Integrated Pest Management on Cotton in South Africa

C.L.N. du Toit
Tobacco and Cotton Research Institute
Private bag X82075, Rustenburg, 0300

ABSTRACT

A wide variety of insects attack cotton in South Africa. Some are such serious pests that chemical control is necessary to ensure a viable yield. Chemical control of one species can influence the occurrence and population density of other species. The bollworm complex can cause severe crop losses and holds the key to overall efficiency of insect and mite control. The American bollworm, Helicoverpa armigera (Hübner), is responsible for most of the losses in seed cotton. The use of American bollworm pheromone traps shows potential as a substitute for time-consuming scouting, and may enhance an IPM approach. Where producers ratoon cotton, red bollworm, Diparopsis castanea (Hampson), can decrease the yield drastically. The spiny bollworm species, Earias insulana (Boisduval) and E. biplaga (Walker), occur in low numbers. The control of bollworms with insecticides such as pyrethroids and organophosphates can cause a severe build-up of these pests because these insecticides are harmful to predators and parasites of the cotton aphid Aphis gossypii (Glover) and the tetranychid mites (Acari) Tetranychus urticae (Kock), T. lombardinii (Baker and Pritchard) and T. ludeni (Zacker). Mites and aphids have the ability to develop resistance to pesticides. Under favourable conditions, cotton leafhoppers, Jacobiella fascialis (Jacobi), can cause the leaves of certain cultivars to turn purple and curl up, thus retarding growth and development. Leafhoppers cannot feed on hairy cotton and can be controlled in an IPM system by planting cultivars with hairy leaves. Thrips tabaci (Lindeman), Frankiniella schultzei (Trybom), and cutworms, Agrotis spp., appear in the early growing season, while stainers, Dysdercus fasciatus (Signoret), D. nigrofasciatus (Stål), D. intermedius (Distant) and Oxycarenus hyalinipennis (Costa) do more damage towards the end of the season. Spodoptera littoralis (Boisdeval) and grasshoppers, Zonocerus spp. sometimes appear, but are normally kept in check by bollworm control programmes. In ratoon cotton, D. castanea and the black cotton beetle, Syagrus rugifrons (Baly), can cause serious problems. The juvenile stages of the cotton stem weevil, Apion soleatum (Wagner), a serious pest in the eastern subtropical areas of South Africa, are difficult to control because they complete their life cycle in the cotton stem. Chemical control should be practised with circumspection, using all possible systems to monitor insect damage and population densities. The injudicious use of insecticides early in the season can lead to the build-up of mites and aphids. Chemical control should only be considered when the number of pests exceeds the economic threshold.

Introduction

A wide variety of insects attack cotton in South Africa. Some are casual visitors or sporadic pests but some are such serious pests that regular chemical control is necessary to lessen their damage to the seed cotton yield. The chemicals used in the control of one species can influence the occurrence and population density of other species.

Material and methods

For many years, cotton trials were planted in all the different cotton-producing areas of South Africa. The effects of chemicals and spray programmes on yield and insect populations, threshold values of different insects and the effects of cultivars and breeding lines on insect populations as well as the effects of different cultivation practices were measured.

Results

The bollworm complex can cause severe crop losses and holds the key to overall efficiency of insect and mite control. The American bollworm, *Helicoverpa armigera*, is responsible for most of the losses in seed cotton (Annecke and Moran, 1982). Young larvae are particularly destructive, since they do not consume whole bolls, but partially destroy many flowers, squares and bolls. Such fruiting bodies are shed and this results in yield reductions.

In South Africa, bollworm control is currently initiated in one of two ways, namely weekly and / or biweekly chemical applications regardless of the size of the population, or by the determination of larval density (Bennett, 1996) on a weekly basis (scouting). Scouting is a time and labour-consuming process and not all producers use scouting results for timing chemical applications. In South Africa, five bollworm larvae / 24 plants are the current economic threshold (Basson, 1987). At least 24 plants per field must be scouted in fields less than 15ha in size. In fields bigger than 15 ha more plants must be monitored. Producers, who do not employ scouts, generally follow calendar spraying programmes, resulting in about 10-15 applications per season. These expensive control programmes are environmentally harmful and uneconomical and do not promote biological/ integrated pest control.

