Summary and Recommendations of the International Symposium on 'Food Security Dilemma: Plant Health and Climate Change Issues', December 7-9, 2012, BCKV, Kalyani, India

Symposium was formally inaugurated by *Professor Asoke Sanyal*, Chairman, West Bengal Biodiversity Board, and the inaugural session chaired by the President of AAPP, *Professor Chitreshwar Sen*. In his Presidential speech, Prof. Sen emphasized on the need for such a Symposium while explaining the recommendations of the last two symposia organized by the AAPP in 2007 and 2009, respectively.

Dr Shashi Sharma, Director, Plant Biosecurity Institute, Department of Food and Agriculture, Western Australia, delivered the key-note address in this session. He gave a lucid account of food security strategies based on a long term vision extending over many generations. A short sighted approach inevitably will lead to long term intergenerational food insecurity, he said. He vividly explained a 3P strategy – Produce, Protect and Provide –as an integral part of this long term food security mission. He emphasized on biosecurity for the globalisation of the food value chain to ensure that food trade and distribution do not expose the recipient/importing regions to biosecurity risks.

Professor C.D. Mayee, Former Chairman, ASRB gave an in-depth account of the food need projections in India and made a strong recommendation for the use of genetically modified and improved varieties to meet the challenge. *Professor D.K. Bagchi*, Former President (AAPP) and Vice-Chancellor (BCKV) and *Professor Aloke K. Banerjee*, Vice-Chancellor, Kalyani University also delivered ~~a~~ brief lectures, addressing the key issues focused in the Symposium. *Professor Bagchi* encouraged the Farmer representatives present to interact vigorously with the scientists, making good use of the platform provided by the AAPP.

Professor Charudatta Digambarrao Mayee was honoured with the **First *Shasya Suraksha Mahajnani* Award – a Lifetime Achievement Award** with a Cash Prize of Rs. 25000/-, a memento, a shawl and other items, awarded for his life long dedication to the cause of Sustainable Agriculture in India.

A ***Shasya Suraksha Innovative Farmer*** **Award** with a Cash Prize of Rs. 10,000/- was given to ***Mr. Debashis Roy*** for his innovation in the development and popularization of a Trap for Rat control in Tripura.

The Symposium was attended by about 250 participants. Scientists from all parts of India, and some others from Australia, USA and Bangladesh participated.

TS 1- Critical parameters in future food security-I: Chemical use in Agriculture

Chaired by *Professor A. Raghupathy*

Two papers were presented by *Professor Raghupathy*, Dean, Agricultural College and Research Institute, Madurai, TNAU, Coimbatore and *P. K. Patanjali* of Institute of Pesticide formulation Technology (IPFT), Gurgaon.

Following points/suggestions emerged out of presentation and discussion:

- The pesticides shall continue to play major role in food production leading to food security, particularly in situations (storage pest, locusts, invasive pests, mites etc.) where other means could not be used.
- The risks involved in use of pesticides are minimized by developing new formulations and nano-formulations.
- Pesticides should be effective with low dose and less persistence which will ultimately reduces the pesticides hazards.
- Development of compounds affecting different targets like ryanodine receptor modulators, GABA gated chloride channels, uncoupling oxidative phosphorylation inhibition of ATP syntheses, intervening mitochondrial metabolic modulations etc. offer scope for judicial rotation of chemistries depriving target pest to develop resistance to pesticides.

The environment friendly water based pesticides formulations replace toxic non-degradable ingredient/adjuvant of the conventional formulations and also increases use efficiency ensuring target efficiency and reduce wastage. Nano formulations will further enhance the bioefficacy and also reduce the dose required.

It was suggested to see the possibility of developing slow release formulations of repellents for the management of rodents- like pests like squirrels in coco plantations.

Concurrent session 1: Climate change *vis-à-vis* issue of food security

Chairman of the session: *Dr. V. U. M. Rao*,
Co-Chairman: *Professor S.A. Khan*

In the lead lecture by *Professor Joyshree Roy* of Jadavpur University, the farmers' need in view of climate change was emphasized. Her work based on the six river basins in India revealed the farmers' perception on climate change. To ensure food security under changing climate, there is a need to understand farmers' response, based on which development strategies should be worked out.

