raj 3765 (40.7g) and Raj 4012 x Raj 3765 (35.6g) had higher grain growth (1000 grain weight) in the terminal heat stress environment as compared to PBW 343 which showed a maximum reduction in grain growth rate and grain yield per plant under terminal heat stress conditions. Transgressive segregants for 1000-grain weight were selected from F2 population of MP 3091 x Raj 3765 (up to 59.0 (g) and Raj 4012 x Raj 3765 (up to 52.0(g). Genotypes HT 90, DI 9 and SG 182 and segregating generations of crosses WH 147 x HT 90, DI 9 x SG 182 figured important for developing early heat stress tolerant genotypes. Both, electric conductivity and Malate Dehydrogenase isozymes, furnished good criteria for early prognosis of heat stress as a measure/indicator of membrane thermostability and heat shock proteins, respectively.

Empowering Rural Women Through Self-Helf-Groups in Haryana

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Abstract

Over the last few years “Empowerment” has become the buzz word in rural development In this content, the Self Help Group (SHG) approach has emerged as the most successful strategy in the process of empowerment of women. The present study therefore is focused on the structure of SHGs, evaluate the functional aspects of SHGs, measure empowerment of women and explore different income generating activities promoted by SHGs members in Haryana. The study sample represents three districts of Haryana state, Bhiwani, Jind and Sonepat. A total of 240 respondents from the three selected blocks, six villages where the project was in operation for at least two years, were selected for study purpose.

The major findings reveal that most of the respondents were from a younger age group, high caste, illiterate; the majority of the members of one organization had nuclear family. The majority of the respondents as housewife, had marginal land holdings, the animal was self-employed income was low, lived in a *pucca* house, had medium access to mass media. The highest percentage of respondents (95.83 %) stated that reasons for joining the Swa-shakti project were to have personal income, 98.33 % joined SHG due to interest in income generation activities. Half of the respondents were highly aware regarding various principles and objectives of the Swa-shakti project. On the useful parameter of training 66.66 % of the respondents rated the training as highly useful. Among fifteen groups 12 groups had taken a credit from NABARD and 3 groups from a co-operative bank. Regarding the purpose of loaning, members for buying dairy animals, rank I and for the fulfillment of personal need, rank II was observed. The majority (86.66 %) of the respondents got support to a large extent from a sister-in-law while 83.33 % from the mother-in-law, followed by the daughter. A maximum number (i.e. 65.83 %) purchase raw material from the city. On the marketing front, half (i.e. 50 %) of the respondents did the marketing themselves. On the empowerment front, amongst various types of empowerment, 37.50 % were empowered to a moderate extent to improve the life of the family, while the majority had a medium level of personal, social, economic and entrepreneurial empowerment. The majority of the respondents (90.41 % and 90.83 % of SHG members) reported that misbehaviour and dowry expectation and violence in the family decreased. Social participation, mass-media exposure, the extension of personal contact and contact with bank personnel were found significantly associated with the empowerment of the respondents.

Roots of Child Labour in Udaipur District and its Consequences

B.S. Bhimawat, Urvashi Nandal and Manoj Kumar

Abstract

Child labour is one of the burning problems of our country in its present scenario. Therefore, the present investigation was undertaken with the objective to study the socio-economic status of child labour and the children's family member's reaction in the study area, i.e. Udaipur, district of Rajasthan. 80 children from urban and rural areas, highways and nearby slums were interviewed. The findings of the study conclude that child labour is done by children of the age group 9-12 years and that they belong to lower classes. Most of the children were Hindu and had studied up to primary level of education. They were mostly working as helpers and labours in households as well as in factories. At the same time, data show that the family composition of those children was generally 3-6 members, where by earning members were less in the family. Most of the children lived in nuclear families in self owned *kuccha* houses. Their monthly income varied between Rs 1000- Rs 1500/-. The findings of the study also reveal that parents/guardians of child labour were interested to make their children work due to poverty and the low socio-economic status of the family.

Possibilities of Sweet Sorghum Production for Ethanol on the Heavy Clay Soils of the Hungarian Plain

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Abstract

In the framework of the Ányos Jedlik Programme entitled „Complex, connected heat - and electrical energy production technology based on biomass" sorghum as a possible energy plant is investigated in Karcag Research Institute. In this paper the results of 2006/2007 years are summarized.

When determining the plants suitable for energy production, we have to take the followings factors into consideration: the agroeco-potential of the region, the important characteristics of plants from the point of view of energetic utilization (biomass production, power value, energy balance etc.).

On the Great Hungarian Plain the most important ecological factors limiting the plant production are the frequently occurring drought and the large surface of problematic soils (acidification, salt accumulation and compaction).

The Karcag Research Institute has significant scientific experiences in breeding and production of sorghum, which is one of the crops that can be produced on problematic soils as well.

In Hungary, sweet sorghum is mainly produced as a fodder crop. Hence the varieties are evaluated according to the feeding-biological parameters. When sweet sorghum is used for energy production, new requirements arise, like high sugar and syrup content and high amount of extractable sugar per area unit. For measuring these parameters we developed an evaluation system, which is based on the determination of extractable syrup content and cellulose/hemi-cellulose yield.

When producing bio-energy plants it is very important to mitigate the input costs. For improving the economics of energy plant production we try to use reduced tillage methods and to solve the nutrient supply by using thin manure of pig farms. On the base of the results of researches it can be concluded that sweet sorghum can utilize the nutrients and the water content of thin manures very well for the energy transformation.

Growing sweet sorghum even on areas with less fertile soils 60-70 t/ha, green mass can be produced that ensures 25-30 m^3/ha of extractable juice with 15-20% of sugar content.

The cellulose and hemi-cellulose production is 2-3 times higher than the sugar yield. Hence an economical bio-alcohol production can be based both on sugar and cellulose/hemi-cellulose yield.

Syntheses of Global Innovation and Traditional Local Governance for Creating Sustainable Development

Zahra Breshna

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Advisor for the Safeguarding of Urban Heritage,
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Abstract

Based on current demographic trends, the world population is expected to reach 9 billion by 2050. At least 85% of the people will live in the developing countries. By 2030, two out of three people will live in an urban environment, with most of the explosive growth occurring in developing countries. Currently, close to 30 % of the urban population in developing countries live below poverty levels. It is estimated that by 2020 this proportion could reach 45 to 50 % of the total population living in urban areas. Poverty (no food and livelihood security) is one of the biggest challenges to sustainable development and global stability. In addition, urban regions are known for their extensive use of natural resources and prolific waste production, leaving an impact on their immediate and distant environment over a long period.

In response to these challenges, there should be put considerable emphasis on developing realistic livelihood strategies, program implementation in metropolitan governance area, regional, land-use, transportation and environmental planning and in coordinated public and private investment-policy to reduce poverty and negative environmental impacts.

This paper concentrates on livelihood strategies and the integration of renewable energy (i.e. biomass) in urban areas. It will describe how improvement in social, economical and ecological areas could be achieved by promoting traditional local governance and taking advantage of the cultural heritage.

Kabul is an example for a rapid and uncontrolled urbanization and suburbanization of rural agricultural land. After decades of war and destruction, the country is plagued by chaos, anarchy and corruption. The social system, shattered by combat, civil war, flight and displacement, significantly hampers the development of a civil society and physical reconstruction. The lack of genuine decentralization, policy and institutional failures, as well as weak governance and lack of accountability at all levels contribute directly to the worsening of poverty, its exponential growth and environmental misbehavior.

The informal sector, in contrast, such as housing construction and trading, forms the strongest growth pillar. It arose from material need, because of the still overly bureaucratic and inefficient administration and also substantially out of a tradition of acting on one's own responsibility.

Historically, an organizational and communication form developed in Afghanistan (as well as in other Islamic cultures), upon the basis of which participatory and self-organizational processes created a differentiated structure and neighborhood solidarity - hence, a decentralized organizational system developed within the traditional (urban and rural) society.

The autonomous amalgamation was equipped with great leeway and was viable without an administrative apparatus.

Developing comprehensive regional, urban and rural programs in consideration of cultural, historical, and traditional values (i.e. participation and decentralization) with emphases on integration of renewable energy (like biomass, solar, wind), water resources management, reduction of solid waste and sewage treatment, reuse and recycling of materials, provides a set of economic and social benefits and contributes to the improvement of the livelihood and the quality of the urban and surrounding rural ecology.

The sustainability of development is guaranteed through integration of the population and the recognition of the informal economy as an important sector for production, consumption, and job creation. Employment and food security is the first step out of poverty and an important step towards better social integration, sustainable development and global stability.

The presentation will be divided into three inter-related parts

1) Current urban and rural condition
2) Traditional systems of governance
3) Livelihood development strategies.

Genomic Srategies to in planta Mdify Sorage Crbohydrates to Dversify Cop Ulization

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Abstract

Two-thirds to three-quarters of plant dry-matter is made up of carbohydrates, many of which are primary products of photosynthesis in plants. Carbohydrates are the major components that provide structural integrity to plants and are used for fiber and fuel by humans. In storage organs such as seeds and tubers, carbohydrates provide energy and substrates for germination and initial plant growth but are also harvested by humans for food and industrial applications. Starch is the major reserve carbohydrate, which supplies almost 50% of calories in human diet and animal feed. Wheat, rice and corn are the major sources of starch around the world. In the tropics, the indigenous starch crops such as cassava, sorghum, millet or yam serve as the staple food for millions of people. Globally about 2050 and 680 million tonnes of storage starch is produced annually by cereal and tuber crops, respectively, and harvested by humans for food, feed and industrial uses. Starch is a major source of calories in human diet and animal feed, but it is also a versatile industrial raw product and forms the basis of several important industries in the paper, pulp, cosmetics and biofuels sectors. Renewable and environmentally friendly raw materials for industrial applications such as biodegradable plastics, adhesives and ethanol-based fuels are examples of carbohydrate-based products.

Carbohydrates have a basic elemental formula $[C_x(H_2O)_y]$ in which carbon is joined to hydrogen and oxygen present in the same ratio as in water. The polymerization of the basic structure gives rise to a vast array of polymers with diverse structures and functions in plants. Starch is a major reserve carbohydrate present in grains and tubers and has been a major target for *in planta* genetic modification to develop novel industrial applications. Starch is present as water-insoluble granules made up of two types of glucan polymers, one-quarter amylose and three-quarters amylopectin along with traces of lipids and proteins. Amylose is a predominantly linear glucan polymer, composed of α-1,4-linked glucose residues, and is sparsely branched through α -1,6-linkages. The degree of polymerization (dp) of amylose molecules is species dependent, ranging from around 800 in maize and wheat to 4500 in potato. Amylopectin is a much larger (dp 10^5 to 10^7) and more complex glucan polymer composed of hundreds of short α -1,4 glucan chains joined by α-1,6-linkages, with approximately 5 % of the residues having both α-1,4- and α -1,6- linkages. Using natural genetic variation, the starch structure has been modified (waxy, high amylose, starch granule size) in several plant species, giving rise to starches with novel functional properties and uses. Genomics technologies have aided in the identification of natural genetic variation and are being used in crop improvement to expedite the development of new crop varieties. The identified genetic variation for carbohydrate biosynthetic / modification / degradation genes can be used to develop new types of carbohydrates to diversify crop utilization and help in sustainable development of agricultural communities.

