MEETING

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INTERDISCIPLINARY AND AREAWIDE INTEGRATED PEST MANAGEMENT

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Promotion of Areawide Pest Management in Israel

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The new concept of Areawide Pest Management (APM) attempts to overcome deficiencies of commodity-based Integrated Pest Management (IPM). Under commodity-focused IPM, pests of high potential risk are often controlled with non-selective compounds, impeding full-fledged adoption of IPM elements. APM, addressing much larger spatial dimensions and affecting systematically numerous pest generations, can devise more selective control practices and therefore promote successfully a more selective pest control policy. Thus, pest control strategies which are especially effective under lower pest populations, such as disruption of communication among adult males and females through release of pheromones, or heavy reliance on natural enemies, could be accommodated easier in APM systems. APM integrates a wide array of various pest control means against multiple pests, on crops and in fields on larger areas. The approach is especially effective against migratory pests, where pest multiplication foci can be identified and treated.

To date APM is being promoted in Israel in five projects: (i) 'Pest-free Arava' established in 1990, addresses the problem of severe regional infestation of melon and pepper by viral diseases through village-level sanitation programs; (ii) APM in the Bet She'an–Gilboa region was launched in 1996 and covers an area of 12,000 ha, encompassing field and vegetable crops and, more recently, date palms, mango and citrus groves. The pest control policy devised by the project is successfully monitored and adjusted through the adoption of an Integrated Resistance Management (IRM) component; (iii) Regional sweetpotato whitefly control in the Golan Heights addresses the problem of direct damages inflicted by whitefly populations to processing tomato and cucurbits, and of the severe infestation with viral diseases vectored by the sweetpotato whitefly. The project relies on monitoring with the aid of susceptible host plants and yellow sticky boards and coordinated aerial spraying when necessary; (iv) APM of field and vegetable crops in western Galilee was applied in 1998 over 10,000 ha grown by collective farms (kibbutzim). The project relies on a multi-crop and pest control policy, pest and resistance monitoring; (v) APM of field and vegetable crops in the northwestern Negev is being initiated in 1998. The project covers two family farm villages (Yuval, Yated) in the Besor region, and focuses on greenhouse flower and vegetable crops, as well as the whole Ma'on region consisting of 13 collective farms specializing in the production of cotton, wheat, groundnuts, potato and carrots over an area of 6,000 ha. The project implements an accepted pest control policy by both of its rural settlement form components, and applies APM, *inter alia*, for the first time under the special environment of family farms: smallholdings and heterogeneous cropping conditions.

‘Clean Arava’ Areawide Integrated Pest Management Project

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The ‘Clean Arava’ Areawide Integrated Pest Management Project was launched in 1990, covering the whole Arava Valley which spans from the Dead Sea in the north to the Red Sea in the south along a strip of 180 km. The project’s main components are self-imposed phytosanitary practices and the installation of a crop-free period, which could prevent the oversummering and subsequent outbreaks of viral epidemics on melon and pepper. Further, the crop-free period ensures low levels of most of the pest populations at the beginning of the new growing season of vegetable crops. In practice, all annual vegetable crops are to be terminated and their vegetal material removed from the fields at one given date, accepted by all growers, in or around late June. The fields are to be maintained free of any vegetation, crops, volunteer plants and weeds for a period of at least 25 days. Concomitantly, perennial crops have to be watched carefully for major pests or diseases and the latter controlled whenever necessary. The new growing season in autumn will begin on a synchronized date, in late July.

The project implies the adoption of Integrated Pest Management (IPM) practices as a vehicle for a reduction in the amount of pesticides used in the area. To support the IPM program, gaps in know-how are continuously identified, a vast field experimentation and research program was developed, and farmers were trained. The promotion of rational pest control was achieved by the training and employment of pest scouts, supervised by the regional extension crop protection specialist. Quarantine pests impeding the export of crops such as the Mediterranean fruit fly *(Ceratitis capitata)* and the blue mold (*Peronospora tabacina*), were closely monitored within the framework of the project. The eradication of the Mediterranean fruit fly is underway through the adoption of the sterile male technique. Areawide ecological practices were adopted, such as recycling of agricultural wastes and garbage, and regional disposal sites of farm chemicals.

