APPROACHES FOR THE INTEGRATED CONTROL OF SOME COTTON PESTS (MINIA REGION, EGYPT)

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Abstract

In an attempt to maximize cotton yield throughout the management of cotton pests population, agricultural and chemical practices were evaluated. Sowing date significantly affected the early season sucking pests infestation. Early sown cotton on March 1 enhanced the propagation of early season sucking pests, however allowed cotton green bolls to mature early and escape from bollworm infestation. A significant reduction in the population of diapausing pink bollworm larvae when grown plants were timely treated with Bestox and Dropp. Better management of cotton bollworms could be achieved by integrating various techniques. Chemical treatments, i.e., seed dressing using Confidor significantly reduced early season sucking pests infestation, as well as adoption of early spraying program against cotton bollworms during the first four weeks of flowering which percent infestation was less than 5% significantly reflected on cotton yield. Applying "Dropp" as a chemical termination treatment at ratios of 15 gm. a. I. / feddan significantly reduced pink bollworm diapausing larvae with no significant reduction in cotton yield.

Introduction

Cotton is considered to be a vulnerable host plant to many primary and secondary arthropod pests. In Egypt, its infestation is manifested during the whole growing seasons. In particular, sucking pests, cotton leafworm, and cotton bollworms are the key pests of cotton in Egypt during early, mid and late season, respectively.

Agricultural and chemical practices are important methods of managing the population of cotton pests and maximizing seed cotton yield. Sowing date is of great interest. Survival of overwintering diapausing larvae and subsequent emerging moth populations can be reduced by a number of cultural practices, sowing date is of great interest (Watson *et al* 1974). Cotton sown early escape from the 1 St. generation of pink bollworm emerged after diapausing. Samra, (1982) reported the greatest cotton yield from plants sown earlier during March. Also delaying the terminal application of defoliants after the most of the bolls became mature reduced number of diapausing larvae (El-Kadi, 1981) with no adverse effect on cotton yield. The Ministry of Agriculture has long be recommended the spray of cotton plants with insecticides against the cotton bollworms when the infestation level reaches 10% (economic injury level). Rizk *et al* (1983) reported about 25% increase in cotton yield when late season chemical control program stared early than that recommended when the infestation averaged 10%. The primary objective of this study was to evaluate the effect of sowing date, defoliation as well as chemical control agents on early and late season cotton pests and the reflection on cotton yield.

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Materials and Methods

1- Chemical used as shown in Table 1

2- Experimental trials

2.1- Effect of sowing dates

An area of a half feddan was divided into three parts using a completely randomized block's design. One part was cultivated with cotton on March 1, another on March 15 and the third part on April 1, i.e., two week intervals. Each part of the same sowing date was divided to 8 plots of 84 square meters each.

Four plots of each part was cultivated with cotton seeds treated with Confidor. The rest did not receive any chemical control treatments. Fifteen days following the sowing date, sucking pests associated with cotton seedlings were counted in weekly intervals for a 2 months period. General averages of sucking pests during the whole period in seed dressing treated and untreated cotton plots of the three sowing dates were statistically separated using analysis of variance at 5% level of probability. The latent effects of the above treatments on infestation by bollworms, as well as on the cotton yield were also investigated. Cotton bollworm infestations were evaluated by counting the number of infested green bolls in a randomized sample of 25 bolls weekly taken from each plot during the whole period of bollworm infestation, i.e., from July 1 to September 30. Cotton yield per each plot was weighed and general averages of each treatment were used for comparison.

2.2- Economic threshold

An area of a quarter feddan was cultivated with cotton on March 15 and divided into 48 plots, 21 square meters each. The forty-eight plots were randomly divided into six groups of eight replicates each and marked before flowering. Group of eight replicates as untreated control one was distributed between five groups for chemical treatments. The latter five groups were sprayed 2, 4, 6, 8 and 10 weeks following cotton flowering. The number of infested bolls per 200 green bolls from each treatment was counted just before the chemical treatment date. At harvest cotton of each plot was weighed and mean cotton yield per each treatment was used in comparison.