The use of American bollworm pheromone traps shows potential as a substitute for time-consuming scouting, and may enhance an IPM approach (Bennett, 1996). Even if the results obtained from the pheromone traps are not used to determine the correct spraying time, they can be used to indicate when scouting should start and stop. Where producers ratoon cotton, red bollworm, *Diparopsis castanea,* can increase dramatically and can decrease the yield drastically. An increase in red bollworm population densities has a significant effect on the effectiveness of a spraying programme based on American bollworm pheromone traps, and the total bollworm complex should, therefore, be monitored.

In ratoon cotton, red bollworm, the black cotton beetle, *Syagrus rugifrons,* and, in the eastern subtropical areas of South Africa, the cotton stem weevil, *Apion soleatum,* frequently develop into serious problems (Bennett, 1993). Larvae of the black cotton beetle attack the root system and lower stems of the plants and can ringbark the plants (Broodryk *et al.,* 1971). It is more difficult to control the larvae in the soil than the leaf- eating adults. The juvenile stages of the Apion weevil drill into the stems of the plants and are, therefore, difficult to control. Monocrotophos which is used to control the Apion beetle, can cause severe repercussions in areas where aphids and mites are resistant to organophosphates. Because of their detrimental effect on predators and parasites and their inherent poor efficacy against aphids some broad-spectrum insecticides, such as some pyrethroids and carbamates, can induce cotton aphid *Aphis gossypii* build-up. Experimental spraying of monocrotophos decreased the number of beneficial ladybird beetles in Northern KwaZulu-Natal. (Richter, 1998) Aphids from different cotton areas differ in their sensitivity to insecticides.

Tetranychid mites (Acari) on cotton, namely *Tetranychus urticae*, *T. lombardinii* and *T. ludeni,* have the ability to develop resistance to pesticides. Early in 1960, *T. urticae* developed resistance to organophosphates (Smith-Meyer, 1981). Different species and even different populations of the same species will react differently to acaricides. Work with the three mite species has shown significant resistance to both monocrotophos and abamectin. Mite infestations may increase after application of some broad-spectrum insecticide sprays such as some synthetic pyrethroids, organophosphates and carbamates that are used for the control of bollworm. These sprays kill the natural enemies of the mites but have little effect on the mites themselves. The earlier the infestation develops in the growing season, the greater is the potential damage to the crop.

Under favourable climatic conditions, cotton leafhoppers *(Jacobiella fascialis*, also known as jassids) can increase on certain cotton cultivars to such an extent that the leaves turn purple and curl up ventrally. During particularly wet growing seasons, the insects occur in great numbers in the low-lying cotton regions of Mpumalanga and Kwa-Zulu - Natal. Growth and development of the plants are retarded to such an extent that flowers, squares and bolls may be shed and serious crop losses can result. In experimental plantings, complete yield losses could be attributed to jassid damage. Adult as well as immature stages of the insects feed on the cotton plant. Because leaf- hoppers cannot feed on hairy-leaved cotton they can be controlled by planting cultivars with hairy leaves in an IPM system. No insecticides will then be necessary for the control of the pest.

Thrips, *Thrips tabacci,* and *Frankiniella schultzei* normally appear in the beginning of the growing season. Seed dressing can reduce early damage but granular insecticides applied at planting can give longer control.

Cutworms, *Agrotis spp,* can cause considerable damage to the stand because the larvae feed on the seedlings at soil level. Keeping the fields free of weeds for at least 6 weeks prior to planting reduces the chance of serious cutworm damage. Cutworms can be controlled by insecticide sprays or poison baits.

Cotton stainers such as *Oxycarenus hyalinipennis, Dysdercus fasciatus, D. nigrofasciatus* and *D. intermedius* do more damage towards the end of the season and can thus be controlled chemically without jeopardising biological control.

Leaf-eaters such as *Spodoptera littoralis* and grasshoppers such as the *Zonocerus spp.* sometimes appear but are normally kept in check by the bollworm control programme.

Although ratooning of cotton is prohibited by law, it is practiced in some areas. Farmers are particularly inclined to ratoon their cotton in areas where cotton is produced under dryland conditions and where the rain for planting the next crop may be late. Growth on the ratooned cotton during late winter and early spring provides food and a reproduction habitat for red bollworm, the black cotton beetle, the cotton stem weevil, cotton stainers and other insects. These pests may be more prevalent in areas where cotton is ratooned than in areas where a cotton-free period is practiced.