Dr. G. C. Debnath of IMD delivered an invited lecture on possible impacts of climate change on agriculture and food security in India. With the help of long term weather data, he explained how the different components of climate are shifting. The IPCC projections were also discussed. Some of the strategic plans to combat the climate change, such as adjustment of cropping pattern were discussed eventually.

Dr. A. Banerjee of KVK- Howrah presented a scientific paper on incidence pattern of pod borers in pigeon pea in relation to abiotic factors in lower Indo-Gangetic plain. The dependence of pod borers on maximum temperature, minimum temperature, relative humidity was discussed in this paper.

In another lead lecture by *Dr. V. U. M. Rao*, the agricultural risk management was discussed. Due to climatic variability or recent change, the risk related to agricultural production system has been increased manifold. Moreover, in recent years the occurrence of drought, flood, and coastal salinity caused a threat to food security. The session ended with vote of thanks given by the Chairman.

Recommendations:

- Integrated farming approach should be adopted considering extreme weather events and loss of a particular crop.
- As per the farmers need, supply of assured irrigation may solve the climate related problems up to a considerable extent.
- The development strategies should be location-specific as the climate related problems are not similar. Policies on ground water must be revisited to save the natural resources.
- With the help of weather-based critical values for crop and animal production, the microlevel Agromet Advisor Service should be prepared at block level and disseminated to the farmers. In India, such services are operating in District level at present. For better understanding of our climate and weather, his slogan is "*one rain-gauge at one village*".

TS2: Possible Biotechnological interventions in field and horticultural crops: improvement for stress management

Chairman: *Professor Amita Pal*, Bose Institute, Kolkata
Co-Chairman: *Dr. P.K. Chakraborty*, Principal Scientist, Central Institute of Cotton Research, Nagpur.
One Lead lecture, two Invited lectures and one oral presentation constituted the presentation session.

In a lead lecture by *Prof Amita Pal*, Division of Plant Biology, Bose Institute, Kolkata, she explained the interaction between Mungbean Yellow Mosaic India Virus (MYMIV) with susceptible and resistant genotypes of blackgram showing genomic, transcriptomic and proteomic study. To a query by *Dr. S. Mondal* of BARC, Mumbai on which types of PR (pathogenesis related) proteins are expressed during interaction of viral proteins with the host plants, Prof Pal indicated that 109 PR proteins have been identified during compatible and incompatible reaction. These protein database are available on internet and can be utilized by any worker across the globe.

First invited lecture was delivered by *Dr. P. K. Chakraborty*, Principal Scientist, Central Institute of Cotton Research, Nagpur. He described the impact of biotechnological tools on plant pathogen research in India with special reference to cotton-pathogen interaction. To a query by *Dr. K.K. Biswas*, Principal Scientist, Division of Plant Pathology, IARI, the speaker confirmed that it was not Burewala isolates, but recombinant isolate (between Indian and Pakistani) that was dominant and were confirmed by analysis of 53 samples of north west India.

The second invited lecture was delivered by *Dr. S Bhattacharyya*, Department of Genetics, BCKV. He described the strategies for identification of superior alleles for P-deficiency tolerance from 250 Bengal Land races of rice using real time quantitative PCR analysis. He showed that marker-assisted breeding was in progress for transfer of these alleles from Gobindabhog into a susceptible cultivar, Satabdi, utilizing financial assistance from DBT, Government of India. *Prof. Amita Pal* cautioned not to transfer these alleles into another cultivar like Swarna as it also carries higher expression of a few P-homeostatic genes as shown by the speaker.

An oral presentation by *Miss A Mondal* described biochemical characterization of *Rhizoctonia solani* from rice in WB. To a query by *Dr. K.K. Biswas*, Principal Scientist,

Division of Plant Pathology, IARI, *Ms Mandal* informed that pectinase activity was linked with the degree of virulence of the pathogens.

Recommendations:

- Resistance gene (*CYR1*) derived marker will be helpful in marker assisted breeding for the development MYMV resistance Blackgram and Greengram.
- The gene responsible for pathogenesis of *X. malavacearum* has been put to use in development of cheaper detection of seed-borne pathogen of quarantine significance. The breakdown of resistance in cotton against *CLCuV* is due to recombination of Indian strain with aggressive Burewala isolates of Pakistan. He recommended ready to use diagnostic tools for detection of seven pathogens of cotton.
- Bengal land race, Gobindabhog carries three different alleles with higher expression of P-deficiency tolerance genes.

