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Determination of Economical Number of Sprays for the Control of Insect Pest Complex of Cotton

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Abstract: An experiment was conducted to find out the most economical number of sprays for the control of insect pest complex of cotton (*Gossypium hirsutum* L.). Different applications of curacron 500 EC and polytrin-C 440 EC were applied on variety gomal-93. The boll number and seed cotton yield increased, while the boll weight decreased with increase in number of sprays. Three and four spray applications gave lowest yield (1449 and 1453 kg ha^{-1} respectively), while five and six sprays were at par with maximum yield (2554 and 2581 kg ha^{-1}, respectively). Although seven and eight sprays gave maximum yield (2605 and 2677 kg ha^{-1}, respectively), but keeping in view of the cost involved and safety of the ecosystem, five sprays based on pest's economic threshold level are most economical that gave reasonable yield (2683 kg ha^{-1}).

Key words: Cotton, insect pest complex, pesticides, sprays, yield, cost benefit ratio

Introduction

Cotton is the most important cash crop of Pakistan and contributes 60 percent of export earning to the national exchequer. In addition to the lint, cotton seed for oil and meal account for 80 percent of the national oil seed production (Anonymous, 2000). Cotton with, its green, succulent leaves, many large open flowers, nectars on every leaf and flower and abundance of fruit attract a variety of insect pests and mites, such as sucking pest complex (whitefly, jassids, thrips and mites) and bollworm pest complex (Spottedd, Pink and American).

In Pakistan about 145 species of cotton pests are recorded (Bo, 1992). Pests cause low damage to *G. arboreum* L. but maximum to *G. hirsutum* L (Myint and Pierrard, 1992). These insects cause considerable damage to the crop from seedling stage to the harvesting stage. Insect pests are responsible for reflecting heavy losses to the cotton crop by reducing yield and quality of seed cotton and are the basis cause of worry and financial loss to the grower (Wilson *et al*., 1980). It is estimated that the losses on an average range from 30 to 40 % and could be as high as 50 to 60 % in some areas (Ahmed, 1980).

More insecticides, both in kind and quantity are used to control the insect pests of cotton, largely due to the fact that no single chemical can control all the pest species. Number of sprays has a positive influence on the physiomorphic characters as well as on the yield of seed cotton. However, insecticide applications to control insect pest complex have been increased upto alarming stage and ranges between 6 to 8 sprays. This indiscriminate use of spray has created many problems as development of insect resistance to pesticides, resurgence to target pests, secondary pest out - break, killing of non-target organisms, disturbance of biological equilibrium, environmental pollution and health hazards. Insecticide application is a very drastic control measure and should only be used as last resort, when other method are not successful to control the insect pests before economic threshold level (Korejo *et al*., 2000). Pesticides are to be used judiciously in combination with proper spray technology. Economic threshold levels have been recommended to reduce pesticide loads (Bakhetia *et al*., 1996).

The present study was undertaken to know that how many number of sprays actually needed for the control of insect pest complex of cotton.

Materials and Methods

Cotton cultivar gomal-93 was sown in a randomized complete block design with three replications and eight treatments including check at Agricultural Research Institute, D.I.Khan during 2001. The treatment size was 3 x 9 m^2 and the rows and plant spacing were maintained at 30 and 75 cm^2, respectively. All other cultural practices were given uniformly to the whole field.

During the study, field area was visited every day to know the pest's economic threshold level (ETL). For sucking pests, data were recorded by counting numbers of various insects through use of magnifying lens on 9 randomly selected leaves from 9 plants, in such a way the one leaf from upper portion of one plant, 2nd leaf from middle portion of 2nd plant and 3rd leaf from lower portion of 3rd plant and so on.

For bollworm pests, data were recorded from 3 randomly selected plants per treatment, by counting total number of bolls, infested bolls, squares/flowers and infested squares/flowers to worked out % infestation.