The Rhizosphere and its Significance for Food Security

Dr. N. Claassen

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Abstract

Food security refers to the production of enough food of high quality. For this, among others, plants need to absorb large amounts of mineral nutrients from soil and none or low quantities of toxic elements.

To produce, for example, 1 t of wheat the plant needs to absorb from the soil around 20 kg N, 4 kg P, 20 kg K or 100 g Fe, 40 g Mn or 20 g Zn and further mineral nutrients. In contrast soils usually contain 100 to 1000 times the quantity needed by the crop, but even so deficiency may occur because most of the soil nutrients are of low solubility and not directly available for absorption by the plant root. It is the activity of the root that changes chemical and biological conditions in the soil surrounding the root, i.e. the rhizosphere, which make the soil nutrients available for uptake by the root. This shows that nutrient uptake by plants and the resulting plant growth and food production depends on the conditions of the rhizosphere. Plant roots affect the rhizosphere in several ways. Absorbing water and nutrients will cause a change of nutrient concentration (depletion or accumulation) causing nutrients to move towards or away from the root. But the root also exudes substances (inorganic and organic) which affect the chemical, biochemical and biological conditions of the rhizosphere.

The root may affect the pH of the rhizosphere. A decrease of the pH will strongly increase the solubility and P uptake of Ca-bound P (e.g. rock phosphate). Also the solubility of most micronutrients is increased. The pH of the rhizosphere can be influenced by the farmer through the choice of N fertilizer. Ammonium fertilizers will reduce the soil and rhizosphere pH.

The exudation of organic compounds may affect the solubility of soil nutrients but a major effect is on the microbial population density and composition, which may increase by a factor of 3 to 50 as compared to the bulk soil. These microorganisms may affect nutrient solubility in soil. For example, they may decrease Mn solubility (Mn oxidizers) or increase it (Mn reducers). Apparently root exudates affect specifically one or the other thereby the respective plant becoming Mn inefficient or efficient respectively.

Mycorrhizal fungi is another group of microorganisms living in symbiosis with most crop plants that affect plant nutrition, mainly P nutrition in soils of low available P. Rhizosphere research in relation to plant nutrition also includes the role of root hairs and the combination of cluster roots (many secondary roots close together) with high organic acid exudation in the absorption of P from soils low in available P.

The knowledge of the relationships outlined above will **a)** help to understand how plants acquire nutrients, **b)** help to develop management strategies for an efficient use of soil and fertilizer nutrients, and **c)** help to breed plants that are efficient in the uptake and use of soil and fertilizer nutrients. Altogether, this will enable us to secure food production for an ever growing demand for food of high quality.

Maize Towards Food and Nutritional Security and Poverty Alleviation in Africa and Asia

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Abstract

Maize is the world's leading food grain and is often produced in quantities larger than rice and wheat. It is grown in more than 150 countries of the world, ranging from the equator to 3000 meters a.m.s.l. The crop has particular significance for a remarkable range of uses in food, feed and industry. It is staple food for world's poor, more so in Asia and Africa which have the burden of poverty. Therefore, the issue of food and nutritional security compels attention. The soil health and agro-climatic conditions in these countries are of uncertain nature, making sustainable farming systems a challenge for the resource-poor farmers. Maize productivity in Afro-Asian countries, with the exception of a few like China, is quite low and belies the potential of maize as the most productive crop in the world.

The low productivity in these areas is a result of poor yield potential of land races and open pollinated varieties of maize, as it is of the poor farm resources. There is practically a stagnation in yield level of maize in most of these countries which however can be improved with the emerging array of new hybrids of maize suited for different agro-climatic conditions and prevalent farming systems. India is one of the recent examples of a push in maize production with 4.2% cumulative growth rate over the last decade. The maize hybrids coming up in India, are like in USA and other western countries, characterized as single cross hybrids with yield potentials touching 8 to 10 metric tones per ha on farmer's fields. The wide adaptability of these hybrids over a considerable range of farming environments is an additional advantage and can contribute a great deal to alleviate production constraints, and hence add to food security in the region.

What is more exciting, however, is the development of single cross hybrids of Quality Protein Maize (QPM) which have a better quality protein, being rich in lysine and tryptophan. The QPM represents a strong support to the approach of food and nutritional security of the masses, not only by means of direct food but also indirectly, as a feed for piggery, poultry, fishes and cattle. Thus, for people not able to afford animal food, QPM can provide a means of warding off hunger and to help develop sustainable high yielding agricultural systems.

The biological value of QPM has been found to be higher than of normal maize, particularly for children and lactating mothers. Even as feed, QPM has shown more rapid growth rate in piggery and poultry. In India, the present growth rate of the poultry sector is 11.5% of p.a. which will further increase the projected growth of QPM and its conversion to poultry feed. The growth rate of young calves has also shown a remarkable increase by the use of QPM in place of ordinary maize. Single cross QPM hybrids have shown a high adaptability for sustainable cropping system with reference to conservation of natural resources. Also with view to enhance the income from the farm, these hybrids can be grown in intercropping without in any way affecting the productivity of other crops. In India, more than 100 QPM inbred lines and a dozen of QPM single cross hybrids (HQPM-1, 2, 3, 4, 5; Shaktiman-1, 2, 3, 4 etc) have been developed and are under cultivation in India.

It has been investigated that large scale coverage of maize areas in Asia and Africa with QPM single cross hybrids can provide a means to alleviate hunger and contribute to food and nutritional security of the less endowed people with a fillip to sustainable cropping and farming systems.

Broccoli Genotype Identified for Animal Fodder

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Abstract

In India, broccoli (*Brassica oleracea* var. italica) is considered as underutilized vegetable crop, mainly grown for vegetable purposes around big cities and sold at high price to upscale hotels and high-income group gentries. While evaluating some broccoli genotypes for curd yield and its attributes at the Vegetable Research Farm, CCS Haryana Agricultural University, Hisar, the line Broccoli No. 1 was found to have good green foliage with late flowering. From the population of this genotype, a single plant progeny (Broccoli No.-1-1) having profuse green foliage, vigorous growth habit and delayed flowering (100 days after planting) was isolated in winter season 2002-03. Broccoli No.-1-1 is rich in protein (25% on dry matter basis), vitamin A, B and C and calcium, phosphorus and potassium. Initially, broccoli was fed to five non-lactating goats, which was preferred by all the goats. The lactating goats fed with broccoli based ration (broccoli as green fodder + grain + guar straw as basal dry roughage) performed better in terms of average milk yield with higher total solids, protein and calcium content of milk and an increase in milk yield 30.22% higher over control. In the subsequent year, the crossbred lactating cattle fed with broccoli gave 14.2% higher milk over the control cattle. The digestibility of all nutrients and efficiency of milk production in terms of milk production per kg dry matter intake was also better in animals fed with broccoli-based ration. The results of experiments indicate that broccoli fodder is highly palatable and its feeding to domestic animals results in significantly higher milk production.

Siderophores: Promoting Plant Growth by Biofertilization and Bioremediation

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Abstract

The use of chemical fertilizers in agriculture poses severe environmental pollution problems, affecting soil, ground water and the health of agricultural workers. In addition to this, at toxic concentrations, heavy metals cause different harmful effects on plants growing in contaminated soils. Heavy metals have been found in significant amounts in foods/feedstock coming from crops grown in such soil. However, iron (Fe) - one such heavy metal - is important for the survival of humans, plants, and most micro organisms. Iron-regulated bacterial secondary metabolites (siderophores) are thought to be involved in plant growth promotion.

We are working on the hypothesis that the use of siderophore-producing soil bacteria, or extracts of this microbial metabolite, can enhance plant growth in heavy metal contaminated soils. Results from our studies indicate that under Fe scarcity, *Streptomyces* spp. producing these high-affinity-Fe chelators, which in addition to Fe bind a range of other heavy metals, where present. We also showed that the siderophores promote legume plant growth under Fe deficiency, and in the presence of nickel; as well as when iron and aluminum are so sufficiently present to become toxic to the plant. In Fe-deficient soil, scavenging and binding of Fe by siderophores results in the solubilization of the metal and subsequent supply to the plant. On the other hand, in heavy metal-polluted soil, binding of Fe and other metals implies the immobilization of these metals and prevention of their uptake by plants. The second scenario alleviated Fe-mediated free radical formation that damages plant cells.

The practical implication of these findings to sustainable agriculture is obvious. It is important to protect the soil from heavy metal pollution; thus conserving the environment for sustainable agriculture. In the light of this, with further research and development, siderophores may be incorporated into the fertilizer regimes of farmers as biofertilisers, and/or applied for the bioremediation of heavy metal polluted soil. This is true, considering the industry-scale solid minerals exploitation activities that abound in developing countries. Mining activities are known to release substantial amounts of heavy metals into the environment. Good enough, being a natural product of biological origin, siderophores by themselves are no potential sources of persistent pollution as they degrade quite easily with time.

Impact of Climate Change and Energy Crises on Food Security in Regional and Global Context

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Abstract

Global warming, energy consumption and food production are closely interconnected. Agricultural yields will substantially be affected by higher temperatures, floods, drought, spread of diseases, and invasion of weeds and destruction of soil nutrients. But could agricultural plants benefit in environments of higher concentrations of atmospheric carbon dioxide, higher rate of photosynthesis, an increase in water use efficiency or from less frost?

The world faces increased hunger and water shortages in the poorest countries, massive floods and avalanches in Asia and species extinction, unless nations adapt to climate change and halt its progress. By 2020, up to 250 million people are likely to be exposed to water shortages. In some countries, food production could fall by half. Parts of Asia are threatened with massive flooding and avalanches from melting Himalayan glaciers. Europe also will see its Alpine glaciers disappear. Australia's Great Barrier Reef will lose much of its coral to bleaching from even moderate increases in sea temperatures. The Americas will see more hurricanes, floods, droughts, heat waves, wildfires; Africa will be hardest hit and Europe will see its Alpine glaciers disappear.

It could be concluded that the technologies and sustainable energy resources known or available today *are* sufficient to feed the ever growing world population and to meet these challenges. There is still sufficient time to build up and deploy them, but only if the necessary decisions are made in the next five years. Yet it is clear that the economic policies and governmental interventions needed to propel this transition are not now in place, or even in prospect in most cases. This is a matter to which the world needs to give urgent attention.

Related aspects to ensure food security in regional and global context will be discussed in this presentation.

Future Biomass Potential for Food, Animal Feed, Energy and Biomaterials – Fierce Competition or Peaceful Coexistence?

