Proposed Strategies in Integrated Pest Management in the Gap Region of Turkey

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ABSTRACT

Most of the cotton in Turkey has traditionally been produced in the Cukurova and Ege regions. However, increasing irrigation possibilities in Southeast Anatolia have enlarged cotton-producing areas in this region to equal those of Ege and Cukurova. It is suggested that after completion of GAP, an important irrigation project now under construction, cotton-producing areas will increase even more. Today there are few plant protection problems in cotton in the GAP region. The increase in cotton growing areas has not resulted in greater pesticide use. However, an increase in plant protection problems caused by several factors, including misapplication of pesticides and environmental changes, is expected. Farmers in the GAP region, like other farmers in Turkey, tend to use pesticides even when they are not required. Integrated pest management will help keep the use of pesticides to a minimum. In this context, some measures to prevent plant protection problems in cotton in the GAP region are suggested: Introduce crop cultivars resistant to common pests; use irrigation and fertilizer in optimal amounts; do not repeat mistakes made in Cukurova (such as the excessive use of pesticides); improve alternative plant protection techniques against important pests such as pink bollworm and employ visual techniques for farmer training.

Introduction

The Southeast Anatolia Region, located between the Antitaurus Mountains and the border of Syria and Iraq, is one of the seven geographical regions of Turkey. Its crop pattern is determined by its steppe climate with almost no rain between June and September. However, cotton production in the region has a long history because of large rivers such as the Tigris and Euphrates. Since the 1970's, cotton-growing areas in the region have expanded rapidly due to increased irrigation opportunities (Figure 1).

The Southeast Anatolian Project (GAP: Guneydogu Anadolu Projesi), an important integrated irrigation project in Southeast Anatolia, has brought changes not only in cultural, agricultural, social, economic and industrial areas but also in the region's name. Now, the Southeast Anatolian Region is called the GAP region. In this region, after completion of all irrigation projects, about 1.7 million ha out of approximately 3 million ha of arable area will be irrigated (DSI, 1988). It is expected that cotton growing areas will increase from 1.43 % of irrigated areas before GAP to 35.85 % (Gencer, 1988). However, in completed parts of project, it has been observed that cotton is grown at larger areas (85 %) than initially proposed. This trend had previously been seen at Devegecidi Irrigation Project (Tarakli, 1987) and in the Cukurova region (Mart, 1993) when large-scale irrigation was introduced there.

Significant changes in cotton agroecosystem caused by rapid increases in the cotton areas are unavoidable. Uygur *et al.* (1995) observed that he number of the insect species decreased while populations of some insect species increased in irrigated areas compared to non-irrigated areas. It is anticipated that plant protection problems will become more complex in the region. The aim of this paper is to summarize current pest problems and current control methods and make suggestions for implementation of better IPM in the region.

Current Pests and Control Methods

Plant protection problems in the GAP region were discussed at a symposium held in Sanliurfa on 27-29 April 1995 (Anon., 1995c). Thirty-eight harmful mite and insect species were identified in cotton fields in the GAP region (Uygun *et al.*, 1995). The main species are shown in Table 1. Among these species *T. tabaci* at early stages of cotton and *A. gossypii, T. urticae* and *Helicoverpa* spp. in later stages are the most important species (Karaat *et al.*, 1987).

As a result of continuous cotton production, (i.e. lack of rotation) diseases have gained in importance in cotton areas. Damping-off caused by *Alternaria* spp., *Fusarium* spp. and *Rhizoctonia solani* Kuhn., angular leaf spot of cotton caused by *Xanthomonas campestris* pv. *malvacearum* (Smith) Dye, and wilt caused by *Verticillium dahliae* Kleb. have become the most common and severe diseases in the region (Sagir *et al.*, 1995).

The most important weed species in the region are *Sorghum halepense* (L.) Pers., *Amaranthus* spp., *Cynodon dactylon* (L.) Pers., *Xanthium strumarium* L., *Solanum nigrum* L. and *Convolvulus arvensis* L. at

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early seedling stage of cotton and *S. halepense*, *C. dactylon*, *Portulaca oleracea* L. and *C. arvensis* at boll stage (Uludag and Katkat, 1991).

There region is rich in beneficial insect fauna with a balance between harmful and beneficial insects and mites (Karaat *et al.*, 1986). This natural balance found in GAP cotton areas in the region has not been destroyed and, along with climate, prevents harmful insects from spreading throughout the region and increasing in numbers. Because of this, the increase in cotton growing areas has not yet been paralleled by greater pesticide use (Figure 2).