2.3-The complementary action of different chemical control agents

An area of about 1/4 feddan was divided to 20 plots of 42 m^2 each. Sixteen plots received seed dressing confidor treatment. Twelve of those plots received Delfos as mid season chemical treatment, eight of them received Bestox twice with two weeks interval as late season control treatment. Terminal application using Dropp was applied on four replicates. Four plots did not receive any chemical control treatments during the whole period of the season and were used as control treatment. For all treatments, mean number of infested bolls, number of diapausing larvae as well as cotton yield were compared among chemical and control treatments.

Results and Discussion

Table 2 indicates clearly that cotton plants sown early on March 1 was highly infested with sucking pests than those sown two or four weeks later. Interestingly, this was not the case with bollworm infestations in late season wherein cotton plants sown on April 1 appeared to phonologically receive the highest infestation compared to earlier sowing date. Without any chemical treatment, there should be some compromise between the early and late infestations, respectively, with sucking pests and bollworms. With the theoretical assumption of equal importance within these two groups of pests, one would suggest March 15 to be the best sowing date. However, there are some other factors that presumably affect the growing pattern of cotton plants from each sowing date. These include the chemical and the weather conditions. Therefore, cotton plants from these sowing dates were subjected to chemical treatments and the integral effects of these treatments and the sowing date were investigated (See Table 2). The chemical treatments appeared to be equipotent on the sucking pest in early season infestation and eliminated the differences due to the sowing dates. This was also true for only the two early sowing date and the late season infestation with cotton bollworms. Chemical treatments were highly effective in the March 1 and March 15 sowing dates as they significantly reduced infestation with bollworms to comparable levels that were statistically independent of the sowing dates. However, with cotton plants sown in April 1, chemical treatments failed to bring bollworm infestation to level similar to that of earlier sowing dates.

The overall pattern of infestation in relation to cotton yield indicates three important points. *First*, in the absence of any chemical control treatments, cotton plants sown on the earlier date produced the highest yield among untreated plots(in agreement with the findings of Khaliifa, (1971) and Abdalla, (1976). Since these plants experienced the highest infestation with sucking pests but the lowest infestation with bollworms, the latter pests appeared to be more important than the former, This results is in agreement with the establishment of Kostandy, (1992) who reported that, cultivating cotton in the first half of March gives a flowering season towards June nearly one month after the peak of pink bollworm moth emergence allowing few moth emerged at the tail of the peak to lay eggs on these flowers. *Second*, with the use of chemical control treatments, cotton yields positively responded in all treatments and yields were higher than those of untreated ones. *Third*, with the treated plots, the two earlier sowing dates gave similar yields that were significantly higher than that of treated plants sown on the latest date (April 1). Since plant sown on the latest date experienced the highest bollworm infestations independent of any control treatments, bollworms seemed to the key pests determining the overall yield of cotton.

From the results discuses above (Table 2), bollworm infestations appeared to be the key factor in determining the cotton yield. It was, therefore, important to attempt to investigate a threshold economically sound for using chemical control treatments against bollworms in cotton plants. The results from such an attempt are shown in Table 3.

Table 3 clearly indicates that there is a relationship between the date of chemical treatment following cotton flowering and its effect on the degree of bollworm infestation. As seen in this Table, this relation portrays a positive relationship between the period post flowering wherein chemical treatment was used and the level of infestation. This pattern could be easily explained if one assumes the flowering stage to be the most sensitive in the plant life cycle to bollworm infestation. It could also be possible that cotton flowers attract more bollworm moths for egg deposition in the blooming stage than later during the boll development and maturity. It is important, therefore, to manage bollworm infestation within the flowering-boll developing period. ln Egypt, El-Ghar *et al*., (1979) and in India, Sidhu and Dhawan (1977), Butter and Sukhija (1983), Sukhija and Reddy (1983) and Chen (1987) proved that, spraying squares and blooms early in the season before cotton boll formation, resulted in reducing percentages of infested bolls with pink bollworm. Table 3 also shows the importance of the level of bollworm infestation in determining the cotton yield. In general, the chemical control practices increased the cotton yield over untreated control by 47-185%. The relation between bollworm infestation and the cotton yield is clearly shown in Figure 1.