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Abstract

Around the globe, we are currently experiencing a constantly increasing demand for biomass for different purposes: Food production, animal feed and other direct biomaterial uses in chemistry and industry as well as the generation of energy. Through this development, numerous problems are becoming evident such as the competition between different land uses for the ever-decreasing available cultivation area of crops and the consequential destruction of valuable natural areas, e.g. tropical forests. In connection with energy production, for example, the increased search for renewable energy carriers with large-scale potentials over the last years has boosted controversial discussions about the sustainability of several high-hope crops, with the oil palm being a very prominent example. Against the background of a rapidly growing world population, one of the most-asked general questions is if the amounts of biomass which will be available for all the above-named purposes will be sufficient to cover the entire demand in the future.

In the past years, the Institute for Energy and Environmental Research Heidelberg (IFEU) has conducted numerous studies on the environmental effects of the production and use of biomass, including life cycle analyses for specific products or production processes. Furthermore, IFEU has critically reviewed existing studies which include numerical statements on the future global biomass potential. These publications – which also include extreme scenarios – were found to deliver a vast range of results with little congruence. Therefore, in 2007, additional, specifically targeted assessments focussing on the available land area were conducted. They included three analyses commissioned by IFEU from other research institutes and allowed the development of a more realistic biomass potential analysis and a corresponding derivation of the amount of biomass which will be available world-wide in 2050. The results were compiled and conclusions drawn from them this past summer. They are based on the precondition that first of all, the basic food needs of a growing world population must be fulfilled and after that, the remaining biomass or available land, respectively, can be used to fulfil the demand of other purposes such as biofuels, for example.

This presentation highlights the most important findings regarding the availability of biomass in the year 2050, with a focus on the uses which surpass the basic living needs of a growing world population. It (1) summarises the main conclusions from the review of previously existing studies, (2) describes the design of the research leading to IFEU's own estimations and (3) presents the results as well as numerous conclusions and recommendations which can be derived from them.

Reference

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Subcontractors: Institute for Energy and Environment (IE), Leipzig, nova-Institut, Hürth (D), and the University of British Columbia, Vancouver; Supported by The German Chemical Industry Association (Fachvereinigung Organische Chemie im VCI), Frankfurt am Main, in print (2007).

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Challenges for Animal Scientists in the 21st Century

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Abstract

The production of edible protein of animal origin is the primary objective of livestock husbandry. Until 2050 the meat production will be more than double, the milk production will increase to 180 % according to recent FAO-figures. The population increases only from ≈ 6.5 to 9 billion people (138 %). The rising incomes lead to the elevated demand and consumption of meat, fish, milk and eggs.
This is a real challenge not only for animal scientists, but also for all those working in agriculture (esp. plant breeders, farmers etc.) Based on this situation, questions, as follow, must be answered:

- What are the real human needs?
- Can the earth feed everyone in the long term?
- Are we making efficient use of the earth's natural resources such as soil, water, fossil fuel, phosphorus etc?
- How do we solve the competition between feed/food for animal/men, fuel, areas for settlements and protected areas?
- What role do animals play in all of this and how should they be treated?
- Do we need genetically modified plants and animals to solve the problems?
- How can we improve the nutrient economy and the safety during the production of food (protein) of animal origin?
- What are the consequences of climate change on animal production as well as animal nutrition?
- Do we have the potential to reduce the excretions of N, P, CH_4 or trace elements by food-producing animals for an environmental friendly animal production?
- Do we need animals to produce edible protein or are there alternatives in the future?

Food of animal origin is a real resource-consuming material, if we consider the dry matter intake of food producing animals (≈ 7 billion tons DM per year) and compare it with human consumption all over the world (≈ 1 billion t). The expectations on animal production have changed in recent years. After the Second World War, people were hungry and asked for anything to eat in Europe. An increase in agricultural production and the utilization of all resources for food production were the challenges for agriculture. Food security was the objective of scientists and farmers. Later it moved to food safety, because enough food was available and the people asked for safe food. Now many people ask "How can we feed the world in the future?" Therefore food security (enough food) and food safety (freedom or minimal content of undesirable contaminants) are the key elements of human health and well being. In addition a number of social questions have emerged, and more are expected in the future. Therefore animal production is presently being considered in a new framework. It is not only asked to produce high amounts of milk, meat, fish and eggs and other food of animal origin. It is also expected to use resources efficiently, consider the environmental, ethical and socio-economic aspects, food safety and quality, as well as some other influencing factors on animal sciences.
Human need, nutrient economy, environmental aspects and further topics of food production of animal origin are discussed in the paper in detail. The increase of animal performance and decrease of animal number seem to be the most efficient way for a better nutrient economy and lower excretion per product of animal origin.

Plant Tissue Culture Application in Field and Horticultural Crops for Sustainable Development in Africa and Asia

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Abstract

Plant tissue culture methods offer a rich scope for the creation, conservation and utilization of genetic variability for the improvement of field, vegetable and horticultural crops. Micro-propagation ensures true-to-type, rapid and large scale multiplication. We have developed micro propagation protocols for several plant species including, sugarcane, potato, mentha, banana, strawberry, citrus, carnations, chrysanthemum, gladiolus, eucalyptus, poplar, stevia, white musli, and aloe vera, which are being exploited for commercial plant production in this region. There are more than 100 commercial tissue culture units in India including 10 in Punjab, each producing hundred thousand of plants per annum. The clean planting material can certainly improve the yield potentials of our vegetatively propagated crops like sugarcane, potato, strawberry, mentha, sweet potato, banana and tapioca. Reproducible methods ensuring high frequency somatic embryogenesis and subsequent plant regeneration have been developed in citrus, cotton, pearl millet, rice, sugarcane, celery, safed musli and maize. Somaclonal variants of sugarcane and potato are under field evaluation. A mapping population has been developed in rice from a cross involving variety PR111 (high yielding rice) x IR 65598 (New plant type) using anther culture through doubled haploid production. An improved method for pollen culture in rice has been developed. For haploid production in wheat, a wheat x maize system has been developed using field grown wheat and maize. A cell line in chilies has been developed that produced 7 times more capsaicin in culture. An improved protoplast culture method has been developed in rice and, following this method, protoplast to plant systems have been developed in two basmati rice varieties. Using the developed tissue culture systems and 'Particle gun' transgenics carrying insect resistance genes have been developed in locally adopted indica rice and sugarcane varieties. Applications of these techniques for crop improvement and production of super elite planting material will be discussed.

Effect of Genotype and Medium on Callus Induction and Plant Regeneration in Soybean (Glycine max L.)

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Abstract

This study was conducted to determine the effect of plant genotype and growth medium on callus induction and plant regeneration in soybean. Ten soybean genotypes, namely PK 416, PK 1243, 9804, SL-432, DS 97-12, NRC 51, JS 94-67, SL-603, AMS 97-1 and NRC 52 were cultured on MS medium supplemented with different levels of hormones. Callusogenesis and plant organogenesis varied depending upon genotype, explant and medium used. Genotypes viz 9804 and NRC-51 were found to be most suitable for callus induction and medium MB1(MS basal salts + B5 vitamins + 3 mg/l BAP + 0.5 mg/l NAA), MB6(MS salts + B5 vitamins + 0.5 mg/l BAP + 2.0 mg/l NAA), MB7(MS salts + B5 vitamins + 1.5 mg/l BAP + 0.5mg/l NAA + 1.5mg/l Kn + 0.5mg/l IAA), MB8(MS salts + B5 Vitamins + 1.0 mg/l BAP + 0.5 mg/l Kn + 1.0 mg/l IAA) and MB9(MS salts + B5 Vitamins + 2.5 mg/l BAP + 2.0 mg/l Kinetin) was found better for callus induction. Genotype 9804 exhibited the highest plant regeneration on MB1 medium (MS salts + B5 vitamins + 3.0 mg/l BAP + 0.5mg/l NAA) among all the genotypes and mediums used.

Future Farming, Food, Feed, Fiber, Fuel, Freedom
Global Trends 2008/2025/2050

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Abstract

Food-Fuel, is a global challenge for the 21st century.
Food security has top priority in future. There is no discussion about the fact that everybody must eat. Nevertheless, this fundamental need was globally addressed by the United Nations in the Universal Declaration of Human Rights in 1948, Article 25: *"Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary services ..."* At the beginning of the 3rd millennium, we all know that this human right is not being realized worldwide.
Within the next 30 years, world food requirements will more than double as a result of population growth and dramatically changing consumption patterns, which means, we will have to produce more food worldwide during this period than over the last 10,000 years put together.

"Food is energy. And it takes energy to get food. *These two facts, taken together, have always established the biological limits to the human population and always will. The same is true for every other species: food must yield more energy to the eater than is needed in order to acquire the food."*
"Humans have become champions at developing new strategies for increasing the amount of energy – and food – the capture from the environment. The harnessing of fire, the domestication of plants and animals, the adoption of ards and plows, the development of irrigation networks, and the harnessing of traction animals – developments that occurred over tens of thousands of years – all served this end." (Heinberg, R., *"Threats of Peak Oil to the Global Food Supply"*, 2005).

Energy security is a global concern at the beginning of the 3rd millennium. Ministers and Government representatives have reaffirmed their urgent commitment to substantially increasing the global share of renewable energy in the total energy supply. They share the vision that renewable energies, combined with increased energy efficiency, will become a most important and widely available source of energy and offer new opportunities for cooperation between all countries (*Bonn Declaration*, 2004; *Beijing Declaration*, 2005).
Key conclusions *"Access to energy: A Human Right?!"*, *"Energy is a fundamental prerequisite of every life"*, *"The availability of energy is a fundamental and indivisible human right"* were addressed by the World Council for Renewable Energy (2005). The political agenda is well defined.
Country-specific goals for renewable energy from biomass between 2025 and 2050 vary from 30 to 50 percent of total energy consumption. A global vision of biomass and crop-based renewable resources for biofuels production and consumption for 2025 and 2050 shows a 5-fold increase by 2025 and is expected to set the stage for another 5-fold increase by 2050. By that time renewable resource inputs will begin to match the use of fossil fuels to meet the projected growth in demand for consumer goods.
Forecasts for 2025 state that 20 to 30 percent of arable land will be used for biomass production, mostly for the production of bioethanol and biodiesel based on corn, sugar cane, wheat, sugar beet, coconut, palm oil, sunflower, oilseed rape, *Jatropha*, and *Pongamia*.

Plants and plant crops have always been, and will continue to be, of vital importance for humankind. They are an essential source of food, feed, fiber, fuel, fun, freedom, raw materials, and energy. Plants, especially biomass crops, will be one answer, and they are a further essential key in renewable energy strategies of the future. Nevertheless, powerful breeding programs are at present rudimentary or in an early phase for the more than 40 plants which are described as potential energy crops.
A broad set of drivers, options, impact factors, limits, and constraints in developing countries as well as developed countries will be given for renewable energy production focusing on biofuels obtained from biomass/energy crops. Key factors of the new biofuels value chain will be addressed.