Needs and Pitfalls in Pesticide Usage in the Framework of the Western Galilee Areawide Intercrop Integrated Pest Management Project

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Proper pesticide usage in the various field crops of an area entails a rational mixture of chemical and non-chemical pest control practices. These practices take into account two major factors–the actual pest control needs of all the various field crops grown in the region, and a strategic attempt to reduce the overall amount of pesticides used and to alternate their application. This strategy is aimed at both the reduction of environmental damage caused by pesticides, and at the prevention of resistance developing in pests toward pesticides essential for their control. In the particular case of Western Galilee these factors are of greater significance than elsewhere, since the region sustains an intensive agricultural production pattern; the region is highly heterogeneous in the size of the plots, which are often in the vicinity of fish ponds, and situated in the midst of dense rural and urban populations. Obviously, these conditions are especially restrictive as to the use of chemical pest control. Furthermore, the area produces a very wide array of crops. The keyword for successful crop production and prevention of crop losses under this complex setting is a high level of technical coordination among all active growers involved in the production of all crops in the area. This is not an easy challenge since growers come from different settlement types and organizational patterns: collective farms (kibbutzim), cooperative family farms (moshavim) and private farms. These different farming structures do not share much in common in terms of joint frameworks for discussion and decision-making. The urgent need for technical coordination necessitated the establishment of a

clearinghouse for regional collaboration bringing together the following bodies: regional field crop growers' association; regional commodity processing industry; and state and regional crop production and protection extension specialists under the aegis of the Western Galilee regional extension office. The first step in this cooperative effort was the establishment in 1997 of an Areawide Intercrop Integrated Pest Management Project. Assisted by the Department of Crop Protection in the Extension Service, the project worked out a regional pest management strategy encompassing all field crops in the area and their respective pest and pest control problems. Since early 1998, the regional project committee, consisting of extension specialists, pest scouts and growers' representatives, has convened on a fortnightly basis, discussing current pest control problems in light of the annual strategy and disseminating pest control information and recommendations to the growers in the area. Pest traps were set up on several sites in the area in order to follow pest movement and populations. The relevancy of the pest control strategy is assessed through regular seasonal pest resistance monitoring. The project is supported by a state-level steering committee and by frequent visits of experienced state crop protection extension specialists and regional specialists from neighboring areas.

The Arava Medfly Eradication Project (AMEP), a Pilot for the EASTMED Project

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The EASTMED project was planned and conceived in 1994 and 1995 by experts from the Middle East and the International Atomic Energy Agency (IAEA), with the goal of eradicating the Mediterranean fruit fly, *Ceratitis capitata* Wied. from the region. The AMEP is a pilot project for the EASTMED as well as an independent attempt to eradicate the medfly from the Arava Valley, which stretches from the Dead Sea to the Red Sea. A detailed working plan for a 3.5-year AMEP was developed in 1996 and financial support was secured from both local and international sources. During the pre-eradication phase, we trained field personnel, invited experts to the region, established a monitoring network of the medfly population, located sources for the purchase of sterile flies (Madeira), and established the rearing and release facility in the Arava (Sappir Center). We also acquired a specially constructed aerial release machine capable of chilling adults and releasing them at a pre-determined density. Prior to the releases we reduced the native medfly population by insecticide application in rural areas, and by mass-trapping in the city of Elat. Sterile male releases began in January 1997, are carried out twice weekly at a rate of 3 million males per release, and are slated to continue until April 1999. We have already observed a reduction in the native population due to the releases. The months of June–July 1998 will prove critical for the evaluation of success. If the project proves to be successful, the Arava will be declared medfly-free by the end of 1999, and the project will proceed to the west and the north. The Arava R&D, the Plant Protection and Inspection Services, and the IAEA participate actively in the project.

Areawide Intercrop Integrated Pest Management in the Bet She'an–Gilboa Area

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Established in 1994, the Bet She'an–Gilboa Areawide Intercrop Integrated Pest Management Project addresses the promotion of supervised and rational pest control policies over all field and vegetable crops in the area and their respective major pests. The project covers an area of 12,000 ha. The main operational components of the project are: (*a*) formulating a regional pest control policy, (*b*) establishing a pest scouting system, (*c*) establishing an insect resistance monitoring laboratory, (*d*) setting up 20 atmospheric pesticide monitoring stations, (*e*) setting up ten trapping stations for the key pests of the area, (*f*) launching a weekly meetings routine, bringing together

pest scouts, extension specialists, and resistance laboratory personnel to discuss monitoring findings and formulate pest control policy and recommendations for the forthcoming week, (*g*) disseminating findings and recommendations to all project members and beneficiaries. The newly devised pest control policy is aimed at creating awareness of rational pest control among growers, reducing the amount of pesticides used, safeguarding effective pesticides against resistance buildup, protecting public health and the environment and reducing crop production costs. The project is run on a voluntary basis. Consequently, growers are expected to provide local pest scouting and contribute US$ 3/ha/year to cover all regional activities. The project encompasses all field crops, indoor and outdoor vegetable crops, herbs and spices, citrus groves, mango and date palms. It is managed by the author, who is the regional crop protection extension specialist who acts as its technical coordinator; the growers' association secretary, who acts as organizational coordinator; and the director of the pest resistance laboratory. A state-level steering committee, chaired by the director of the Crop Protection Department in the Extension Service, oversees the project's performance.