Competition papers for *Shashya Suraksha Yuba Pratibha* Award:

This Session was chaired by *Professor C.D. Mayee* with two jury members, *Dr. C. Chattopadhyay*-and *Dr Megha N. Parajulee*.

Ten lectures were delivered by promising young scientists covering the area of bio-pesticides, biocontrol, molecular markers and their utilization in developing insect and disease resistant plants, biological and molecular characterization of plant parasitic nematodes, integrated management of insects and pathogens, arsenic transporter genes in rice grains and their utilization etc.

Scholars and scientists participated from CRIJAF, Kolkata; BARC, Mumbai; IARI, New Delhi; PORS, Berhampore; NCIPM, New Delhi and BCKV, Mohanpur.

Dr. Tushar K Dutta, Scientist-I from IARI, New Delhi, received the *Shashya Suraksha Yuba–Pratibha* Award for the year 2012-13 for his presentation on 'Biological and molecular differences in host recognition of root-knot nematodes, *Meloidogyne incognita* and *M. graminicola* in tomato and rice'.

TS-3: Pest profile of field and horticultural crops vis-à-vis climate change issues & TS-6: Corporate participation in producing marketing and recycling of genetically improved varieties

These **two sessions** were combined for presentations on forenoon of 08.12.12 which was chaired by *Dr. Shashi Sharma* of Australia and co-chaired by *Dr. Mehgha N. Parajulee* of Texas A&M, USA.

One lead lecture by *Professor C.D. Mayee* and another invited lecture by *Dr. Nilashis Goshdostidar*, Bayer CropSciences Ltd were presented under TS-6. One lead lecture, two invited lectures and three oral presentations were presented under TS-3.

Recommendations:

- Success of GM technology experienced by Bt cotton growing states should serve as an indicator in decision making on acceptance of transgenics in other states.

- Since the technology development is ahead of politics, the potential technologies would definitely stake their claim overcoming the policy barriers, ~~al~~though gradually. Therefore need of the hour is to ~~be~~ have confidence with patience. Extension agents of the states should be converse in local language to promote their faster implementation.

- Climate change and its impacts are evident on insect pests and disease, alerting us on changing pest scenarios and outbreaks. However, interactions operate at field level. Therefore, strategic research segregating the impacts of climate change should be attended to through development of suitable methodologies.

- Multispecies pest situations on crops need continuous research attention for timely reorientation of pest management practices in the form of adaptive IPM for dynamically changing agro-ecosystem due to climate and other environmental changes.

Concurrent Session 3

Critical parameters in future food security - I: Water

Lead-lecture by *Prof Surajit Mallick*, BCKV and two invited lectures by *Dr. D. K. Kundu* of CRIJAF and *Dr. M. Hasan* of IARI and one oral presentation by *Dr. Susanta K. De*, BCVV.

Professor Mallick in his lead lecture gave an idea of crop specific water requirement and status of ground water of Indian states. He clearly described that population growth rate in our country is increasing by 1.8% which ultimately reduces the availability of water below critical value of 1700m^3/year/person by 2025. Ultimately, food production will be hampered due to lack of water unless necessary measures are taken immediately for higher water productivity.

Dr. D.K. Kundu of CRIJA, almost echoed the same concern of *Professor Mallick*. He gave importance on multiuse of water. Government policies on input subsidy, particularly on components of irrigation water need to be withdrawn as farmers can adopt water conserving measures for remunerative crops.

Professor S. Jha requested *Dr. Kundu* to explain how globalization or green revolution helps in enhancing water productivity. He explained rice should be cultivated only in those areas where no other option are left. We have to reduce rice area by at least 50%. He also opined in favour of collaboration with other states or even with other countries for export of water saving crops and import of water intensive ones. Dr. Jha asked whether we are in a position to follow such drastic measures? *Professor Mallick* again requested not to calculate the water productivity only in terms of economic productivity. Instead, social productivity should also be keep under consideration. *Dr. P. Dey*, ICAR told a policy decision should be considered for announcing support price of other crops (other than rice, wheat, sugarcane) or penalizing overuse of energy utilized for irrigation. *Dr. P. Patra*, BCKV also was in favour of considering support price of low water-requiring crops like potato.