Agricultural biomass production, and especially biofuels production, must not compete with food production, but should increase diversity in some regions of the world and make feasible the beneficial use of often destructively exploited land resources. But caution is necessary. If the population-food supply balance is to be maintained in future, long-term planning will be essential.
Key questions at the beginning of the 3rd millennium are: *"How can we improve the value creation in plant production? How can we improve the biomass/crop energy production in agriculture? How can we develop a more efficient and effective use of land, energy and material, or: how can we establish a superior 'industrial ecology'?"*

Fortunately, the World Bank claimed in their *World Development Report 2008*: ***"After 25 years, agriculture has top priority – again!"***

In the 21st century, agriculture continues to be a fundamental instrument for sustainable development and poverty reduction. Managing the connections among agriculture, natural resource conservation, and the environment must be an integral part of using agriculture for development. In a lot of regions, agriculture has to shift to high-value agriculture. The focus is definitively the right one.
Sustainable production of food, feed, fiber, fuel, freshwater and industrial products in the future will depend for its success on a future-oriented, knowledge-based and added-value agriculture – that finally, will enable freedom and will safeguard global peace.

Impact of Sowing Environments on Photosynthetic Rate, Growth and Yield of Wheat

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Abstract

The sowing environment is an important factor influencing the physiological processes of the wheat crop. The present study was conducted at the Research Farm of CCS Haryana Agricultural University Hisar, India (29010'N latitude, 75046'E longitude and altitude of 215.2 meters above mean sea level) to determine the impact of sowing environments on photosynthetic rate, stomatal conductance, transpiration rate, growth and yield of wheat during the crop seasons of 2002-03 and 2003-04. Photosynthesis increased from tillering to anthesis stage and declined thereafter till crop maturity and it was significantly higher in 20th November sown wheat crop as compared to 20th December sown. The photosynthetic rates at anthesis were 18.34 and 19.64 µ mole m-2s-1 in flat bed sowing and furrow irrigated raised bed sowing during first crop season, respectively. The corresponding values of second crop season were 17.12 and 18.36 µ mole m-2s-1 in P1 and P2, respectively. The photosynthetic rate in furrow irrigated raised bed planted wheat crop was more than that was observed in conventional flat sowing wheat. The photosynthetic rate was maximum in wheat fertilized with 180kg N ha-1 at anthesis which was 20.01µ mol m-2s-1 and 18.54 µ mol m-2s-1 during the crop season of 2002-03 and 2003-04, respectively. Irrespective of treatments, the photosynthetic rate decreased progressively after anthesis might be due to mobilization of leaf nitrogen for the development of protein rich seeds. It was also noticed that a higher dose of nitrogen had increased the photosynthetic rate of plant leaves due to the direct effect of nitrogen application on leaf area index and radiation interception. Significantly lower stomatal conductance was recorded with the conventional flat planting system as compared to furrow irrigated raised bed planting wheat. The stomatal conductance was higher at anthesis in comparison with other phenophases in all the treatments during both crop seasons. Higher transpiration in 20th November soon crop was recorded as compared to late sown crop, i.e. 20th December due to comparatively higher leaf area index and stomatal conductance in first sown crop. The maximum transpiration rate of 8.43 and 7.80 m mol m-2s-1 was recorded in 180 kg N ha-1 fertilized crop in 2002-03 and 2003-04, respectively. Maximum value of LAI was 4.4 and 4.1 in first date of sowing during 2002-03 and 2003-04 respectively, was probably due to the elongated vegetative phase and higher photosynthetic rate as compared to delayed sowing. Maximum grain yield was recorded in 20th November sown wheat crop in both years. This could be attributed to the higher photosynthetic and leaf area index rate in 20th November sown crop. The improvement of grain yield due to increasing N levels was brought mainly due to the beneficial effect of N levels on various physiological parameters.

Managing Soil Productivity – Evaluation of the Results of the long-term Field Experiments in Differing Soil and Climate Conditions

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Abstract

Green revolution and technical development brought about powerful tools to increase agricultural production all over the world. Mineral fertilisers, pesticides and new cultivars of the crops that respond to the elevated level of mineral nutrients in soil belong to the most important reasons for the dramatic increase in the productivity of agriculture. This has been clearly documented by Cassman et al. (2003) who have shown an almost constant increase in the cereal production all over the world over the last four decades. However, we should not forget about the constraints of this development. The first one is a potential harvest area that seems to have already reached its top and it seems to decline, predominantly in the developed countries, over the last two decades. The second one is sustainability of the cropping systems.

Sustainability became a frequented word which encompassed many aspects, environmental, economical and societal, as well. Most of the definitions of sustainable land use, however, encompass maintenance or enhancement of production and production risk reduction. Sustainable land use also combines measures to protect natural resources and prevent degradation of soil and water quality and it should be economically viable and socially acceptable.

Obviously, there are close links between soil productivity and sustainability of agricultural land use. Soil productivity remains an equally important aspect of agricultural land use as sustainability. Productivity of the farming systems is a *conditio sine qua non* for the present human civilisation and it will certainly be still more important in the future.

Evaluation of soil productivity and sustainability of farming systems is a rather complicated problem. The most frequent criterion of soil productivity is the yield of the main product. Due to the variability of climate conditions, there are relatively high differences in the yields of cultivated crops in individual years. For this reason, several years observations are needed to evaluate the soil productivity. Besides the time variability, there are remarkable differences in the soil, climate and site specific conditions. The agricultural land use has to be tailored to the existing soil and climate conditions, as precisely as possible and its long-term effect on the soil quality has to be evaluated. Apparently, long-term field experiments are invaluable in this connection. The long-term data are invaluable for better understanding structure and functions of the agro-ecosystem in given soil and climate conditions, for the estimation of effects of various management practices and also for calibration and validation of crop models.

In our contribution, we have evaluated results of seven long-term field experiments established in differing soil and climate conditions. Besides of the dry matter yields of the main and second products, the organic C content in the topsoil was evaluated. Differing management practices included differing organic and mineral fertilisation and differing crop rotations.

Effect of Crop Residues and FYM on Yield and Quality of Carrot Roots

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Abstract

A field experiment with twelve treatments was conducted at the Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, during winter 2004-05. The incorporation of crop residues in soil had a negative effect on growth and quality parameters and significantly reduced the yield of carrot roots. Root and shoot length, crown diameter, root to shoot ratio, cortex to core ratio, TSS, dry matter and carotene contents and yield were found minimum and percent forking highest in plots where maize, sorghum and pearl millet were grown as preceding crops and their root stubbles were incorporated 50 days after harvest. Addition of decomposed FYM in plots where crop residues were incorporated showed significant improvement in all previously mentioned characters, but it was not as high as that of recommended dose of NPK. The root and shoot lengths, crown diameter, TSS, dry matter and carotene contents were significantly higher of roots grown in plots supplied with recommended decomposed FYM than with other treatments (except recommended dose of NPK), however, the application of recommended decomposed FYM had no significant effect on root: shoot ratio, cortex: core ratio and yield of carrot roots as compared with the recommended dose of NPK. The effect of NPK at recommended dose on all the characters such as root and shoot lengths, crown diameter, TSS, dry matter and carotene contents was equal to that of recommended decomposed FYM, however, the root: shoot ratio, cortex: core ratio and yield were recorded significantly higher in treatment of recommended NPK.

Sorghum [*Sorghum bicolor* (L) Moench] – A multipurpose Crop for Livelihood Security and Bioenergy in the Developing World

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Abstract

Global Climatic changes have posed many challenges for the developing world in the 21st century. The exponential rise in green house gases due to the burning of fossil fuels such as petroleum and coal raised many issues for the precious natural resources. Reducing the use of non-renewable fossil energy reserves, together with improving the environment, are two important reasons that derive interest in the use of bioethanol as an automobile fuel because it is made up of organic compounds which are chemically less complex than gasoline and diesel fuels. Keeping the environmental concern and renewable energy security in focus, the Government of India has taken initiative on blending ethanol with petrol (5-10%).

Sorghum [*Sorghum bicolor* (L) Moench] is a multipurpose crop grown for food, feed, fodder and fuel across the world in the arid and semi-arid tropics having warmer climate under poor management and low input conditions. It has a C_4 photosynthetic pathway and thus can produce 50 g m^{-2} day^{-1} of dry matter. This unique carbon assimilation capacity, coupled with ability to accumulate very high level of extractable sugars in the stalk, makes this crop a promising candidate for bioenergy production. Unlike sugarcane, a main crop for ethanol production all over the world, a tropical plant which takes 18–24 months to complete a life cycle and requires more water and inputs; sweet sorghum can be cultivated in nearly all temperate and tropical regions with a little care, matures within 110-125 day and can be grown in all three seasons taking advantage of the vast agroclimatic conditions of the country. A few of the NGOs in Maharashtra and some private companies in Karnataka and Andhra Pradesh have succeeded to work out the protocols for efficient ethanol production from sorghum along with its profitability. Scientists at the National Research Centre for Sorghum through AICSIP are working to identify sweet sorghum genotypes having higher recovery and photosynthetic efficiency to meet the demand of an emerging industry. Further, the realized potential of such wonderful biomass producing crops if achieved at commercial scale with the help of industry, government policy and scientific efforts, so this crop could help the country in saving the foreign exchange spent in importing petrol and the risk of environmental pollution could be minimized.

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Management of the Uplands: Key for Sustainable Development in Asia

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Abstract

Along with a sharply increasing population in Asia there is increasing need for food, fuel, fibre and other human necessities. Particularly in Asia it is observed that land conversion from its natural state to domesticated landscape, e.g. agriculture, is often resulting in degradation processes with erosion and floods as visible indications. Supported are such negative developments by effects of global change incl. climate change resulting in an increasing frequency of natural disasters like floods, droughts, landslides etc. These are causing severe problems in rural livelihood and result in the loss of biodiversity, pollution and others. While on one hand, growing populations along with economic growth call for more production (and thus, the consumption of ever more resources), there are indications that the renewable natural resources are rather in decline.

Particularly in some areas in Asia, it becomes very obvious, that the sustainable management of the uplands is essential for the sustainable land use in the lowlands and therefore may be the key for the sustainable development of the rural areas as such. Considering the interaction with urban society, the region as a whole will somehow depend on the wise management of the uplands. Upland deforestation is seen as a major problem with regard to the watershed management in the lowlands; e.g. the logging ban in China is a good example: The logging ban came into force after the floods of the Yangtse river believed to be caused by the deforestation in the uplands. However, the socioeconomic circumstances in many areas call for a use of the uplands for rural development and improved livelihood. While natural forest management may not provide enough employment and income, agroforestry systems are seen promising as they allow more or less intensive land use management and are at the same time, preserving the environmental functions in the uplands and safeguarding the watersheds.