Discussion

Chemical control must be done in a sensible manner and with circumspection because the injudicious use of insecticides for pest control early in the season can lead to the build-up of mites and aphids. Chemical control should, therefore, only be considered when the number of pests exceeds the economic threshold value.

The value of the scouting system lies in getting producers to think in terms of reducing pesticide applications. It is also much cheaper than programmed spraying. It is more economical to strive for maximum profit than for maximum yield.

Summary of recommendations

- Do not ratoon cotton
- Adhere to a cotton-free period
- Where jassids are a problem, plant hairy cultivars
- Base decisions to spray on scouting
- Spray only when the number of pests exceeds the economic threshold.
- Do not use (especially in the first part of the growing season) insecticides that are known to induce outbreaks of other cotton pests

References

Pearson E.O. and R.C. Maxwell-Darling. (1958): Insect Pests of Cotton in Tropical Africa. Empire Cotton Growing Corporation and Commonwealth Institute of Entomology, London.

Ammecke, D.P. and V.C. Moran. (1982): Insects and mites of cultivated plants in South Africa. Butterworths. Durban.

Basson N.J.C. (1987): An intergrated control programme for cotton pests in South Africa. Farming in South Africa Leaflet Series: Cotton G.1.1.6/1987. Department of Agriculture and Water Supply. Pretoria.

Bennett, A.L. (1993): Biology of *Apion soleatum* Wagner (Coleoptera: Apionidae) relative to cotton production in South Africa. African Entomology 1:35-47

Bennett, A.L. (1996): Determination of a preliminary economic threshold for *Heliothis armigera* (Hübner), using pheromone traps, in South African cotton. ARC-TCRI Project Report TK 205/06 1995/96.

Brooderyk, S.W., T.J.D. Coates, C.L.N. du Toit and E.M. Malan. (1971): Arthropoda associated with cotton in South Africa. Entomological Symposium, Pretoria.

Du Toit, C.L.N. (1996): Threshold values and control of spider mite species on cotton ARC-TCRI Project Report TK205/07.

Richter, E.A. (1998): Chemical control of leafehoppers on cotton in the Makatini area ARC-TCRI Project Report TK 205/15.

Richter, E.A. (1998): Nuwe riglyne met betrekking tot vroeë seisoens gebruik van insekmiddels op katoen ARC-TCRI Project Report TK 205/13.

Smith-Meyer, M.K.P. (1981): Myt plae van landbou gewasse in Suidelike-Afrika. Science Bulletin Department of Agriculture and Fisheries. Republic or South Africa.No. 397 :1-92.

van Hamburg, H and R. Kfir. (1982): Tests of threshold levels based on larval counts for chemical control of cotton bollworms. Journal of the Entomological Society of Southern Africa. 45:109-121.

Table 1. Threshold values for important cotton pests.

Pest		Control Threshold	
American bollworm		5 larvae/24 plants	
Red bollworm		6 eggs or 2 larvae/24 plants	
Spiny bollworm		2 larvae/24 plants	
Bollworm complex		5 larvae/24 plants	
Aphids	Irrigated Cotton	Control when honeydew appears	
	Dryland Cotton	Control when found on 6 or more of 24 plants	
Red spider mite[1]	Spot infestation	Apply control to spots only	
	Complete Infestation	Apply blanket spray when mite index reaches the following thresholds:	
		Up to week 10	0.5
		From week 11	Add 0.125 to threshold 0.5 for each week after 10 weeks
Stainers		When first colonies appear	

[1] Scout 48 plants (24 for other pests plus 24 for mites only) per block of 15 ha. for mites.
Examine three mature leaves per plant, one from the middle third and two from the upper third of theplant and assign values to the plant

0 = no mature females
1 = 1-10 mature females
2 = 11 – 30 mature females
3 = 31 or more mature females

Compute the average for the block. Control mites until the first boll burst or 20 weeks afrer germination.

Figure 1. The spraying costs, yield, and the gross margin for cotton produced at the TCRI at Rustenburg. The highest profit was not obtained at the highest yield.