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Introduction

The Food and Agriculture Organization of the United Nations and the Government of Pakistan jointly organized a regional workshop on Integrated Pest Management in cotton in Karachi, Pakistan. The workshop discussed the status of Integrated Pest Management in different countries of the region and considered the sharing of each other's achievements. The workshop continued for four days from 25 to 28th February 1991 and was attended by delegates from eight countries, FAO officials and a large number of local Pakistani scientists. Dr. M. Rafiq Chaudhry, who has recently joined on the staff of the ICAC Secretariat as Head of the Technical information Section, acted as coordinator/organizer of the workshop on behalf of the Government of Pakistan, when he was working with the Pakistan Central Cotton Committee as Director of Research. He has produced a report on the workshop for the readers of *THE ICAC RECORDER* including the recommendations drawn on the basis of discussions of country reports and other technical papers.

FAO-PCCC Regional Workshop on Integrated Pest Management in Cotton

Minimizing the use of pesticides on cotton has attracted the interest of breeders, physiologists, agronomists, pathologists and entomologists. At the same time societal concern about environmental pollution from pesticide spraying is increasing. However, pesticides are still the major tool to increase productivity of cotton. They are used to tune the plant to produce more and more fruit and protect that fruit to maturity. Thus reasonable solutions must be found.

With the same objective, the Food and Agriculture Organization of the United Nations, in collaboration with the Pakistan Central Cotton Committee (PCCC), organized a Regional Workshop on Integrated Pest Management (IPM) in Cotton in Pakistan from 25 to 28 February, 1991. The workshop, which was held at PCCC headquarters in Karachi, was attended by delegates from China, India, Bangladesh, Thailand, Philippines and Myanmar, in addition to a large number of research scientists from Pakistan. Dr. M. J. Luke Fahr and Dr. G. Pierrard were specially invited by FAO for the

workshop. The workshop provided an opportunity to exchange experiences on IPM in cotton.

After an inaugural session on February 25 country reports were presented. Dr. M. Shafi, Director/Advisor, Federal Plant Protection Department of the Government of Pakistan, who headed a three member delegation from Pakistan, reported on the Cotton Control Act, West Pakistan Agricultural Pest Ordinance, Agricultural Pesticides Ordinance and Plant Quarantine Act in Pakistan which provide a number of regulations regarding varietal purity, cultural practices, crop rotation, date of sowing, zoning, use of pesticides, eradication of alternate host plants, in addition to post-harvest practices to check the spread of cotton pests in the country. He stressed the need to exploit all biotic and abiotic components of the agro-ecosystem so as to modify the behavior of pests to achieve economic yields. He stressed the use of selective pesticides, especially insect growth regulators so as to save natural predators. He also proposed the establishment of an Integrated Pest Management Institute in the region for developing IPM programs on cotton and other major crops of economic importance.

The country report of Bangladesh was presented by Mr. S. M. Akramuzzaman Khan who is the Deputy Director of the Plant Protection Wing of the Agriculture Extension Department, Dhaka, Bangladesh. He stated that the cotton growers in his country lacked information on economic threshold levels for various pests and the range of pesticides available, which made developing an IPM system in the country difficult. He mentioned that lately the government has started small-scale research projects on IPM at the government farms but still it will take years to extend the IPM approach to the farmer's level.

Mr. Jingyuan Xia gave a brief of the IPM system in China. He is Entomologist/Vice Chairman, Department of Plant Protection, Chinese Academy of Agricultural Sciences, Anyang, Henan Province. In China, depending upon ecology and systems engineering, different kinds of regionalized programs have been prepared and implemented in the last five years. All established IPM systems are composed of four major components: technique; information; decision making; and extension. The technique part is the major component, which includes built-in resistance of varieties, cultural control, biological control, sex pheromones, pest forecasting and system simulation modeling in addition to economic threshold levels for pesticides use. Ac-

cording to Mr. Xia, the IPM systems still need to be perfected and implemented more rigorously to avoid the 15% loss in yield which still occurs due to pest attack.

The report on the status of IPM in India was presented by Dr. A. D. Pawar, Entomologist and Joint Director, Department of Plant Protection, Quarantine and Storage, Ministry of Agriculture, Haryana. In India, where 56% of pesticides go to cotton, commercial cotton hybrids, which are usually a blend of *G. hirsutum and G. barbadense,* require at least 8-10 sprays to realize a good harvest. Of the total acreage of over 7.3 million hectares, the area under such hybrids is over 28% and is increasing every year. The interspecific hybrids need a higher number of sprays because of their longer growing period and susceptibility to jassid inherited from *G. barbadense*. In India the IPM system, as in other countries, is comprised of a number of factors. It has shown amazing results, without impairing yield, at Coimbatore in Tamil Nadu. The development of better tolerant varieties has also shown encouraging results.