It seemed that chemical treatments for protecting cotton yield is indispensable with the current agroecosystem milieu. However, it also seemed important to decide on pesticidal chemicals as well as their control value against the pest complex of cotton in Egypt. Therefore, it was decided to test for the efficacious of different chemical control regimes to possibly eliminate the use of chemicals that show low control value but high environmental risk. Listed in Table 4 are the results obtained from testing four control regimes as compared to untreated control. The effects of these treatments were evaluated using the common criteria of infestation degree and yield level.

Table 4 shows that Confidor was highly active only against sucking pests as previously established by Ibrahim *et al.. (1993)* and Graham, (1996) who reported that Gaucho is an insecticide from new class of chemistry (chloronicotinyls), it is active against several early season sucking pests that affect cotton. The compound had no significant effect on the number of bollworm infestation. However, even though it resulted in a significant increase in the yield over untreated control, the difference between the yield from treated and untreated seemed to be extremely low. This may have been a reflection of the ability of cotton plants to recover sucking pest infestation during the growing season. As expected, this treatment did not significantly affect the degree of bollworm infestation. The minor reduction in infestation cannot be explained solely as due to the persistence of the insecticide used and a conjecture of the main reason requires further investigation and differently designed experiments. The effect of Confidor on the number of diapausing larvae appeared to follow the same pattern as the effect on bollworm infestation. When Bestox was added to the previous treatment regime, further and significant decrease in bollworm infestation and diapausing larvae was observed with a concomitant, significant increase in cotton yield. The greatest efficiency of Bestox in controlling cotton bollworms was previously established by Ibrahim *et al.*, (1993). To the contrary, when a further treatment with Dropp was complemented with all the above treatments (Confidor, Delfos, and Bestox), the effect was only manifested on the number of diapausing larvae. However, no further decrease in bollworm infestation or an increase in the yield was observed. As a matter of fact, Dropp caused minor drop in the cotton yield and its overall use in the protection of cotton plants has to be evaluated much critically. Application of plant growth regulators (chemical termination) in late season effectively terminated the fruiting of cotton and significantly reduced populations of diapausing larvae of *Pectinophora gossypiella* in soil and debris after harvest by 90% or more [Kittock *et al., (* 1973) and Bariola *et al., (* 1976)]

In conclusion, bollworms were found to be more important than the sucking pests in the early season when their effects were evaluated based on the relationship between their degree of infestations and cotton yields. Chemical treatments seemed to far more important than the sowing date in protecting cotton plants from infestation, especially that the optimum sowing date required for escaping each of the two pest complexes are quite different. Chemical treatments directed against bollworms appeared to be highly effective when used as close as possible to the post flowering stage of cotton plants. Bestox was found to be instrumental in decreasing bollworm infestation, the number of diapausing larvae and in increasing the cotton yield. Rizk *et al.*, (1983) mentioned that, better management of cotton bollworms could be achieved by integrating various techniques and adoption of early spraying program.

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References

Abdallah, M. M. 1976. Physiological studies on the effect of nitrogen and irrigation frequency under different planting dates on growth and yield of cotton. Ph. D. Thesis, Fac. of Agric., Cairo Univ., Egypt.

Bariola, L. A.; D. L. Kittock; H. F. Arie; P. V. Vail, and T. J. Henneberry. 1976. Controlling pink bollworms: effects of chemical termination of cotton fruiting on populations of diapausing larvae. J. Econ. Entomol. 69: 633-636.

Butter, N. S. and H. S. Sukhija. 1983. Economic threshold for bollworm on *Gossypium arboreum* in the Punjab. (10 th Internal. Cong. of Plant Protection, Vol. I. Proc. of Conf. held at Brighton, England, 20-25 Nov., 1983).