This paper discusses the actual problems and interdependencies of upland and lowland areas in rural Asia and presents some cases focusing on the conflict, convergence, and complementation between food security and environmental conservation. This includes the threats of loss of agricultural and forest lands to biofuel initiatives to produce biodiesel and ethanol.

Use of Bio-Inoculants in Sustainable Agriculture

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Abstract

Microbial inoculants constitute an important component of integrated nutrient management systems that would lead to sustainable agriculture. Bacteria thriving in tropical and subtropical soils may get eliminated at high temperatures. Developing strains which can survive at normal to high temperatures and using them as biofertilizers for different crops hence play a useful role in agriculture. In this study, *Azotobacter chroococcum* strains have been subjected to spontaneous mutations and mutants resistant to metabolic analogues and some tolerant to high temperatures have been obtained. Some wild high temperature tolerant (48^0C) cultures of *Azotobacter* spp have also been isolated from soils of the cotton-wheat fields of Haryana, Punjab, Nagpur and Rajasthan (India). *In vitro* nitrogenase activity of these cultures has been tested and found to be ranging between 47.5 (HT17) to 756.5 (HT7) nmoles ethylene hr^{-1} mg^{-1} protein even at high temperatures. Beside nitrogen fixation *Azotobacter* excrete ammonia, produce growth promotors like IAA and siderophores etc some of whose role is considered to be greater in crop productivity than that of nitrogen fixation. Some of these metabolic analogue mutants are found to contribute highly towards N nutrition of some cereal and oil seed crops under Indian conditions with 25 kg N saving. In all cases mutants resulted in better biomass and grain yields of various crops under field and farmers' field conditions.

Effect of Aphid Secondary Symbionts on Resistance against Parasitoids

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Abstract

The pea aphid, *Acyrthosiphon pisum* (Harris) (Hemiptera: Aphididae) is a polyphagous phloem feeding homopteran that attacks a variety of legumes. Its hosts are spread over different families of plants including alfafas/Lucerne, *Medicago sativa*, clovers, *Trifolium pratense*, field beans e.g. peas, *Pisum sativum.* From an economic standpoint, it causes extensive damage to pea crops, pea aphid vectors viral diseases in its host plants and indirectly it excretes honeydew that encourages growth of sooty mould. Biological control by use of its natural parasitoid, *Aphidius ervi,* provided a successful alternative to the environmentally hazardous chemical pesticides until resistance was reported. The wasps attack aphids by injecting a single egg through the aphids' cuticle that hatches into a larva in three days depending on ambient temperatures. The Larvae develops by feeding on the aphid internal organs and eventually kill the aphid before pupation. We sought to determine the physiological mechanisms of resistance by screening clones from different host plants containing varied secondary symbionts. The presence of *Hamiltonella defensa,* also known as PABS, and *Regiella insecticola,* PAUS, reduced the levels of successful parasitism. The mechanisms could be through inhibition of parasitoid egg hatching and aborted or prolonged development of parasitoid. Establishing the genetical mechanisms of the resistance would help in breeding programmes for biological control of this major insect pest.

Sustainable Tourism to Revitalize Regional Economies

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Abstract

In 21st Century, the environmental and ecological conservation of the Earth's systems are urgent global issues, in which forest conservation has the first priority for sustainable eco-system management. In developing countries, forests have been seriously deforested and disturbed, resulting in soil erosion, loss of diversity, and decreased water-holding capacities. As a result, plant productivity has decreased and forest fires occur more frequently, leading to decreased carbon storage and accumulation in ecosystems, and greatly increased carbon emissions. The governments of many countries have been trying to establish new systems and rules for forest conservation. These systems and rules have largely been ineffective however, because of the difficulty in including local people in these kinds of governmental projects. As local people need natural resources to live, a harmonized system of natural resource management is required. Therefore we propose to develop a new forest management system that includes a new type of forest eco-tourism, which we define as Sustainable Tourism.

Genetic Study Impacting Development of Source and Sink in Wheat under the High Temperature Condition of Gujarat

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Abstract

Wheat is a crop of temperate climate and the photosynthesis is highest at 20°C - 22° C temperatures. Central and Peninsular India grows wheat under the limitations of a short and mild winter with a very narrow appropriate temperature growing window of around fourteen weeks that affects both source and sink development. Many alterations have been tried to break the productivity ceiling, among which an increase in biomass, in the number of spikes, number of spikelets, in tillering capacity, leaf senescence, grain filling period, chlorophyll content, and other characters that are related to engineering of source and sink. Lately broad leaved, long ear types and stay green habits called *"buitre"* have been used to expand the sink to avail the maximum advantage of developed source. Therefore, to unravel important information regarding genetics of component characters conditioning source and sink using fourteen parents and their ninety-one cross combinations were evaluated during *rabi* 2005-06 for 14 different source, sink and quality attributes under high temperature condition created by late sowing. The analysis of variance revealed considerable variation among parents and hybrids for all traits under study. Considering the mean performance, ABV 2002-120, GW 323 and Raj 4038 among the parents and GW 344 x KYZ 9636 was the best cross combination. General combining ability and specific combining ability variances were significant and the ratio of gca and sca indicated predominant non-additive gene effects in the expression of source, sink and quality characters. Further KG 123, KYZ 9712, GW 323, Inqualab 91, ABV 2002-120, Raj 4038 and GW 337 were the good general combiners for grain yield/plant. Among these, GW 323 was a good general combiner for eleven characters. GW 344 x KYZ 9636 was the best and significant specific combination (sca) for grain yield. The crosses for individual source and sink characters were identified. Considering mean performance, general and specific combining ability, the parents GW 323, ABV 2002-120 and KYZ 9712 and cross combinations like GW 344 x KYZ 9636, GW 344 x GW 337, PHR 1010 x GW 323, PHR 1010 x Raj 4038 may be exploited for better source, sink and quality development under high temperature conditions.

Integrated and Innovative Agricultural Technologies for Sustainable Pulses Production

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Abstract

Pulses as an important source of protein help to meet perhaps the most important nutritional need of the people in developing countries. Pulses also enrich the soil by their unique characteristic of atmospheric nitrogen fixation. The importance of this group of crops has further increased in recent years due to global shortage of chemical fertilizers. In India, greengram (*Vigna radiata* L. Wilezek) and blackgram (*Vigna mungo* L. Hepper) are the most important pulses in terms of both total area and production. The production of cereal grains like wheat and rice have been an impressive advance and the country today is not only self sufficient in meeting its food needs, but also has some exportable surplus. Pulses, on the other hand, continue to be in short supply.

Greengram and blackgram have an enormous potential for cultivation because of their short duration nature, nitrogen fixing capacity and adjustability under different cropping systems / situation. However for the present, these desirable characteristics of pulses could not be exploited or capitalised for the following reasons: (1) the inherent low yield potential of existing varieties, (2) improper time of sowing, (3) growing in marginal and submarginal drylands as mixed crops with cereals and oilseeds, (4) inadequate fertilization and plant protection.

Increased productivity is attained only when pulses are grown adopting integrated and innovative agro-techniques. An improved genotype, timely planting and line sowing have been increasing the productivity of pulses. Plant density is one of the important factors that influence the yield in pulses. An improved method of fertilizer application is one of the important crop management techniques by which the yield of pulses can be stepped up considerably. But pulses are rarely fertilized on farmers fields. Seed coating with nutrients, biofertilizers etc. is also one of the improved practices that exerted a remarkable influence on the crop growth and yield. Foliar application is a simple and effective method of providing nutrients to crops. This is considered as an efficient and economic method of supplementing nutrients requirements. The advantages of foliar nutrition are that it often brings about immediate improvement and is much more effective than the soil fertilization.

Field experiments were conducted at the Experimental Farm, Department of Agronomy, Annamalai University, Tamil Nadu, India, to study the integrated and innovative technologies for sustainable production of pulses. It is inferred from the study that the winter season is conducive for the saving of pulses, adopting a spacing of 30 x 10 cm and NP fertilizer at 31.25 kg N and 62.5 kg P_2O_5 in conjunction with the seed coating treatment and foliar spray of 2 DAP at 2 %. These measures are found to be appropriate agro-techniques for augmenting sustainable productivity and profitability of pulses without prejudice to the soil fertility and soil health.

Impact of Integrated Nutrient Management for Sustainable Production of Rice

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Abstract

Less productivity in rice could be attributed to various reasons like poor nursery management, lesser plant population, low organic manure application, improper nutrient supply, water, weed, pest and disease management. In view of the escalating prices and high demand-supply gap of chemical fertilizers, there is a strong need to adopt an integrated nutrient supply system by judicious combination of organic manure, inorganic fertilizers and biofertilizers to improve soil health and rice productivity. In this context, INM holds great promise in meeting the growing nutrient demands of intensive agriculture and maintaining the crop productivity at a fairly high level. Hence, the present investigation was taken up to develop an INM package for rice.

Field experiments were conducted at Annamalai University Experimental Farm, Annamalai Nagar, to study the effect of integrated use of organic manures, inorganic fertilizers and bio-fertilizers on the growth and yield of rice cv. ADT 43 during 'Navarai' (December-April) 2002-2003 and 'Kuruvai' (June-September) 2003. In the study, there were six main-plot treatments and three sub-plot treatments, all replicated thrice adopting split-plot design. Nursery studies revealed that in both seasons the basal application of vermicompost at 5 t ha^{-1} + DAP at 2 kg $cent^{-1}$ + $ZnSO_4$ at 25 kg ha^{-1} + Azospirillum + phosphobacteria markedly influenced the germination percentage, shoot and root lengths, root volume, biomass, vigour index and nutrient uptake by rice seedlings. In both the seasons, the growth and yield attributes of rice viz., plan height, leaf area index, dry matter production and number of panicles m^{-2} were greatly increased by the application of 120:38:38 N, P_2O_5 and K_2O kg ha^{-1} (recommended schedule) (S_1), in conjunction with basal application of vermicompose at 5 t ha^{-1} + DAP at 2 kg $cent^{-1}$ + $ZnSO_4$ at 25 kg ha^{-1} + Azospirillum + phosphobacterial (M_6). In 'Kuruvai' season of 2003, this treatment combination resulted in a maximum grain yield (4175 kg ha^{-1}) and straw yield (5675 kg ha^{-1}) which was 39.02 and 34.19 % higher than the control (no manure at S_1 level). It may be concluded that integrated nutrient management (INM) technique promises to be an appropriate technology for achieving a higher yield in rice without affecting soil health.

