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**Session VIII: Responsible Crop Production**
**11:00 March 18, 2016**

**Mr. Allan Williams in the Chair**
**Cotton Research and Development Corporation**

**Dr. Menahem Yogev**
**The Israel Cotton Production & Marketing Board**
**"Integrated Pest Management & Insect Resistance Management in Israeli Cotton"**

IPM and IRM are a way of life in Israel. IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques, with pesticides used only as a last resort, only as needed and only against target pests. IRM consists of strategies to prevent insect populations from developing resistance to insecticides and to ensure that the resistant insect populations are less prolific than susceptible populations. IRM involves taking care to ensure that each insect population is exposed to only one class of chemicals, the use of a central monitoring system within a country or region for pest population levels, studying the influence of new insecticides on beneficial populations, and ensuring that farmers are informed.

Techniques employed in the implementation of IPM and IRM strategies include visual scouting and the use of pheromone traps to measure population levels. When scouts determine that population levels have exceeded an economic threshold (the level when crop damage exceeds the cost of control), farmers, pest control advisors and pest management committees for the affected region(s) are informed and actions taken in accordance with recommendations.

The pink bollworm is a major pest in non-biotech cotton. To confuse males seeking females, pheromone ropes (cotton ropes about 50 cm in length laced with pheromone) are placed in fields to disrupt mating. The ropes are 95% effective when 500 ropes per hectare are placed in fields at the beginning of each season, and another 500 ropes are placed in fields 50 days after the 6-leaf stage. The technique results in a reduction in insecticide use from 16.2 applications per season to 4.8 per season. The use of pheromone ropes facilitates the propagation of beneficial insects.

IPM/IRM strategies must be continuously re-evaluated and updated. The IPM and IRM strategies developed in Israel require careful implementation at proper times each year. It took several years to organize all farmers into a nation-wide system of IPM/IRM. In addition, other pests, the White Fly for instance, are controlled with different classes of chemicals than those used against boll worm, and they are applied at different times. Consequently, an all-crop, whole-farm region wide system of chemical management is highly complicated and difficult to implement.

**Dr. Francesca Mancini**
**Food and Agriculture Organization of the United Nations**
**"Sound Plant Protection Practices"**

Ensuring observance of sustainable agricultural practices is crucial to mankind because only about 1.5 billion hectares, or about 12% of the world land surface, is arable, and not much undeveloped land is available for conversion to agricultural uses. There are approximately 570 million farms worldwide, of which about 90% are family run and 80% are classified as small-scale. Approximately 70% of all surface water used by mankind is used in agriculture, and about 20% of agricultural land is irrigated.

An estimated 166 million tons of fertilizer are used each year, including 100 million tons of nitrogen (N), 38 million tons of phosphorous (P), and about 28 million tons of potassium (K).

In addition, an estimated 35 million tons of pesticide active ingredients ("pesticides" is an umbrella term referring to all plant-protection chemicals) are used each year, and the annual rate of growth was 9.8% between 2007 and 2012, according to Croplife International 2015. Cotton production accounts for about 5% of world pesticide use by value, or about $2.6 billion, according to "*Pesticides: Health, Safety and the Environment," by M.* Graham*, 2016*. By country, between 10,000 tons and 20,000 tons of insecticide active ingredients are used each year in Australia, India, Pakistan and Turkey, and about 70,000 tons are used in Brazil each year.

Cotton has made a great deal of progress since the 1970s. Cotton may have accounted for 25% of world insecticide use at one time, but cotton's share of insecticide use fell to around 18% in 2000 and is lower now. However, increases in pest pressures may result in higher insecticide use on cotton in the future, and the industry cannot become complacent. Challenges facing cotton producers include outbreaks of White Fly in Pakistan and the state of Punjab in India, sucking pests in China, boll weevil in Brazil and Mealy bug in Ethiopia and the development of resistance to insecticides in boll worm populations in India.

World agricultural policies need to be focused on intensification and efficiency in order to reestablish an environmental equilibrium while also improving efficiency in farming systems. Sound plant protection strategies include reductions in pesticide use, and reductions in both the hazards associated with agricultural production and the exposure to those hazards.

About 70% of all farmers use some form of integrated pest management strategies which can result in reductions in use of more than 75%. It is crucial to take a systems approach to pest management to prevent cycles of overuse of pesticides resulting in the development of resistance.