Dr. M. Hasan of CPCT, IARI advocated that protected cultivation of high value crops for saving irrigation water. He also explained the zero energy protected structure suitable for vegetables and flowers even under adverse climatic conditions. *Dr. P Patra* and *Professor Mallick* asked whether light or the placement of water tank at an height of 2mt, is sufficient for zero energy, structured for protected culture. The Speaker informed that nowadays special type of plastic is available where light will not be a problem. He further asserted that even a 2kg pressure is sufficient for irrigation of the zero structured protected culture.

Dr S.K. De of BCKV informed that jute based geo-textile is efficient in increasing productivity of tomato controlling soil erosion under red & lateritic soil in comparison to coco-coir and sunhemp based geo-textiles.

Recommendations:

- Water productivity need to be increased by novel irrigation technologies, multi use of water and development of genotypes having high water use efficiency. Not only the economic productivity but also social productivity must have to be taken into consideration for calculation of water productivity.
- Micro-irrigation facilities and protected cultivation should be promoted aggressively for increasing the water productivity.

TS-4: Innovative management of fastidious entities, primarily plant viruses

This session was chaired by *Dr. S.M. Paul Khurana*, Amity University, India. Lead lecture was delivered by the Chairman himself. He emphasized on the use of advanced molecular tools like real time PCR, Immuno-capture PCR, microarray based in the detection of load and variants of viruses.

Invited lecture by *Dr. J. Tarafder* of BCKV identified emerging virus variants in important vegetables of West Bengal like Okra, Tomato, chilli etc. and dwelt on their possible management strategies.

Another invited lecture by *Dr. K. K. Biswas* of Virology division of IARI, described the diversity of *Citrus tristeza virus* (CTV). He reported that diagnostic kits, specific primers and antibody are now available for early detection.

Recommendations:

- Special emphasis should be given on detection and management of virus variants and their insect vectors emerging in groundnut, legumes and potato.
- Immediate cautions needed for *Tospoviruses* and *Ilarviruses* which have become an emerging problem
- Immediate research should be started for identification of virus variants and their epidemiology infecting vegetables or citrus.
- Care should be taken for supply of disease free planting materials of citrus.

TS 5: Soil health and crop productivity *vis-à-vis* pest management

This Session was chaired by *Professor S. K, Sanyal*, Ex-Vice Chancellor, BCKV.

Lead lecture was delivered by Co-Chairman *Dr. Pradip Dey*, Project Coordinator (STCR), ICAR. Soil-test-based site-specific nutrient management for realizing sustainable agricultural productivity was presented by the Co-Chairman, He brought out the trends of gradually emerging plant nutrient deficiencies in most of the

cultivated soils the country. He stated that the AICRP (STCR) developed model equations from soil test data after conducting verification trial and field level demonstration (FLD). The parameters of the equations can further be linked with soil maps in order to make spatial fertilizer recommendations.

Dr. Kallol Bhattacharya, BCKV, pointed out the variability of fertilizer recommendation equations in different years for the same gradient, same field, and even with the same crop - a fact which tends to limit the use of STCR equations for making fertilizer recommendations. The speaker advised conduct ion of the verification trials and adjustment of the equation thereto, as per the need, where the common general equation does *not* hold well. The Chairman suggested that the Researchers also need to consider the soil buffering capacity of nutrients while developing the equations as this plays an important role in the nutrient supply system, especially over a long-term basis. Consideration of economic assessment in SSNM analysis was also suggested.

The second paper on bioavailability of arsenic in *boro* rice irrigated through arsenic contaminated groundnut water in West Bengal was presented by *Dr. Bhattacharya*, BCKV. Through speciation study of arsenic, it was found that arsenite, the most toxic inorganic species, accumulates relatively more in grain than in straw. Therefore, the mere consideration of total arsenic loading only for assessing the given metalloid toxicity would be *incomplete* as difference in species distribution governs the *net* toxicity potency in respect of arsenic. Alarmingly high degree of maximum dietary risk of arsenic through the intake of transplanted *boro* paddy was observed.