Myanmar, which grows cotton on about 170,000 hectares, was represented in the workshop by Dr. U. Myo Mint, Myanmar Agriculture Service,

Yangon. *A. devastans, H. armigera and P. gossypiella* are the key pests of cotton in Myanmar. The IPM program in this country still needs a lot of work. However, it is strictly recommended to discard ratooning and destroy the cotton stalks after harvest. Pesticides are used on limited acreage, but they are becoming popular. Preservation and augmentation of natural enemies, as part of the IPM program is strongly advocated.

The country report of the Philippines was presented by Mr. Isagani Catedral who is the Executive Director of the Cotton Research Institute. He enumerated the IPM system components as close season planting; use of leaf hopper resistant varieties; cultural manipulations (dense planting, water and fertilizer management and use of trap crops); maintenance of a cotton-free period by cutting and burning cotton debris after harvest; pest monitoring; and mass rearing/release of Trichoderma for the control of *Heliothis armigera.*

Amrasca biguttula, Heliothis armigera and *Aphis gossypii* are the major pests of cotton in Thailand, which if not controlled properly cause losses of up to 70% in productivity. This was stated by the delegate from Thailand, Mr. Swang Wangboonkong, Assistant Director, Entomology and Zoology

Division, Department of Agriculture. The bollworm has developed resistance to synthetic pyrethroids due to indiscriminate use. The solution lies in adoption of an IPM system. Varieties resistant to leaf roll disease are grown on over 70% of the acreage. Trichogramma releases are also being tried. Research findings are disseminated to the farmers through agriculture extension workers, who also lay out demonstration trials independently.

Dr. Di Yuan Bo, Regional Plant Protection Officer of the FAO Regional Office in Thailand spoke on objectives of the workshop. He listed the objectives as follows:

1. To review the present situation of pest control in cotton production.

2. To exchange information on establishment/development/extension of IPM in cotton among the member countries in the region.

3. To identify the successful technologies and major problems in the implementation of IPM.

4. To strengthen the cooperation and coordination on IPM in cotton programs in cotton producing countries in the region.

Dr. S. Barbosa, IPM Officer from FAO headquarters in Rome, referred to IPM in rice in Asia and in soybeans in Latin America, which is providing economic benefits and a safer environment for millions of farmers in the countries involved. He emphasized the need to have an easy, simple and practicable IPM system for cotton so that farmers can understand and adopt techniques quickly. He preferred to start with making the fullest use of (1) Cultural control, particularly crop sanitation and planting dates and (2) Careful choice of pesticides, both in quantity and quality, to minimize risks of human intoxication and damage to natural enemies and to delay the appearance of resistance as far as possible. According to Dr. Barbosa, the IPM program would naturally develop to include thresholds, resistant varieties, pheromones, biological control and other components that developed from research.

Technical papers were presented by the local Pakistani scientists regarding their own work on IPM in cotton. They covered cultural control measures suited to the local agro-ecosystem, sex pheromones as a strategy to

control bollworms, biological control, host plant resistance, use of pesticides in IPM systems and resistance to pesticides, its mechanism and management strategies. In total, 11 papers were presented in addition to two special papers from Dr. M. J. Luke Fahr and Dr. G. Pierrard on "A Review of *Heliothis* and *Helicoopa* Host Plant Resistance in Cotton" and "Biological control in the IPM Cotton System" respectively.

Questions from the audience and discussions of the country reports and technical papers led to the formulation of recommendations on host plant resistance, cultural control, sex pheromones, biological control and safe and efficient use of pesticides. It was realized that there is a strong need to start a regional project on IPM in cotton and establish an information center to exchange latest developments on IPM in cotton through periodic publications among the countries in the region. The exchange of resistant germplasm was identified as another area where the countries in the region needed formal procedures to exchange information and seed of desired stocks.