Chen, R. H. 1987. Control of the first generation of *Pectinophora gossypiella* (Plant Protec. 13(4): 2-4) (c.f. R.A.E. A 77 (1): 492).

El-Ghar, M. R. A.; H. S. A. Radwan and I. A. El-keie. 1979. Effect of different spraying programs on the pink bollworm *Pectinophora gossypiella* (Saunders) infestation and the yield of cotton. (Lepidoptera: Gelichiidae). (Bull. Ent. Soc. Egypt, Econ Ser., 9: 202-210.

El-Kadi, M. B. A. 1981. Effect of Amino-triazole and plant population density on yield, yield components, fiber and yarn quality. of Egyptian cotton. M. Sc Thesis. Fac. of Agric. Ain-Shams Univ.

Graham, C. T., 1996. A review of Gaucho seed treatment insecticide trials across the Midsouth and Southeast. In Proceeding, Beltwide Cotton Conferences, Cotton Insect Research and Control Conference. Nashville, TN. Vol 2: 938-939.

Ibrahim, S. A. , J. A. Ottea and S. H. Martin. 1993. Field evaluation of certain synthetic pyrethroids and IGR's /insecticide mixtures against some cotton pests. In Proceedings of Beltwide Cotton Conferences, Cotton Insect Research and Control Conference, New Orleans, LA. Vol. 2: 769-772.

Khaliifa, A. 1971. The status of pink bollworm in the Gezira, Sudan, with special reference to variety of cotton and sowing date. (Bull. Soc. Ent. Egypt, 55: 105-123).

Kittock, D. L., J. R. Mauney, H. F. Arie and L. A. Bariola. 1973. Termination of late-season fruiting with growth regulators as an insect control technique. J. Environ. Qual. 2: 405-408.

Kostandy, S. N. 1992. Effect of deflowering on cotton boll infestation with the pink bollworm, *Pectinophora gossypiella* (Saunders). Bull. Ent. Soc. Egypt. 70(45): 45-49.

Rizk, G. A.; M. A. Soliman and M. A. Rizk. 1983. Management of cotton bollworms as monitored by early and late sprays. Proc. 5th Arab Pesticide Conf. Tanta Univ. Vol. (11) 54-62.

Samara, A. M. 1982. Effect of sowing and defoliant application dates on cotton yield and quality. Agricultural Research Review, 6(9): 179-194.

Sidhu, A. S. and A. K. Dhawan. 1977. Timing sprays against pink bollworm, *Pectinophora gossypiella* (Saunders) 47 (10): 521-524. (c.f. r. A.E.A. 66 95): 2777).

Sukhija, H. S. and G. J. Reddy. 1983. Time of initiating insecticidal application for the control of *Pectinophora gossypiella* (Saunders). (J. Res. Punjab, Agric. Univ., 20 (1): 47-56. (c.f. R. A.E.A. 72 (1-7): 926).

Watson, T. F., K. K. Barnes, J. E. Slosser and D. G. Fullerton. 1974. Influence of plow down dates and cultural practices on spring moth emergence of the pink bollworm. Ibid. 67: 207-210.

Table 1: Chemicals used

Trade names	Common name	Formulation and (% ai.)	Rate (gm. a.i./fed)	T i m e of application
Confidor or Gaucho	imidacloprid*	WS(70)	4.9#	Seed dressing
Delfos	chloropyrifos/ hexaflumuron mixture	EC(48+2)	500.0	June 15 in1995 and Julyl in 1996
Bestox	alphamethrin	FL(20)	25.0	July 26 and Aug. 15
Dropp	thiodiazuron *	WP-(50)	15.0	October 30

Rate per kg. cotton seed.
*Chemical definition of imidacloprid I (6-chloro-3pyridylmethyl)-N nitroimidazolidin-2-ylidene amine.
* Chemical definition of thiadiazuron N-phenyl-N (1,2,3-thiodiazol-5-yl) urea

Table 2: Effect of sowing date and pesticidal treatment of cotton plants on early and late season pest infestations and cotton yield.