The presentation was followed by a discussion and the Chairman pointed out the importance of 'forewarning' of the farmers' as well as the generation of the awareness as to which particular varieties the farmers may cultivate in the endemic areas so that the least amount of arsenic accumulates in the grain. The Co-Chairman informed the house about the opposite behaviour of arsenic and selenium toxicity. The mechanism as to how the humic and the fulvic acid fractions of vermi-compost and other commonly used organic manures form stable metal-chelate complexes with arsenic, and thereby render the same less accessible to plant roots in soil solution was discussed.

Recommendations:

- The AICRP (STCR) developed a software model that calculates nutrient requirement for specific crop yield target, based on the soil fertility. To obtain a good fertilizer response ratio, achievable yield target needs to be fixed from that at the lower level to the level of maximum possible yield, through the moderate yield level.

- Vermicompost was found to be a fairly satisfactory ameliorating agent that significantly reduced the concerned per cent PTWI level of arsenic through the dietary intake of rice.

Group Discussion: Major stakeholders in food security issues in India

Professor Sankar Acharya, Director, Extension Education, BCKV Chaired the Session and *Dr. Amit Roy*, Director of Research co-chaired the session. *Professor Acharya* welcomed the participants and explained about the importance of the session and expects close interaction between scientists, farm innovators in respect to food security issues. He also briefed in nut shell how climate change plays a vital role in agriculture scenario of the country.

Dr. A. Roy, felt the necessity to work in rural villages in collaboration with KVKs, NGOs and University Scientists to overcome the challenges of food security.

Seven numbers of KVKs viz. Gaya, Lohardaga, Tripura, Nimpith, Purulia, Howrah, Nadia with innovative farmers, PCs, NGOs were invited to share their experiences in the forum.

HOWRAH-KVK: *Mr. Sujoy Bera*, innovative farmer of Howrah KVK highlighted the following points in his innovation:

In spite of tremendous pressure from his home, he did not sell the cultivated land and stuck to cultivation. With the help of KVK, District line departments started vegetables, flower cultivation in 2 ha of land. He introduced low cost poly house of 5 layered UV stabilized 200 micron poly film which opened from both sides for aeration which has been technically modified by KVK. By introducing the poly house he saved vegetable saplings from attack of insects and pests and starts producing off- season vegetables. His income has increased to the tune of 50%.

Dr. Sudipta K. Mukherjee, PC, Howrah KVK supported *Mr. Bera*'s innovation in respect to low cost poly house as well as termite resistant treatment in bamboos which are being replicated in 8 villages of the district.

GAYA- KVK: *Mr. Sashi Kumar*, innovative farmer shared his views regarding bee keeping: Mr. Kumar used to do conventional paddy cultivation which did not fetch adequate return. He undertook training in KVK about bee keeping and started bee keeping in 1995 with 10 bee-hives. He tried surguja, mustard, toria, drumstick, litchi, karanj for honey production. Presently he is leading honey producer in Bihar, and

Jharkhand. He has tie up with commercial company to sell the produce and formed a company called ***"SHIVA AGRO NATURAL PRODUCTS PVT LTD".*** This helped check migration to the extent of 30%. This helped check migration to the extent of 30%.

TRIPURA- KVK: ***Mr. Debasish Roy*** *of Tripura KVK was awarded with* ***"Sashya Surakha"*** *award for his innovation of rabbit trap. He used very simple technology by using 3 ft bamboos and fine tuned it to a rabbit trap. The loss in paddy crop was minimized by using rabbit trap. Dr. L. Patel, PC, Tripura KVK disseminated the technology in 12 villages of the district.*

LOHARDAGA-KVK: *Mr. Nawal Kishore Singh*, innovative farmer of Lohardaga KVK shared his experience in the forum: Mr. *Nawal Kishore Singh*, innovative farmer of Lohardaga *KVK* shared his experience in the forum. Initially farmers were dependent on paddy cultivation in *kharif* season. By conducting training programme through *KVK*, he motivated the farmers for mono-cropping. In collaborative mode with AMA, *KVK* wheat, vegetable cultivation was initiated in *rabi* and summer. Mono-cropping has paid dividend. 200 acres of land been converted to mono-cropping. Marketing avenues were created through Kolkata, Rourkela. As part of integrated farming, 2.5 quintals milk was produced. For this commendable achievement, *Mr. Naval Kishore* was adjudged best farmer from Jharkhand by ICAR.