The use of pesticides for disease and weed control is presented table 2. Chloroneb 200 g ai/100 kg seed and PCNB 45 g/100 kg seed have been used against damping-off, and mancozeb 900 g/100 kg seed and TCTBM 168 g/100 kg seed against angular leaf spot of cotton (Akkaya, 1996; KKGM, 1995). The area sprayed for weed control has been increasing slightly as a percentage of the total cotton area. Trifluralin, incorporated pre-sowing, and post emergence grass herbicides for *S. halepense*, are the main herbicides.

Research on plant protection has been conducted in the region and farmers have used the results. IPM-related research commenced in the 1980's. Identification of harmful and beneficial fauna in cotton areas by Karaat and Goven (1983) can be considered a beginning of IPM research in the region. As a result of their research, Karaat *et al.* (1992) developed an IPM system for insect and mite control in cotton based on conservation of beneficial fauna, promoting natural balance and continuous monitoring.

Between 1991 and 1995, a national cotton IPM project developed, with the aim of collecting data for implementation of an IPM program. It included basic research on all pests (Anon., 1995a). A second phase of the project has continued since 1996. This includes implementation, training and research (Anon., 1995b) with sub-projects (Anon., 1996) specifically for the GAP region.

Discussion and Suggestions

No significant pest problems have been experienced in the region and the increase in cotton growing areas has not been accompanied by an increase in pesticide use. However, a study in the region has shown that to 90 % of farmers, plant protection meant chemical application and the same percentage was not aware of biological control. (Yucel *et al.*, 1995). There is a natural balance among insect pests in the region that should be conserved and farmers should be made aware of the importance of beneficial fauna. Visual techniques illustrating how beneficial organisms work and means of identification should be used for farmer training. Visits to farmers who are already aware of beneficial organisms and who implement their knowledge would benefit other farmers. Training in the field on identification of pests and beneficial organisms, sampling and application methods should be an important element of IPM.

Another human factor in the region is the influence of contracted farmers from the Cukurova region. These farmers play two roles: they produce cotton using their own methods and influence farmer practices in the GAP region. After almost half a century's experience in cotton growing and irrigated farming, 40% of Cukurova farmers apply pesticides, even when there is no pest problem, 40% apply pesticides at higher rates than recommended, and 50% do not take thresholds into account (Mart, 1993). For successful IPM in the GAP region, the influence of these Cukurova farmers should be counteracted. Demonstration plots should be employed to show how recommendations from extension services are better than their traditional ways. Since only a third of farmers are advised by extension services in both regions (Yucel *et al.*, 1995; Mart, 1993), the suggestions of Yilmaz *et al.* (1995) that it is necessary to establish phytoclinics as a kind of controlled consultant system, in order to prevent irrational chemical control are supported. It has also been observed that farmers apply pesticides at incorrect times and dispense incorrect volumes with poor equipment and nozzles. These are tools for efficient control and can reduce environmental impact of pesticides. Research and training on this subject are needed.

Diseases in cotton fields are a limiting factor. Wilt is an important disease in the GAP region. Although some cotton cultivars sown in the region are resistant or tolerant (Sagir and Tatli, 1995), lack of rotation may cause sensitivity in these cultivars over time. Continuous effort is needed to breed new cultivars. Furthermore, a breeding program should be initiated to improve multi-adversity resistant cultivars (El-Zik and Thaxton, 1989) which are resistant to the harmful organisms and abiotic factors such as drought, have higher yield potentials, and better fiber qualities. Currently, genetically engineered cultivars such as Bt cotton for the control of lepidopterous insect pests are not being recommended because of current lower insect pressure. Genetically engineered cultivars for weed control are not recommended because hand hoeing and inter-row tillage are still cost effective and efficient means for weed control in the region. However, research on genetically engineered crops should be conducted. We also recommend that rules for registration and use of genetically engineered crops be set up immediately for the whole country.

In addition to genetically engineered crops, new techniques should be the subject of research for future problems. For example, pink bollworm (*Pectinophora gossypiella* (Saund.)) is spread in cotton seed and farmers use seeds from different sources instead of using registered clean seed. Mating disruption with artificial pheromones is known to be a successful technique for pink bollworm control. Applicability of such techniques in the region should be investigated.