Household Energy Status and Indoor Air Pollution in Rural Kitchens: A Case Study

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Abstract

The kitchen is the most important work zone of homemakers, where a woman spends a maximum of her energy. Rural kitchens are the most neglected areas of the house. A glimpse in a rural kitchen reveals that it is dark and sooty, ill ventilated and ill lighted, with outdated tools and equipment. The major problems of this type of kitchen is air pollution, as the rural households use solid biomass fuels, in inefficient traditional cook stoves, which results in large-scale emission of pollutants. These pollutants may cause respiratory infections, chronic lung diseases, lung cancer, eye irritation and reduced visibility. Traditional biomass fuel accounts for 80 % of India's domestic energy consumption when the fuel burns in simple cook stoves in an unventilated kitchen. During meal preparation, air inside homes gets heavily filled with smoke that contains large amounts of toxic pollutants such as carbon-mono-oxide, oxide of nitrogen, sulpher di-oxide, aldehydes, polycyclic aromatic hydrocarbons and respirable particulate matter. Rural homemakers use the traditional cook stove with open fire mostly indoors and rarely with adequate ventilation or chimney. This situation leads to higher recorded levels of air pollution, to which young children and women are exposed daily for many hours.

An improved cook stove is the domestic wood heater, with higher thermal efficiency as compared to the traditional one and reduced fuel consumption for a given task. It yields a higher power output level so as to cook faster, and has provision for overcoming the problems of pollution and inconvenience caused by blowing, fuel adjustment, smoke, soot radiation etc. It also has a longer useful stove life and reduces the frequency of repairs. The present paper is the outcome of a research study on household energy status and indoor air pollution in rural kitchens with special reference to the assessment of health aspects of rural households in the Udaipur region.

Important specific recommendations for reducing fuel consumption and indoor air pollution were made, which includes that there should be a separate space for cooking in the form of kitchen or cooking pantry, good and adequate ventilation should be provided in the kitchen by proper placement of door and windows with special reference to their sizes, instead of using the traditional cook stove in the rural kitchen the households should be prompted for using improved cook stoves in view of an efficient use of primary energy sources and for improving health and hygienic conditions. Awareness should be created in the minds of the rural housewives about the indoor pollution and its impact on their quality of life and productivity.

Decentralized Power Generation for Sustainable Development

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Abstract

In the present power scenario, the contribution of renewable energy in the form of wind energy is about 1% of overall energy production. The present production of 115.000 MW electricity in our country also highlights 8% shortfall in the availability over the energy demand. In this situation, the scope of decentralized power generation based on new and renewable energy acquire a promising option.

This paper deals with the fundamentals of power generation based on conventional as well as non-conventional energy sources. In the present context, an attempt has been made to highlight the power generation potential of conventional sources (fossil fuels, petroleum, hydro power) and non-conventional energy sources (Solar energy – Thermal and Photovoltaic, Bio energy, Wind energy, Ocean energy – MHD and Geothermal) based an their techno-economic feasibility. It is observed that renewable energy-based power generation is a techno-economically feasible option and is locally available as well as environmentally sound. A comparison is made on the basis of cost per MW power generation for various options available. A new approach based on down draft based gasifier for power generation is also included in this paper.

Energy Balance Analysis of Wood Based St-5 Hamara - M Stirling Engine

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Abstract

A stirling engine is an externally fired engine which can utilize any type of fuel for its operation. In this engine, the alternately expanding and compressing of an entrapped fluid at different temperatures develops work. Due to its multi-fuel capability in utilizing a variety of agriculture residues and the simplicity in construction, operation and maintenance, it presents a potential to be a motive power-source at farm level. This will also offer a great promise for the future in terms of eliminating environmental pollution, reducing fuel consumption and offering costing advantages through fuel savings.

Provided pressure and temperature levels are maintained, increasing swept volume results in increase of power output, but increasing swept volume is constrained by ensuing real losses and heat conduction losses. Bore to stroke ratio of two has been found favourable for particular swept volume.

Keeping this in view, the analysis of energy balance of the wood based ST 5- HAMARA-M Stirling engine system for each of its components was done in order to know its overall efficiency for optimum power requirement. During the operation, different types of wood particulates such as Saw-dust, wooden twigs and briquettes were used as fuel for the engine. This study shows overall effectiveness of the wood based stirling engine for different farm operations.

Energy Conservation in Agricultural Operations Through Wood Based Stirling Engine

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Abstract

India is an agriculture based country, in which agricultural production is emerging as an important consumer of commercial energy. The Indian farmer, on the average, is using over 2000 MJ of energy in the form of fertilizer, chemicals, machinery, electricity and diesel oil to produce one tonne of food grains. To the individual farmer, the restricted supply of electric power and frequent shortages of diesel oil poses the most disturbing and immediate energy problems. Further, if we resolve one energy problem for crop production, a major part of energy goes in irrigation pump sets, which are mostly diesel fuel-based. Thus, in the present dismal picture of energy availability for agricultural operation, there is an urgent need to identify and develop a suitable medium for energy conservation in agricultural operation. The stirling engine has acquired an important position in the rural energy scenario. The biomass based stirling engine further boosted the technology for wide acceptance among Indian villages.

Keeping this in view, the Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India, has modified existing wood-based engines to incorporate wide varieties of fuel and mounted it on mobile chassis to perform different on-farm agricultural operations. This paper discusses the presently available biomass based stirling engine technology in the vague, efforts made to make its operations reliable and efficient in its energetics and operational characteristics.

This paper also highlights the specification of the mobile wood based stirling engine system suitable for energy conservation in agricultural operation and its performance in different agricultural operations like chaff cutting, water pumping, threshing, etc.

How Can We in Africa at the Same Time Increase Food and Biofuel Production and Simultaneously Reduce Vulnerability to Climate Change, Reduce Greenhouse Gas Emissions and Preserve Forests?

Professor Arthur Riedacker

Abstract

Up to now increasing food production, reducing vulnerability to climate change, reducing greenhouse gas emission (mitigation of GHG) and preserving forests have been considered as separate issues. With the new tool that we developed, the "Global Environmental Integrated Assessment" (GEIA) we show that with the promotion of a "Triple Green Revolution" taking into account food supply, sustainability of agricultural production, health and other basic needs per capita and the environmental issues at the global and the local level, several aspects of the UN Millennium Sustainable Development Goal and of sustainable development could be achieved. As the population is to double during the next 50 years in Sub Saharan Africa, increased food production per unit of land, more net bioenergy output per hectare, less GHG emissions per ton of food production, lower vulnerability to climate change, and more sustainable agriculture, less climate change, and less deforestation are required. To maintain the climate change within acceptable limits, GHG emissions should, during the next 50 years, be divided by 2 at the world level and at least by 4 in industrialized countries. The GIEA model uses IPCC default emission factors. But it can be shown that even with higher emissions factors it would still be beneficial to increase agricultural inputs, inter alia mineral inputs and transportation facilities etc. For instance increasing fertilizer inputs from an average to day of 8 kg per ha to 50 kg per ha, would help to increase yields, to reduce dependency on food imports and limit the present mineral depletion of African soils, which makes agriculture non sustainable in this part of the world. The latter figure is still 4 times lower than the average fertilizer inputs in industrialized countries. Reaching that target would nevertheless improve the present situation. Better feeding of animals would also reduce GHG emissions per ton of milk or meat. Direct conversion of vegetable protein would also help to some extent improve diets and reduce GHG emissions. Conclusions are robust and show that it is not necessary to spend large amounts of money for instance for precise carbon stock change measurements. For the next fifty years or more, it is sufficient to just assess changes in land use with remote sensing. This issue should be considered not only under the Millennium goal, but also under the UN Climate Change Convention, under a specific fund, for instance the Fund for Least Developed Countries. Industrialized countries would largely benefit from helping to increase inputs in Sub Saharan agriculture.

From a practical point it is interesting to discuss where we should join our efforts to start to put this in practice and demonstrate these options; to simultaneously increase land and livestock productivity, to increase (1) food and biofuel production, in most tropical countries (1a), in Soudano-Guinean regions (1b), and (2) to better use the land and provide more proteins for direct human consumption.

It is also interesting to list the type of research programmes which are to be developed to achieve more sustainable development, including conversion of biomass for various biofuels.

Micronutrient Disorders
Challenge to Sustain Food Grain Production in Punjab, India

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Abstract

Micronutrient deficiencies have become one of the major constraints in sustaining food grain production in India. Analysis of more than 200.000 soil samples in different states of the country revealed the predominance of Zn deficiency in 48 % samples followed by Fe and Mn deficiency in 12 and 5 %t samples, respectively. Coarse textured, alkali, flood plain and calcareous soils, which have a relatively high pH and/or low organic matter content, are more prone to micronutrient deficiencies. Organic manures are not only a good source of micronutrients but have also been found to enhance their availability in soil through chelation, redox reactions and reduction in pH. Judicious and efficient management of costly micronutrient fertilizers holds the key to maintain sustainable food grain production. Zinc has received the major focus of attention of the micronutrient scientists due to its widespread deficiency. Soil application of zinc sulphate is the most commonly used method to correct Zn deficiency in different crops. Severe Fe and Mn deficiency is difficult to manage with soil application due to the oxidation of soil-applied iron and manganese sulphate at high soil pH. Foliar application of Fe and Mn is an immediate effective measure to combat their deficiency; however, Fe and Mn have to be applied repeatedly through foliar application. Another approach could be the sowing of nutrient-efficient crops that can grow well on soils low in micronutrients. For nutrients such as Fe, Mn and Zn which generally have an extremely low solubility in soils of arid and semi-arid regions, the response to nutrient deficiency stress is mainly biochemical. The response may involve changes in rhizosphere pH, redox potential, root exudates and microbial activities. Identification and /or evolving of micronutrient efficient crop cultivars, having either low micronutrient requirement for potential yields or being capable of mining micronutrients from the less available pools should be given priority.

Additive Effect of Mixed Biofertilizer Inoculation on Seed Yield of Mustard [Brassica juncea (L.) Czernj & Cosson] in Typic Ustochrept Soil of Hisar, India

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Abstract

The present study was conducted during the winter (*rabi*) season of 2003-04 and 2004-05 on the Dryland Research Farm of CCS Haryana Agricultural University, Hisar, India, to study the effect of mixed biofertilizer (mixture of N-fixer, P-solubilizer and PGPR) and their monoculture inoculation on seed yield of mustard, grown in associations at varying percentage of recommended dose of fertilizers (RDF) on a sandy loam soil with and without inorganic fertilizers. The finding reveals that among the treatments, inoculation of mixed biofertilizer at 75% RDF was found superior (2.26 t/ha) to single culture inoculation (2.16 to 2.20 t/ha) and significant increase in seed yield was observed over the uninoculated control (1.79 t/ha) during both the seasons. The maximum seed yield (2.52 t/ha) was observed with mixed biofertilizer inoculation at 100% RDF ($N_{40}P_{20}$ kg ha). The seed yields at 100% RDF and 75% RDF with mixed biofertilizer inoculation did not vary significantly. Strain inoculated mixed biofertilizer survived better 30 days after sowing as well as at harvest stage. Nitrate N levels were higher than control as well as before sowing with the application of RDF and mixed biofertilizer inoculation.

Key words: *Azotobacter, Azospirillum, Bacillus polymixa, mixed biofertilizer, mustard yield, rhizosphere population*.