Recommendations

a. Cultural Control

- The planting dates should be established to commensurate with increased productivity and minimized use of chemical control.
- In order to break the multiplication cycle of the pests, each country must have the crop-free period as long as possible.
- The seed to be sown should be 100% acid delinted. Seed coating with chemicals was recommended only under specific conditions of the countries.
- It was observed that left-over bolls are the major source of carry-over of pink bollworm in all countries of the region. Grazing/destruction of left-over bolls after final harvest was strictly recommended.

b. Biological Control

- The decision to spray should be based on pest scouting which should also include a count of natural enemies to determine the pest-natural enemy ratio.
- The use of selective pesticides should be preferred to conserve natural enemies.
- The farmers are usually aware of the pests and cannot identify the predators and parasites. Efforts should be made to educate farmers and extension workers to recognize natural enemies.
- A mechanism should be developed to help in identification and introduction of promising natural enemies among various countries of the region. Rearing of natural control agents should be developed for augmentation in the field.

c. Safe and Efficient Use of Pesticides

- Economic injury levels should be ascertained according to specific conditions and strictly followed.

- The pesticides to be sprayed should be selected carefully and applied in recommended dosages with an appropriate type of sprayer.
- Pesticide toxicity and effects on beneficial arthropods should be carefully studied. The member countries should be urged to observe the International Code of Conduct on the Distribution and Use of Pesticides.

d. Host Plant Resistance

- Early and fast fruiting cultivars should be used as an escape mechanism to reduce the number of sprays.
- Leaf hairiness, nectariless and high-gossypol characters should be exploited commercially to decrease dependency on pesticide usage.

e. Sex Pheromones and Forecast

- The moth catches of bollworms in sex pheromone traps give an idea of their activity. Such monitoring should be continued as far as possible. Since moth catches provide information on new generations, vigorous efforts should be made to develop the relationship between moth

catches in the traps and actual infestation in the field for each type of bollworm. Once the relationship is established, the use of pesticides can be regulated in a better way and unnecessary sprays can be avoided.

- The effectiveness of sex pheromones as a confusion technique to disrupt mating should be confirmed. The experiences of Pakistan and China, where it has been observed that sex pheromones can successfully be integrated with broad spectrum insecticides to have season-long control of bollworms, may be shared by other countries in the region.

f. General Recommendations

- A regional project on IPM in cotton should be formulated along the lines of integrated pest control in rice.
- A center should be established to exchange information on latest developments via periodic publications/news letters.
- Exchange of bio-control agents and host plant resistant cultivars should be facilitated among countries in the region.

- A working group on IPM in cotton should be established within the Asia and Pacific Plant Protection Commission for strengthening the cooperation and coordination on IPM in cotton in the region.

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Short Notes

- **Egyptian Cotton's Resistance to Verticillium Wilt Unveiled**
  Egypt produces about 30% of the world's extra-fine cotton from an area of little over 400,000 hectares. Cotton in Egypt is attacked by cotton leaf worm, *Spodoptera littoralis* and pink bollworm, *Pectinophora gossypiella.* Since 1988 serious attacks of aphids and whitefly have been noticed which adversely affected productivity. Among diseases Fusarium wilt has been the most threatening, but it has been controlled as a result of joint efforts by the breeders and pathologists.

  Egyptian cotton, *Gossypium barbadense*, has remained resistant to Verticillium wilt but the basis of its resistance was not known. A three member team from the U.S. Department of Agriculture has been working at Southern Crops Research Laboratory, College Station, Texas, to find out what confers resistance to Verticillium wilt in Egyptian *G.barbadense. It* has been concluded that it is the speed with which Egyptian *G.barbadense* plugs its own vessels and immobilizes the disease-causing pathogen *Verticillium dahliae* before it spreads throughout the plant.

Normally the plant produces four antibiotics in its own defense against the disease but desoxyhemigossypol, being soluble in water, plays an important role in checking the spreading of *Verticillium dahliae.*
(Source: *The Cotton Digest International,* Vol. 65, No.10, 1991)

- **Environmental Audits**
  It is the responsibility of everyone to protect the environment to keep this earth habitable. Apparently, the farmer's role encompasses minimum use of agrochemicals, meaningful soil conservation, reduced tillage, efficient irrigation and perhaps other practices according to specific conditions. Among all the agrochemicals, pesticides are the major threat to the environment. Since the adoption of pesticides in the agriculture sector in 1940, a lot of work has been undertaken to minimize the risk of their usage. Undoubtedly today they are less persistent in the environment, effective in small quantities and to some extent selective in nature to encourage biological measures. But their continuous use, heavy doses of fertilizers, soil erosion and excessive irrigation all run counter to environmental safety.