Simulation models for forecasting and decision making are needed for IPM programs. Models can be developed using data collected already, especially for insects. Forecasting models using soil seedbank and environmental data can be prepared for weeds, but there is great need for more research in this area. For example, trifluralin use for weed control has caused an increase in weeds such as *Physalis alkekengi* L., *X. strumarium* and *S. nigrum* that are not in the control range of trifluralin. Since this herbicide is inexpensive, its use has been increasing. Research is still needed on population dynamics of pests and beneficial organisms, thresholds, critical periods and competition.

IPM should not be considered different from integrated agricultural production (Boller *et al.*, 1998). Monoculture systems affect pests and beneficial organisms as well as yield and soil. An ecologically sound and cost effective crop pattern will increase yield, conserve the environment and reduce pest pressure. Biological balance loses stability when species diversity decreases. This, in turn, can lead an outbreak of crop adapted pests. Irrigated agriculture causes a rise in basic inputs such as fertilizer and water because farmers associate these inputs with yield increase. Excessive use of inputs causes soil and pest problems, especially diseases. Farmers should be trained in optimal use of inputs and the relationships between inputs and pests should be investigated. Seeds should be clean to prevent the introduction and spread of pests and farmers should be encouraged to use only registered, delinted seeds.

Without supportive policies, an IPM program may not be implemented successfully. For the GAP region, the government has applied aerial ultra-low-volume insecticides against sunnpest (Eurygaster integriceps Put.). Unfortunately, the application area has been increasing year by year (Simsek *et al.*, 1996). This treatment program could affect the natural balance throughout the region, not only in cereal areas. New techniques and systems should be employed for sunnpest control to achieve targets. The Agricultural Ministry should continue to support IPM-related research activities and IPM implementation. In addition, well-trained technical staff should be appointed to the region. Farmer support should be determined by the goals of IPM.

It should be emphasized that there is a natural balance in the region that should be conserved. It is fundamental that conserving the current balance is easier than fixing a destroyed system.

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Table 1. Main harmful insect and mite species in the GAP region.

ORDER	FAMILY	SPECIES
Acarina	Tetranychidae	Tetranychus urticae Koch.
Homoptera	Aphididae	Aphis gossypii Glov.
	Aleyrodidae	Bemisia tabaci Genn.
	Cicadellidae	Asymmetrasca decedens (P.)
		Empoasca decipiens Paoli.
Heteroptera	Miridae	Exolygus pratensis (L.)
		E. rugulipensis Scopp.
Thysanoptera	Thripidae	Thrips tabaci L.
Lepidoptera	Noctuidae	Helicoverpa armigera Hbn.
		Heliothis peltigera Schiff.
		Spodoptera exigua (Hubn.)
		Earias insulana Boisd.
		Agrotis segetum Schiff.
		A. ipsilon Boisd.

Table 2. Disease and weed control in the GAP region.

Years	Fungicide applied against damping-off Metric tonnes	Bactericide applied against angular leaf spot Metric tonnes	Herbicide applied area (ha)
1985	145	210	15315
1990	110	355	33350
1995	242	375	46400
1997	348	503	75850

Source: Annual Plant Protection reports

Figure 1. Cotton sown areas of Turkey.
Source: National Cotton Advisory Board

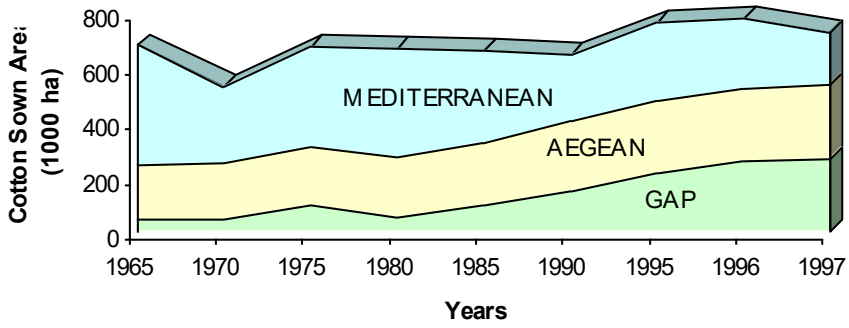

Figure 2. Comparison of cotton-sown areas and insecticide applied areas in the GAP region.

Source: National Cotton Advisory Board and Annual Plant Protection reports.