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Prosopis juliflora L., a Controversial tree in Ethiopia: Review

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Abstract

Prosopis juliflora is a native tree of Central and N. America. Among the 44 species in the genus Prosopis*, P. juliflora* exists in both diploid (2n=28) and tetraploid (2n=56, rarely 112) forms. The one in Afar and Dire-Dawa regions has been identified as tetraploid (2n=56).

P. juliflora is an extremely hardy species that can thrive very harshly environmental elements, which are hardly tolerable by others. This has enabled it to spread in many areas and it usually escapes invasively as a weed. These days, the issue of Prosopis is one of the debating topics worldwide. The global invasive species program has registered many species in the genus including *P. juliflora* as one of the dangerous invader threatening the biodiversity of this world. In Ethiopia it is highly condemned for its invasion of large grazing land in north Eastern lowlands, particularly in Afar. It has made life difficult for herders who are highly dependent on animal rearing. By virtue, it has also caused a threat to the biodiversity of the areas.

On the other hand, the tree is very versatile in its uses providing fodder for animals, fuel, timber, shade and even food for people. In addition, it plays an important role in soil fertility improvement, reclamation of salt affected soils and fixation of sand dunes. However, the exploitation of these potentials of the tree is constrained by the knowledge and experience of the people in the area and technical staffs. In many areas around the world, it is the source of income for many poor. Some people in Ethiopia particularly in the Dire-Dawa region are benefiting from sells of Prosopis as firewood. Prosopis wood is cheaper although it is known that it has a high wood quality. Currently, people around Dire-Dawa city gain a total estimate of about 1.642.500 Birr (>124.346 €) per year by supplying Prosopis' fuel wood to Dire-Dawa. Charcoaling of Prosopis is also becoming a common practice in Afar where cooperatives have already been organized to deliver their produces directly to the capital. Nevertheless, Prosopis is highly underutilized even as a fuel wood, owing to the difficult accessibility of its areas and to transportations to reach the markets where fuel wood demand is very high. This, in turn, could have reduced the extensive cutting of other threatened tree species for fuel.

Generally, whether to consider *P. juliflora* as an exploitable resource that substitutes the over use of other trees or as invader that threatens the biodiversity and livelyhood of the people has remained controversial. This paper draws a picture on the experiences in other countries for Ethiopia on the exploitable potentials of the species comparing its invasive nature with the peoples advantages and biodiversity of an ecosystem.

Key Words: Biodiversity, conservation, fuel wood, invasive, *Prosopis juliflora*

Effect of Explants and Media on Plant Regeneration in Different Genotypes of Tomato

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Abstract

The explants were cultured on MS medium supplemented with different concentrations of BAP and kinetin in combination with IAA and IBA 0.2 mg/l. Two media, i.e., MS basal medium fortified with BAP 2.5 mg/l + IAA 0.2 mg/l and kinetin 2.5 mg/l + IAA 0.2 mg/l, showed the highest number of shoot formation and number of shoots per explant among 24 different media combinations. The cotyledon explants were found to be more efficient in producing shoot formation. Among 24 treatments, the MS basal medium containing BAP 2.5 mg/l + IAA 0.2 mg/l for hypocotyls and MS basal medium supplemented with kinetin 2.5 mg/l + IAA 0.2 mg/l for cotyledons was found the best for days to shoot formation, percent shoot formation and number of shoots per explant. The regenerated shoots produced roots (100%) in both the cultivars Hisar Lalima and Hisar Anmol on MS medium containing IAA 0.2 mg/l and were successfully hardened and transferred to the screen-house conditions.

Keywords: Tomato, *Lycopersicon esculentum*, explants, media combinations, regeneration

Induced Translocations Between Wheat and Rye Chromosomes for High Biomass and Other Desirable Traits

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Abstract

The rye (*Secale cereale*, 2n=14) genome has been considered as a valuable source of genetic material from the point of view to develop high yielding triticales and wheat cultivars. But due to some known and some unknown impediments, the rye genome has not been utilized to the extent of its potential. Genes for rust resistance have been transferred by Singh and Joshi (1978) through homoeologous recombination, crossing Russian rye with monosomic line 5B of Var. Pb. C591. Subsequently, Satyanarayana and Singh (1999) isolated translocations possessing several traits of rye in the genetic background var. C306. The contribution of 1B/1R translocation (an spontaneously induced translocation involving chromosome 1B of wheat and 1R chromosome of rye) is known world over which has not only protected the wheat from rust pathogen but also enhanced the yield (Rajaram *et al*., 1983). The present investigation is most relevant for the creation of the new genetic variability possessing rye traits which is the demand of the day to break the plateau of wheat yield.

In the present study, 10 different varieties of wheat were taken and crossed with three strains of rye. Crosses were attempted in all possible combinations. A total of 640 stripes were crossed and a total of 2730 crossed seeds were obtained. Crossed seeds were irradiated with a dose of 20 Kr of gamma rays. Seeds were germinated in the Petri-dishes and later transplanted in the field.

All the total 66 M_1 plants survived upto maturity. Cytological analysis at first meiotic metaphase revealed the presence of univalents, bivalents, trivalents and isochromosomes. Cytological analysis of M_1 plants at first meiotic metaphase showed a high degree of chiasma formation which ranged upto 3.6. A total of 412 spikes were backcrossed to their respective parents. Due to abnormal development of female gametes, extremely poor seed setting resulted. Very small numbers of crossed seeds (42 seeds) were obtained from backcrossed spikes. All the M_1BC_1 crossed seeds were planted in the field and data were recorded on traits like plant height, tiller number, spike length, spikelet number, and grain number per plant (Table 3). High values of these traits were observed in M_1BC_1 hybrids which got translocated in the background of varieties of hexaploid wheats from strains of rye.

All this material is at a preliminary stage of development. It needs to be stabilized and characterized.

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Improving Productivity of Water Through an Integrated Farming System Approach in Semi-arid and Subtropical Environments of Developing Countries

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Abstract

The world population is expected to grow to about 10 billion by the middle of the current century. The increase in population and subsequent rise in demand of food, fuel, energy and fodder are expected to be greater in developing countries, especially under fragile environments. Out of several factors which affect the agricultural production and productivity, water is one of the dominating factors which influence the efficiency of other inputs used in crop and animal production. Therefore, improving the productivity of water would play a pivotal role for food, fodder and fuel security for sustainable progress of agriculture. At present, agriculture alone consumes about 85% of available water resources on the Indian subcontinent. For the next ten years, the share of available water to irrigation is expected to reduce around 73% due to more demand of water for drinking and industrial purposes. Also, the per capita availability of land is going to reduce to about 0.1 ha during the same period in India. Thus, concerted efforts will have to be made to produce more and more food, fodder and other items required for feeding an ever increasing human population with less and less availability of land and water. Therefore, there is an urgent need to increase the productivity of water by using an integrated farming system approach. The integrated farming system approach is holistic in nature: The crop production is combined with horticulture, an agro-forestry system, live stock and other complementary enterprises (such as sericulture, mushroom cultivation, floriculture etc.) to generate more income and employment by improving soil health and environment. This paper reviews different location-specific models of integrated farming systems with a view of improving the productivity of water along with the efficiency of other inputs, in order to provide a sound basis for an evergreen revolution for small and marginal farmers in arid and subtropical environments of developing countries.

Agricultural Production and Trade Policies for a Sustainable Global Economic Development

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Abstract

Historically primary commodities exporting countries have tried to increase their output and to improve their foreign exchange earnings to help urgently needed economic development programs to improve the educational, nutritional and health standard of their citizens. Unfortunately this traditional strategy had consistently led to higher production cost for the small farmers, the producers of the export crops in the developing countries, and at the same time lowered the prices of the of the export commodities in the importing developed countries. Several poor countries are unable to achieve the development plan they had set and many of them are unable to lift their citizens from abject poverty. The efforts of rich developed countries to help the poor developing ones with various bilateral and multilateral technical development and financial aid programs, are on balance negative.

The standard recommendations of reviving the agriculture industries in the developing countries through better agronomic practices to increase yield and fruit quality have yielded very little to help the majority of the farmers. The traditional approaches of increasing the output of a few commodities, has also limited the potential of diversification of agricultural production for small farmers in the developing poor countries and limited the nutritional diversification of hundreds of tropical fruits and vegetables for consumers in the developed world. By encouraging the production of export crops, many governments also failed to encourage the production of other crops including local food crops, particularly in Africa, where population growth is now greater than food production since independence. Developing countries agricultural policies and subsidies geared primarily towards supply expansion of production and export quantities with very little effort in export marketing activities for other alternative crops.

The study examines the history and experience of agricultural production and trade policies of developed countries and developing countries, and draws broad conclusions and makes tentative alternative approaches for the world agricultural commodities production and trade policies for a sustainable agriculture, natural resource management to meet the global food and energy crises.

Sustainability, Global Change and Pollution-Control: Seen by Pragmatic Logics versus Bio-Political Fairy Tales

Substituting the former Dinosaurs by trees reverts global warming and climate changes

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Abstract

All carbon on earth is distributed in three forms:

- **Solid:** mainly as coal and as carbonates such as corals and coral reefs considered as "under water trees", other minerals and incorporated into all biomass.
- **Liquid:** mainly as fossil fuel under ground, and as dissolved inorganic bicarbonates in the sea.
- **Gas:** mainly as carbon dioxide in the atmosphere and as organic gases.

In each situation and any time the organic carbon is in a stationary state between photosynthesizing (CO_2 fixing, so green plants) and not photosynthesizing (only CO_2 emitting, so men and animals and microbes) organisms on earth and the sea. This stationary state is hold in a quasi stable balance by the CO_2 concentration in the atmosphere.

- **Every volume of coal and fossil fuel burnt**, produces not only the gas carbon dioxide, it also increases the total amount of this gas in the atmosphere (also called green house gas, due to its capability of absorbing the reflected heat radiation coming from the earth surface). The effect is:
- ***Global Warming, followed by climatic changes.***

There are many ways to **slow down** the global warming and therefore **retarding** the climatic changes, however **not solving** the problem at all. There exists practically **only one** procedure which is able to **stop** (increase zero) and **revert** (net decrease) the climatic changes, the global warming and the increase of the CO_2 concentration in the atmosphere:

- **Every piece of coal and every volume of fossil fuel burnt** increases in the final balance the concentration of CO_2 in the atmosphere. To take it out from there in an autocatalytic and auto regulated way is to assimilate it by photosynthetic organisms, building up biomass and coral reefs, Mangrove forests or bringing the carbon in a mineral form into the soil. Only the **non-food and non-fuel biomass** counts in the balance and the only real and powerful carbon storages are **living trees,** stored **non burnt wood** on earth and "**coral-trees**" in the sea.
- ***Each tree more on earth replaces about the carbon pool or the biomass of an ancient Dinosaur, which was transformed with its surroundings during evolution into fossil fuel.***
- ***Each molecule of CO_2 coming from coal or fossil fuel combustion has to be incorporated into the skeleton of additional trees to avoid global warming, followed by climatic changes.***

Practically this can be achieved by information and educational campaigns which stimulate the awareness of the importance of any tree, such as:

- ***Call to enter the Venerable Trees in the list of the World Natural Heritage (proposed by Jerome Hutin), reforestation projects (realized by Nobel laureate winner Wangari Maathai and in action by several other institutions), mangrove forest along coastlines (research projects by Prof P. Mohanty, Orissa India and other places) and the research in favor of the consolidation and protection of living corals and the growth of coral reefs (e.g. by M. Pecheux and other)*** *See Google for all topics.*

As being involved in all of these projects it's my desire to contribute to the sensitization of the population about the importance of the existence, the additional planting of trees and additional research about the vitality of trees and wood farming and storage. With the catalysis of a huge **network of collective intelligence,** we have a chance to cope the challenge of controlling climatic changes due to global warming.