Sowing date	Chemical treatment ?	Numbers of Sucking pests /plant	% bollworm infestations	Cotton yield/84sq.m.
March 1	No Yes#	17.11a±3.70 3.50d±0.72	24.25b±5.64 3.00c ±0.75	9.73c±1.66 20.28a±5.72
March 15	No Yes#	11.88b±3.01 4.20d±1.10	35.25b±6.3 5.75c±1.1	7.51c±1.63 19.56a±5.44
April 1	No Yes#	11.76b±3.32 5.50d±2.20	56.2a±10.5 24.5b±5.6	4.18d±0.93 15.37b±3.89
LSD 0.05	-------	2.69	l 2.54	2.81

Means within the same column followed by the same letter are not significantly different at 5% level of probability.
#All treated plots were subjected to the same chemical control program (Confidor seed dressing, mid season Delfos and late season Bestox twice).

Table 3: Economic threshold for starting chemical control program against cotton bollworms.

Date of spray, Weeks Post Flowering	Rate of bollworm infestation	Cotton yield Kg./21 square meters	%Increase i n cotton yield
2	0.00d±0.0	9.03a±1.6	184.9
4	3.25d±1.5	8.35ab±1.57	163.4
6	5 75cd±2 75	6.94b±1.17	118.9
8	12.25c±2.5	4.61c±1.07	45.4
l 0	28.5b±5.25	4.66c±1.04	47.0
CONTROL	≤39.5a±13.25	3.17c±0.99	0.00
LSD 0.05	6.74	2.12	-----

Means within the same column followed by the same letter are not significantly different at 5% level of probability.

Table 4: Complementary action of different chemical control agents in increasing cotton yield. In this table, means within the same column followed by the same letter are not significantly different at 5% level of probability.

Chemical control program *	Sucking pests infestation	% Bollworms infestation	No of diapausing larvae /42 sq..m.	Cotton yield /42 sq.m.
1:Confidor	6.5b=2.52	18.5a±3.7	98.0 ab±9.6	6.8b±1.26
2:1+Delfos	-------	21.75 a ± 4.43	75.5b± 15.1	7.8b±1.45
3:2+Bestox	-------	4.25 b ± 1.85	39.75c± 7.8	13.2a±2.46
4:3+Dropp	-------	3.75 b ± 1.75	12.5d±4.4	11.8a± 2.8
5:Untreated	22.25a=5.6	29.5a±6.9	111.0a± 20.2	5.6c±1.4
LSD 0.05	6.9	9.54	24.2	1.23

* Confidor treatment as seed dressing on March 15, Delfos treatment on June 15 and July 1 in 1995 and 1996 seasons, respectively, Bestox on July 28 and Augus 15 in both seasons and Dropp on October 30 in both seasons.

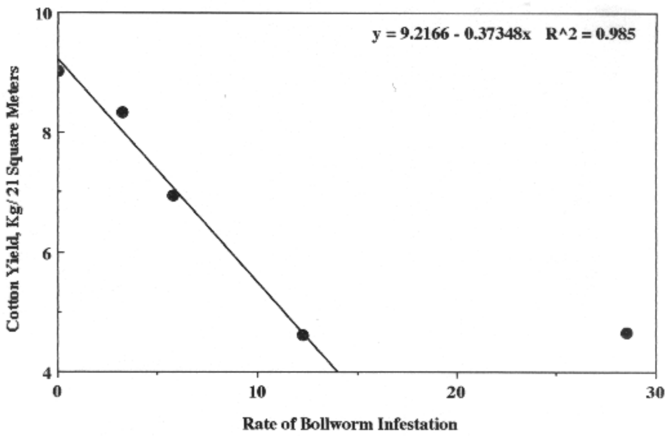

Figure 1. Relationship between bollworm infestations and cotton yield. Note that the linear regression line and its equation exclude the highest infestation rate as it appeared to exceed the highest limit of infestation that may influence cotton yield and, therefore, the least responsive to chemical treatment.