In the United States of America, the most progressive legislation in history, according to the National Cotton Council, has been included in the 1990 farm bill. This includes an Environmental Conservation Acreage Reserve Program, an Environmental Easement Program, Water Quality Protection Program and integrated Farm Management Option. Under the programs, environmentally-sensitive areas will be identified and the government will come into contract with growers to carry out approved farm management plans. The Environmental Easement Program even allows up to 100 percent cost sharing.

The Australian Cotton Foundation has contracted with Arbour International----a company based in England----to undertake an environmental audit of the cotton industry as a whole in Australia. Arbour International experts visited Australia in February 1991 to collect the required data through questionnaires and interviews of people in the line including growers. It is hoped that the report will be ready in July 1991. The report will isolate the problems within the industry and recommend guidelines/strategies to the growers to increase awareness and minimize the environmental impact of cotton growing. (Source: *Cotton Grower,* Spe-

cial issue, Spring 1991, and *The Australian Cotton Grower,* Vol. 12, No. 2,1991)

- **Environmental Issue in Textiles**
  In most of the developing countries, standing waste water from the coloration units of textile plants is a nuisance. In Europe waste water from the textile bleaching, dyeing, printing and finishing industry is more than a nuisance. It is feared that the cost of pollution control may increase to become a significant proportion of the production cost. Precision in the identification of impurities is tightening the safe limits of undesirable compounds in waste water. Recently a conference of textile finishers was held in Manchester, U.K., to discuss the environmental issues arising from textile manufacturing. It was observed that one of the major pollutants, the color discharged in the waste water, hides other colored and colorless compounds which maybe of even more serious concern, such as pentachlorophenol and tributylltin. It was emphasized that special attention should also be given to decreased Chemical Oxygen Demand (COD), as a 50% reduction in COD could depress the effluent charge by 40% as observed in the U.K. The formulation of plans to incorporate cost recovery, such as re-use/re-cycling of water, re-use of materials and better effluent

load management as well as using less polluting chemicals, was stressed. The problem areas identified also included the use of chromium and other heavy metals in dyeing, the use of phosphorus and nitrogenous-based compounds, the area of rotproofing and chlorine-based bleaching agents. (Source: *African Textiles,* February/March, 1991)

- **World Cotton Production During 1991/92**
  Currently world cotton production is estimated for the year 1991/92 at 91.9 million bales as against the latest production figures of 86.5 million bales for the year 1990/91. The additional production is anticipated to be contributed mainly by China (Mainland), on account of increases in the acreage under cotton. However, India is also likely to add to world supplies as the yield per unit area continues to rise. The USA, in spite of the water shortage in California and over all lower average yield prospects, may produce around 16 million bales, 500,000 bales more than in 1990/91.

  This increase in production is attributed to a 9% increase in area. However, the sowing of cotton has been affected both by heavy rains in the Memphis area and dry conditions in West Texas. Brazil is also going to

expand cotton acreage resulting in about a 600,000 bale increase in production during 1991/92.

The production of extra-fine cotton which had shown a sharp dip during 1990/91 is likely to decline further. Egypt, USSR, Sudan, Israel and Peru are going to produce less extra-long staple cotton. In Egypt a declining trend in production continues to persist due to lack of adequate price incentives to the growers. Poor demand for extra-fine cotton in the USSR has affected its production in the country. In Israel a shortage of irrigation water is going to be more severe during 1991/92 thus depressing the cotton acreage and production. In Sudan, government priorities are shifting to favor food production over cotton production. The USA and China may expand acreage under *G.barbadense* but the increase in production will not compensate the loss in production from other countries. (Source: ICAC, May 29,1991)

- **International Cotton Symposium in China**
  The Chinese Society of Cotton Sciences and the Cotton Research Institute of the Chinese Academy of Agricultural Sciences, Beijing, China, are jointly organizing an International Cotton Symposium. The symposium,

held at Beijing from 10-13th September 1991, is being organized with the objective to identify possible areas of co-operation with other cotton producing countries of the world. The symposium which will cover mainly the production aspect, will discuss inter-species hybrids to incorporate desirable traits of non-cultivated and wild species. The recent biotechnical innovations to improve genotypic potential of the cultivars in cotton will also be discussed. Interspecific incompatibility, the current status and future prospects of somatic culture, systems modeling and other important components of Integrated Pest Management will be discussed. The proceedings will be conducted and published in English. Participants are expected to pay their own expenses and pay a US$200 registration fee. For more information contact:

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