Highly Hazardous Pesticides (HHPs) are either not permitted or severely restricted in industrialized countries, but HHPs are still used in some developing countries, either legally or illegally.

Efforts to reduce exposure include the use of protective clothing and safe-handling techniques. However, such methods are often not effective in tropical environments because of wearer discomfort or in developing countries because of operator ignorance.

Success factors underlying the sustainable intensification of agriculture include the adoption of IPM strategies on a large scale and the availability of alternative plant protection measures other than the use of pesticides. It is necessary to invest in farmer training to enhance capacities to understand and implement successful IPM strategies, and governments must support IPM strategies by providing adequate resources for agricultural research and extension, while curtailing subsidies for the purchase of pesticides and discounting the practice of centralized pesticide procurement, which leads to overuse.

**Dr. Sebastião Barbosa**
**EMBRAPA, Campina Grande, Brazil**
**"Why so much use of Insecticides in Cotton Production?"**

The cotton boll weevil is a pernicious pest native to the Western Hemisphere that has the potential to destroy an entire crop. The boll weevil arrived in Brazil in 1983 and transformed the industry by essentially eliminating small holder production in the traditional producing states of Southern and Eastern Brazil. Only large-scale mechanized production practices are viable under Brazilian agronomic conditions with boll weevil pressure. Cotton area totaled 4 million hectares in Brazil prior to 1983, but area today is only a little more than 1 million hectares. However, yields have risen from less than 200 kilograms per hectare to approximately 1,500 kilograms per hectare.

Brazilian cotton producers apply insecticides between 20 and 40 times each season and spend approximately $1.2 billion to combat the boll weevil, and insecticides account for approximately one-third of total production costs. (Combining the data on total insecticide use on cotton reported by Mancini and Märkl, with the data provide by Barbosa indicates that between one-third and one-half of all insecticides used on cotton in the world are used in Brazil.) It is evident that Brazil is using too much insecticide and must reduce.

Non-chemical strategies of boll weevil control have been tried, including the release of sterile males into the environment, the placement of pheromone traps, and the release of parasites. However, none of these strategies is cost effective. Therefore, an integrated program of boll weevil control is needed in Brazil. Such a program would include cultural control, chemical control and biological controls. Cultural controls include strategies such as planting short-season cultivars to get cotton off fields before damage can occur, enforcement of mandatory plow-down and first-plant dates, and ensuring total stalk destruction at the end of each season. Chemical controls must be managed to reduce the development of resistance by minimizing applications until economic thresholds are breeched and population suppression across entire regions is achieved. EMBRAPA is facilitating the growth of populations of natural enemies of the boll weevil, while also engaging in research to identify biotech solutions that may result in cotton cultivars resistant to the boll weevil in the next ten years. When such biotech solutions are developed, the technology will be shared with other countries.

**Dr. Martin Märkl**
**Bayer Crop Science Monheim, Germany**
**"Bayer's View on Crop Protection in Cotton."**

Global spending on insecticides used in cotton production totaled $1.72 billion in 2014, and spending on insecticides by cotton farmers fell by 10% in 2015. Cotton is the 4th largest insecticide market by crop, following fruit and vegetables, soybeans, and rice. Three-fourths of world insecticide use on cotton occurs in Brazil, India, China, USA and Pakistan. Modern, selective chemistry [calcineurin inhibitors (CNIs), insect growth regulators (IGRs), Diamides] dominate the cotton insecticide market. However, low cost organophosphate and carbamate chemicals are still widely used. Crop protection chemicals account for 10% of total cotton production costs, higher than the 4%-average for other broad-acre crops.

Integrated crop solutions provide IPM/IRM-compatible tools to farmers to meet the challenges of pest pressure sustainably. Integrated crop solutions must reduce yield losses while also providing for operator and environmental safety. Bayer is developing pest management cross-technology strategies that combine seed traits with biological controls and the use of small-molecule chemical tools.

The cross-technology approach for sustainable, season-long pest control in cotton divides the cotton season into five “windows” of approximately 30 days each. During the first window from planting to 10 days post-emergence, pest control is provided by seed treatments. During the second through the fourth windows lasting from 10 days post-emergence to 100 days post-emergence, pest control is provided by a combination of seed traits and small-molecule applications. During the fifth window ending with harvest, seed traits and biological controls are utilized.