NIMPITH-KVK, South 24-Parganas: *Dr. N. J. Moitra*, PC, Nimpith *KVK* highlighted on landscaping, rain-water harvesting as a part of NICRA project. 2200 liters diesel was saved in 2.6 ha of land that restricted carbon emission to 1610 kg. Migration of 15000 labourers was checked. For the aforesaid achievements, Nimpith *KVK* was adjudged the best in Zone II by ICAR.

PRASARI: *Mr. Saikat* from Prasari NGO highlighted following innovations in Sundarban area viz. land shaping, water harvesting, soil salinity etc.

PURULIA- KVK: *Mr. Dayamoy Mahato*, innovative farmer explained the usage of *Parasi* leaf to control Yellow stem borer and Case Worm in Paddy. The dose of *Parasi* leaf is 150 kg/ha. There is a manifold increase of yield to 34.4 q/ha as against 26.6 q/ha in conventional practice. The technology has been disseminated by KVK to 24 adopted villages. *Mr. Mahato was rewarded by ICAR for his innovation*.

NADIA-KVK: *Mr. Swapan Mondal*, innovative farmer of Nadia KVK shared his views for vegetable seed production in large scale. *Mr. Mondal was also awarded by ICAR for his innovation of vegetable seed production. Dr. K. Goswami*, PC, Nadia-KVK emphasized that AAPP may join hands with KVK in respect to crop planning and seed production.

Professor S. Acharya, Chairman of the session expressed his heartiest congratulations to all the KVKs, NGO for their fruitful deliberation which need to be to be replicated.
Dr. A. Roy, Co-Chairman felt that all deliberations were very much effective for entrepreneurship development which will be able face threats against food securities under the present climate change.

TS7: Integrated pest management including non-pesticidal mismanagement

This Session was Chaired by *Dr. S. Maiti*, Director, Directorate for MAPRs, ICAR, Boriavi, Gujarat.

Two invited lectures were delivered by *Dr. Madhuban Gopal*, IARI, New Delhi and *Dr. Arunava Goswami*, ISI, Kolkata. Both of them discussed the potentiality of nanotechnology in pest and disease management with emphasis on safety and hazards to environment. They also claimed to have demonstrated the efficiencies and mechanism involved for the products developed (nano-particles of Oxides, sulphur) in their laboratories. They also discussed the prospects of nano-techniques for fertilizers, water and weed management.

Dr. Mansoor Alam of CMAP, Lucknow presented the use of *Bacillus, Pseudomonas, Streptomyces, Trichoderma* on disease management as well as growth promotion of medicinal plants. *Dr. MSA Mamun* shared their experience of different components of IPM strategies in Tea gardens of Bangladesh. *M.S. Sultana* also presented the success stories for disease free seed production technology of potato in Bangladesh. *Dr. M. R. Khan* of BCKV presented recent status of *Meloidogyne* species from West Bengal and distribution of *M. incognita, M. javanica* and M. *graminicola* with their crops hosts. The occurrence of *Meloidogyne* species was confirmed through morphological and molecular diagnosis. *Mr. G. Samui* of BCKV presented an idea on ecology and management of branch gall of mango.

TS-8: Novel and nuclear approaches to post harvest plant protection and food security

This Session was chaired by *Professor S.K. Mitra* of BCKV.

Dr. S.F. D'Souza, BARC, Mumbai, in his lead lecture, described the varieties and variations of pulses, oilseeds, cereals, fruits, vegetables, flowers etc. released by BARC thus taking a significant contribution in food security of our country. He also unveiled the role of radioisotope on '*sterile insect techniques*', '*sludge hygenization research irradiation*' 'increasing shelf-life of fruits like litchi' etc. Chairman exclaimed on the extended shelf life of litchi by forty days by irradiation only. Speaker informed that not only radiation rather a combination of treatment was responsible for such a long extended life. Chairman also requested the speaker for starting fruit breeding programme in their Institute.