Let's keep in mind:

The globe **EARTH without men is sustainable**; let's install sustainability in presence of Mankind.

Root ROS as Determinant of Plant Responses to P Deficiency in Pigeonpea

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Abstract

Plant roots adapt in different ways to a changing nutrient status of the soil and ability of plant roots in sensing and adapting to changes in the nutrient status of soils is vital in determining long term productivity. However, molecular mechanisms or regulatory genes involved in determining nutrient responses of plants remain to be identified. Reactive oxygen species (ROS) have been shown to play an important role in plant responses to P and K deficiency. ROS plays a significant role in many signal transduction pathways by modulating ion channel activity and other processes, but little is known about the role of root ROS especially with reference to macronutrient deficiency. The present work was carried out as a prelude to developing root ROS as diagnostic tool for determining plant and soil fertility and identify low input pigeonpea genotypes for sustainable crop production.

Plants were raised in defined nutrient media in germination paper wraps with lower end of the cylinder dipping in the nutrient solution and exposed to natural light in the screen house for about 5 h daily. The plants were supplied with 0,20 and 100% of P present in Hoagland solution. Plants were sampled 15 days after being planted in the germination paper rolls. The whole root system was stored at -20^0 C and used for various biochemical estimations. Twelve pigeonpea genotypes were screened during these studies.

All genotypes adapted to limited P availability by increasing the number of lateral roots formed, however, the level of increase varied with different genotypes. The redox balance of the roots shifted to the more oxidative side. Roots showed considerable genotypic variation in their capacity to generate ROS. However, in response to decreasing P availability, most of the genotypes showed considerable increase in generated ROS. This was reflected in 2-3 fold increase in the root aqueous and organic peroxides under low P conditions. Contrary to this, free radical scavenging activity of roots in most genotypes decreased parallely with decreasing P availability. However, it is still to be worked out whether shift in redox balance of roots is only index of P deficiency or somehow related to their P acquisition capacity.

Sustainability Aspects in Plant Nutrition and Agriculture

Christian Richter

Abstract

- Sustainable plant nutrition requires the choice of plant species and varieties being well adapted to the special regional soil conditions, e.g. concerning soil pH, salinity or nutrient status.

- Nutrient impoverishment in some regions and nutrient accumulation in other regions of the world should be prevented. Nowadays, an important export of foods and feeds from the Third World Countries to Europe leads to nutrient deficiency of soils in Africa, Asia and Latin America and, at the same time, to nutrient excess, especially by organic manure (slurry) of European soils.

- Nutrient return from the towns back to the agricultural fields should take place, but only fertilizers being free of toxic substances, e.g. heavy metals, should be applied. This requires a separate collection of residues and a recycling of dangerous elements.

- Nutrient losses by leaching in the soil profile and by erosion (soil loss as well as run off) should be diminished, e.g. by means of mixed culture, by covering the soil with plants throughout the year or by leaving plant residues on the field after the harvest.

- Crops should be provided as much as possible with nitrogen resulting from the binding of symbiontic or asymbiontic microbes' nitrogen fixation, e.g. by sowing leguminous plants or by the use of the *Azolla-Anabaena*-symbiosis, not only in wet rice systems, but also for other crops.

- As the natural resources of the world become more and more limited, natural as well as synthetic fertilizers should be applied in small quantities only. Fertilizers should be distributed equally, and not only in the rich countries of the world.

Identification of Fertility Restorer Lines in Pigeonpea {*Cajanus Cajan (L)* Millsp.} for A_2 Cytoplasm (*Cajanus scarabaeoides*) Based Male Sterility

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Abstract

Pigeonpea is the most preferred pulse crop under subsistence agriculture. The crop is widely grown in India and in African countries. Despite huge biological yield and wide variations in pigeonpea, the inherent yield of the crop is low and static. *Cajanus scarabaeoides*, a wild species, has been extensively used to develop male sterility in pigeonpea [*Cajanus Cajan (L)* Millsp.] and enhanced productivity in recent years. The first ever CGMS based commercial hybrid was released in Gujarat, India, with A_2 cytoplasm based Male Sterile line CMS GT 288 A as female parent. Genetic diversity being the most important for any successful hybrid programme, 474 lines were grown during 2005 to screen for fertility restoration of A_2 cytoplasm based male sterility. CMS GT 288 A was grown in insect proof net house to avoid any stray cross pollination and was hand pollinated with pollens from three individual plants from each 474 lines grown for screening for fertility restoration. Each plant used as male was also selfed to maintain purity of the restorers under net house conditions. The hybrids were individually harvested and grown during 2006 in insect proof net house and were evaluated for fertility restoration and autogamous seed setting. The self seed of each plant was also sown simultaneously. The hybrids varied enormously for fertility restoration on individual plant basis from 0 to 100 % with 72 hybrids out rightly evincing complete sterility indicating that their male parents did not restore fertility. Among the 247 lines that resorted fertility, the pollen fertility varied from 32 to 97 % with 102 hybrids showing more than 70 % pollen fertility. The fertility restoration of the hybrids was further verified under net house conditions and 53 hybrids showed complete autogamous seed setting with complete fertility restoration on plant basis. Thus, the male parents of these hybrids are confirmed as fertility restorers for A_2 cytoplasm background male sterility and may be used in synthesis of test hybrids with due consideration to their individual nicking ability.

Phytoextraction and Higher Biomass Potential for Sustainable Biomass Energy of Indian Mustard Plant Genotypes form Cd Contaminated Soils

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Key Words: Phytoextraction, Cadmium, Indian Mustard, biomass energy

Abstract

Phytoextraction is a green technology for sustainable remediation of surface soils contaminated with toxic heavy metals. Indian Mustard is a high biomass producing a crop having heavy metal tolerance characteristics. This biomass produced from contaminated soils would be an important source of energy in developing countries and its use is still increasing in the domestic sector and small-scale industries such as brick kiln etc in India. Moreover, it also reduces the risk of entering the food chain when used as biomass energy and also reduces the reentry of heavy metals in the agricultural field by using the byproduct in land fill and in making bricks also. Hence managed properly, biomass energy (or bio-energy) can be sustainable, environmentally benign and economically sound. Moreover, biomass energy creates substantial local employment. A pot experiment was conducted to investigate the Cd phytoextraction potential of three Indian Mustard plant genotypes, namely, RH - 819, Varuna and Rh-9304, in a light soil from sand dune areas of Balsamand, Hisar. Five levels of Cd concentration ranging from 0-120 mg kg^{-1} soil were taken for the study. The toxicity symptoms were recorded; biomass production, Cd concentration and finally the Cd uptake were measured to screen the best Cd tolerant Maize genotype. The plants were harvested at maturity. Results of the study showed that symptoms of chlorosis, yellowing and burning of lower leaves and poor growth were more prominent with the increasing level of Cd and finally a drastic reduction in dry matter yield was recorded at Cd_{60} and Cd_{90} levels. Moreover at Cd_{120} level, only genotype RH-819 was to survive with acute chlorosis, burning of leaves and producing 1.16 g pot^{-1} dry matter yield even though having highest Cd concentration 68.67 µg g^{-1}. Overall, the growth of genotype RH-819 was better as compared to the other two genotypes. The mean dry matter yield was highest (18.32 g pot^{-1}) in RH-819 followed by Varuna (14.75 g pot^{-1}) and RH-9304 (12.68 g pot^{-1}). The shoot Cd concentration significantly and progressively increased with the increasing additions of Cd. Similar to the dry matter yield, the mean Cd concentration was highest (30.94 µg g^{-1}) in shoot of RH 819. It was 4.84 % higher than Varuna and 15.96 % higher than RH-9304. The results further indicate that the mean Cd uptake by shoot was significantly more in RH-819 as compared to Varuna and RH-9304. In RH-819 it was 47.08 % higher than Varuna and 76.24 % than RH 9304. In all the three genotypes, the Cd uptake by shoot increased significantly up to Cd_{30} treatment and thereafter it decreased significantly in comparison to this level. On the basis of highest Cd uptake and biomass production, the RH-819 genotype was found to be the best accumulator among three genotypes of Indian Mustard.

Strategies for achieving for Sustainable Development in Afghanistan

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Abstract

Being predominantly an agricultural country, about 80% people in Afghanistan earn their livelihood through agriculture .The area for agriculture is about 8 million hectare. Of the 3.8 million ha arable land, around 1.2 m ha could be irrigated. The irrigation system is traditional conduits such as karej , canals and reservoirs. However, infra structure for crop and live stock production has been destroyed during last two decades due to obvious reasons. Consequently, trade and processing related activities have also hampered .This has affected food security and sustainable development in Afghanistan.

About three decades ago, Afghanistan was self sufficient for cereals and used to earn good foreign exchequer through export of dry fruits and fine quality animal wool. Rich biodiversity for fruits and vegetables, varied climatic conditions and adequate water resources in Afghanistan indicate that good progress in agriculture can be made through judicious use of natural resources and integrated management of nutrient inputs and insect pest. More than 70% of land that can be cultivated is in areas of 8 to 20 ha in size. Many small farmers have leased areas of 0.5 ha. Both he target groups require seed, pesticides and fertilizers and above all water. Viewed climatically, Afghanistan is a country with a continental climate. During the six summer months there is no rain fall. The rain fall which is concentrated in the winter months is therefore of particular importance to agriculture. Dry field farming is practised in many parts of Afghainstan. Food security issues are a matter of concern in rainfed hilly and other problematic areas.

Sustainable crop and livestock production for economically deprived populace Of Afghanistan is a pious objective for all stewards of peace and progress. Generation of appropriate agro-technology for food production, processing and value addition , transfer of technology to farmers , agricultural and nutritional interventions , reorientation of research and development activities in network mode for crop and food diversification, seed production, use of biomass and solar energy are some options to mitigate he problems associated with sustainable agricultural production for food, bio-energy and livelihood security. A multidisciplinary approach with focus on sharing knowledge and resources, capacity building, development of basic infrastructure and good extension service to sensitize local to use technology is needed for sustainable development. This paper examines some of these core issues related to food security and sustainable development in Afghanistan.

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