**Damien Sanfillippo**
**BCI, Geneva, Switzerland**
**“BCI’s Approach to Crop Protection.”**

BCI exists to make world cotton production more efficient through optimization of input use, adherence to social standards, and increases in yields and quality. Cotton produced within BCI accounted for 2 million tons, or 12% of world cotton production in 2015, up from 8% in 2014.

The use of crop protection chemicals (pesticides) is a major sustainability issue that BCI seeks to address by encouraging a reduction in the use of such chemicals through a strong focus on IPM. BCI has determined that setting standards for reductions in pesticide applications is easy; the challenge is farmer adoption. Over-dependency on plant protection chemicals is the norm because farmers often lack knowledge of IPM techniques, they become impatient when confronted with the threat of crop losses, and because chemicals are simple to use. BCI works to identify good tools and practices that are locally relevant and to train and support small holders in the use of such best practices.

BCI encourages the implementation of IPM techniques by requiring farmers to record their input use by name, concentration, and volume of chemical used, and by providing information on chemical use by comparison farmers. Data from China, India, Mali, Mozambique, Pakistan, Tajikistan and Turkey indicate that profitability among BCI farmers increases by between 14% and 65% over comparison farmers.

Next steps for BCI will include using an indicator of toxic load, not just kilograms of active ingredient per hectare, as a measure of improvement.

**Christoph Kaut**
**Aid by Trade Foundation/Cotton made in Africa**
**Hamburg, Germany**
**“Cotton Crop Protection by Local Means.”**

Cotton made in Africa (CmiA) works to reduce health risks for farmers, reduce toxicity for the environment, and to improve farmer’s profits by reducing input use while protecting yields.

Crop protection strategies include teaching good agricultural practices (GAP) and encouraging the use of natural methods of insect control such as molasses traps and natural fertilizers for healthy plants. CmiA teaches simple pest scouting techniques and botanical control methods, with chemical controls used only as a last resort.

Teaching good agricultural practices results in reduced pesticide use, but continuous training is needed. Techniques for teaching farmers to scout for pests and to apply control methods only as needed have been developed and are ready for use by small holders. The use of natural fertilizers, molasses traps and botanical pesticides can improve profitability, but lack of access to cow urine and molasses, cultural barriers and increased labor requirements inhibit adoption of some of these techniques.

A single boll worm moth laying 400 eggs can lead to a yield loss of 3 kilograms. Each molasses trap can catch up to 155 moths per week, for a potential yield savings of 465 kilograms. The use of cow urine as a foliar fertilizer can result in yield gains of about 5% over comparison plots. CmiA is implementing aspects of improved plant protection techniques in 9 countries beginning in 2016.

When developing botanical pesticides, CmiA is experimenting with plants grown in targeted areas. Neem has been proven effective as a botanical control but is not always grown in each area. Biological pest controls are tested for impacts on beneficial insects and human toxicity. Biopesticides can be as dangerous as synthetic pesticides, depending on dosage and exposure, and researchers need to find a balance between toxicity and efficacy. Farmers participating in CmiA are taught that pesticides don't need to kill everything in a field, only the targeted pest.

**Cotton: Dangerous and Destructive?**

Members of the audience noted that cotton is often criticized by NGOs and retailers. Among other allegations, it is claimed that cotton accounts for 25% of world pesticide use and either 20,000 or 40,000 deaths per year due to acute pesticide poisoning.

**Dr. Mancini** repeated that the cotton industry may have accounted for 25% of insecticide use (not pesticide use) several decades ago, but that cotton has demonstrated tremendous progress and now accounts for about 5% of total pesticide use and less than 18% of world insecticide use. Nevertheless, she emphasized that the industry cannot be complacent.

She said there are no data on prompt deaths attributable to chemical use for any crop. The World Health Organization (WHO) estimates that there are 400,000 deaths per year from exposure to all pesticides, and there are certainly additional cases of injury that go unreported. Certain chemicals are not appropriate for use in some countries because safe handling practices are rarely followed.

**Dr. Barbosa** noted that the number of people in rural areas living near cotton fields is much fewer, and pesticides are lower in toxicity, than decades ago. Consequently, human injuries due to pesticide exposure are less than they used to be.

**Mr. Kaut** noted that spinners and consumers have little understanding of good agricultural practices. Nevertheless, consumers are interested in pesticide use and adherence to social conditions, especially child labor.

**Dr. Märkl** said that the cotton industry should be more proactive in dealing with criticism. He said that there is a clear need to generate more data in order to provide answers to specific allegations.

**The Chair thanked members of the panel for their contributions.**