Professor J. Kabir of BCKV recommended that irradiation before storage may increase the storage temperature i.e. instead of 2^{o}C it can be at 15^{o}C which also prevents depletion of reducing sugar.

TS9: Distribution, pricing and marketing issues relevant to crop health and food security

This Session was Chaired by *Professor Sudin K. Mukhapadhayay*.

Professor Mukhopadhyay in his lead lecture explained the importance of availability of quality food to all people and for this they must have physical access, social access and economic access to food. Our goal towards food security needs to be shifted from national to household level.

Professor S. Acharya of BCKV explored the idea of equivalence between social-entrophy and enthalpy. He described the utilization of social chaos in formation of stable and improved society with higher entrophy.

Recommendations:

Some policy instruments like increased productivity, improvement of distribution system, protection of genetic diversity and diversified crop to be adopted, suitable adaptation for climate change, etc. need to be addressed to manage food security risk enable independent food reserve and coordinated food reserve to be built-up.

Posters: A stupendous 169 papers were placed under Posters divided into two sessions. To do justice to those excellent presentations, a competition was instituted for those willing and nearly 155 of them were assessed by a team of 3 experts, *Professor A. Reghupathy, Professor S.K. Mondal* and *Dr. C. Chattopadhayay*. The adjudged presentations were :

First Award : *Amrita Banerjee, R. Dutta and S. V. Ngacha*
Molecular characterization of *Banana bunchy top virus* based on DNAR segment from Meghalaya: A new member of "Pacific-Indian Oceans" group

Second Award : *Jyothsna Yasur and Usha Rani Pathipati*
Physiological implications in certain Lepidopteran insects due to nano- silver exposure and bioaccumulation

Third Award: *B.S. Gotyal, S. Satpathy and K. Selvaraj*
Mechanism of resistance of wild jute to Bihar hairy caterpillar, *Spilosoma obliqua* Walker (Lepidoptera: Arctiidae)
All winners were given a certificate at the Plenary Session.

PLENARY SESSION

Dr. Satyabrata Maiti, Director, DMAPR, Boriavi, Gujarat and Chairman of the Plenary Session presented a brief outlook on the theme of the Symposium and pointed out that the theme has been critically described in the Symposium. He introduced the Co-Chairman and rapporteures to the House and handed over the mike to the Co-chairman of the session. *Dr. C. Chattopadhyay* expressed thanks and stated that the younger researchers were very innovative and thoughtful about research, which provided enough hope for the future.

The outcomes in the form of general recommendations are as follows:

i) Biosecurity is to be taken up in right earnest for long term food security.
ii) Integrated farming approach with assured irrigation supply need to be adopted considering extreme weather events. Location specific strategy development has been found to be a requirement. Micro-level Agromet Advisory Service at block level needs to be developed.
iii) Water productivity need to be increased by novel irrigation technologies. Multiuse of water and development of genotypes having high water-use efficiency is the need of the time. Micro-irrigation facilities and protected cultivation need to be

promoted aggressively. So far as water productivity is concerned, emphasis has to be given on social productivity.

iv) The pesticides will continue to play a major role in food production. The risks involved in its use need to be minimized by developing new formulations and nano-formulations. Environment friendly water based formulations also need to be promoted. Possibility of developing slow release formulations of repellents for rodents and squirrels need to be explored for plantation crops.

v) Marker assisted breeding for development of resistance against viral diseases especially in blackgram and green gram have been proved to be useful. The gene(s) responsible for pathogenesis can be used in development of cheaper detection techniques for seed-borne pathogens of quarantine significance.

vi) Success of GM-technology experienced by Bt-cotton growing should serve as an indicator of decision making on acceptance of transgenics.

vii) Climate change and its impacts are evident on insect-pest and diseases. Strategic researches on segregating its impact through suitable methodologies need to be promoted. Research attention for timely reorientation of pest management practices for dynamically changing agro-ecosystem need to be given with due emphasis.

viii) Use of sterile insect techniques, 'sludge hygenization through irradiation', increasing shelf-life through irradiation as is evident in litchi can well be used as post-harvest technique.

ix) For managing food insecurity risks, independent and well co-ordinated food reserve development has been suggested.

x) Learning from farmer's experiences was also very importantly considered in the symposium.