Areawide Insecticide Resistance Management (IRM) Strategies in Cotton Fields

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Cotton production is associated with many species of arthropod pests; hence, many pesticide treatments are applied during the season to cotton fields worldwide. As a consequence, resistance to insecticides has evolved in cotton pests. To combat resistance, several programs have been developed in various parts of the world.

An IRM strategy was implemented in the 1983/84 season in Australia, in response to the appearance of *Helicoverpa armigera* resistance to pyrethroids. This strategy was based on the rotation of insecticides with different modes of action during the period of a pest generation, and use of ovicide/larvicide mixtures. According to pest occurrence and insecticide groups, the season was divided into three stages (windows). The pyrethroid window was set in the middle of the season at 42 days (*ca* one field generation). Within a few seasons the strategy had to be modified as a result of development of an alternative resistance mechanism toward the insecticide mixtures in *H. armigera*. Nonetheless, the Australian strategy was able to 'buy time', enabling the introduction of new technology such as novel insecticides and synergists, a test kit for identifying the resistant *Helicoverpa* species *(H. armigera*), and transgenic Bt-cotton seeds. Other tactics were also applied, such as non-cotton refuge crops (sorghum or corn), and pupae destruction by cultivation after harvest.

The Israeli cotton IPM–IRM strategy, introduced in 1987, has adopted the window idea (rotation scheme in particular periods) from the Australian program, but applied it to other pests. The Israeli strategy is focused primarily on controlling *Bemisia tabaci* and other cotton pests with novel insecticides, especially insect growth regulators (IGR) such as pyriproxyfen and buprofezin for controlling the whitefly, and benzoylphenyl ureas for controlling leaf- and bollworms. The strategy utilizes alternative control measures such as sex pheromone disruption and natural enemy encouragement, along with insecticides. Based on the cotton IPM–IRM strategy, various programs are being developed and implemented in three regions in Israel: Bet She'an, western Galilee, and the western Negev.

A whitefly resistance crisis in Arizona, USA, in 1995 promoted the formulation and implementation of an IRM strategy in 1996. Based on the Israeli experience, the IGRs pyriproxyfen and buprofezin were introduced into the Arizona cotton through emergency registration, and restricted to a single application of each per season. The use of synergized pyrethroid insecticides was delayed until late in the cotton-growing season. Implementation of this strategy was able to control effectively the whitefly and also reduced its resistance to various conventional insecticides.

The three examples described above are considered successful national cotton strategies. They encourage an exchange of ideas and procedures and resulted in delay of resistance in major insect pests.

The Pest-Monitoring Laboratory Supporting Integrated Pest Management in the Bet She'an–Gilboa Region

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The discovery of DDT and similar insecticides constituted a major breakthrough in pest control since they were fast-acting, economical, and easy to use; moreover, they had long-range effects and were relatively non-toxic to human beings. After extended use of DDT, ecological and health problems became apparent, along with pest resistance to these pesticides. To overcome this, new insecticides were developed, mostly organophosphates and carbamates. They were effective, but toxic to warmblooded animals; also, soon, pests developed resistance against them.

When a grower notices that a specific pesticide does not have the desired effect, he blames the product, the sprayer, etc., and often does not perceive that the problem is caused by resistance. Real-time identification of incipient resistance can contribute to long-term usage of pesticides. From this aspect, it is obvious that the pest-resistance-monitoring lab plays an important role in policy-making regarding correct and sophisticated pesticide use.

Resistance monitoring is done by three bioassay methods:

i Topical application: Direct application of the pesticide on the insect, *e.g.* the larva.

ii Application of the pesticide to the inner walls of a scintillation vial and introduction of the insect into the dry vial for 24 h.

iii Treating a sample plant with different dilutions of the pesticide; the leaves are dried and the pest placed on them.

Example: One of the most effective pesticides used against the whitefly (*Bemisia tabaci*) is Tiger (pyriproxyfen). In spite of clearcut recommendations to use it only once in a season, a grower used it twice. Lab work showed a dramatic increase of 100 times the usual resistance. In the following year the misuse was not repeated and resistance returned to former levels.

The lab provides assistance also in areas outside Israel. Laboratories in Jordan and Egypt have been contacted and we plan to contact the Palestinian Authority when they will have their own lab. This activity, partially funded by the U.S. government, is in its initial stages.