First spray of curacron 500 EC at its recommended dose to all the treatments was given when the insect pests reached to its economic threshold level (ETL). After 15 days interval 2nd spray of curacron 500 EC at its recommended dose was given to all treatments, except T_1. For the next 6 sprays polytrin-C 440EC was used at its recommended dose.

All other sprays except T_1 and T_2 were adjusted by dividing the period from the date of 2nd spray to the end of October by the spray numbers. T_2 received its 3rd spray at ETL for bollworms. T_1 received every spray at pest's reaching to ETL through out the entire growing period, to know that how many sprays, based on ETL, actually needed for the control of insect pest complex. The detail of the treatments are given in Table 1A and B.

The data were subjected to ANOVA technique and LSD test by using MSTATC, a computer software package (Bricker, 1991).

Table 1: Details of the treatments given to cotton cultivar gomal-93 (A) T_1 = Number of sprays based on pests economic threshold level (ETL)

Treatments	No. of sprays	Pesticides	Dose/acre (ml)	Spray was done against	Dates of pests ETL	Dates of Sprays
T_1	5	Curacron 500EC	1000	Sucking pests	27.7.2001	28.7.2001
		Curacron 500EC	1000	Sucking pests	13.8.2001	15.8.2001
		Polytrin-C 440EC	600	Sucking and bollworm pests	21.8.2001	22.8.2001
		Polytrin-C 440EC	600	Bollworm pests	18.9.2001	19.9.2001
		Polytrin-C 440EC	600	Bollworm pests	12.10.2001	13.10.2001

Table 1: Continue

B. Treatment details other than T_1

Treatments	No. of sprays	Pesticides	Dose/acre (ml)	Spray was done	Dates of sprays
T_2	3	Curacron 500EC	1000	Sucking pests	28.7.2001
		Curacron 500EC	1000	Sucking pests	13.8.2001
		Polytrin-C 440EC	600	Sucking and bollworm pests	22.8.2001
T_3	4	Curacron 500EC	1000	Sucking pests	28.7.2001
		Curacron 500EC	1000	Sucking pests	13.8.2001
		Polytrin-C 440EC	600	Bollworm pests	19.9.2001
		Polytrin-C 440EC	600	Bollworm pests	27.10.2001
T_4	5	Curacron 500 C	1000	Sucking pests	28.7.2001
		Curacron 500 C	1000	Sucking pests	13.8.2001
		Polytrin-C 440EC	600	Bollworm pests	12.9.2001
		Polytrin-C 440EC	600	Bollworm pests	29.9.2001
		Polytrin-C 440EC	600	Bollworm pests	27.10.2001
T_5	6	Curacron 500EC	1000	Sucking pests	28.7.2001
		Curacron 500EC	1000	Sucking pests	13.8.2001
		Polytrin-C 440EC	600	Sucking and bollworm pests	28.8.2001
		Polytrin-C 440EC	600	Bollworm pests	12.9.2001
		Polytrin-C 440EC	600	Bollworm pests	29.9.2001
		Polytrin-C 440EC	600	Bollworm pests	13.10.2001
T_6	7	Curacron 500EC	1000	Sucking pests	28.7.2001
		Curacron 500EC	1000	Sucking pests	13.8.2001
		Polytrin-C 440EC	600	Sucking and bollworm pests	28.8.2001
		Polytrin-C 440 EC	600	Bollworm pests	12.9.2001
		Polytrin-C 440 EC	600	Bollworm pests	29.9.2001
		Polytrin-C 440 EC	600	Bollworm pests	13.10.2001
		Polytrin-C 440 EC	600	Bollworm pests	27.10.2001
T_7	8	Curacron 500 EC	1000	Sucking pests	28.7.2001
		Curacron 500 EC	1000	Sucking pests	13.8.2001
		Polytrin-C 440 EC	600	Sucking and bollworm pests	28.8.2001
		Polytrin-C 440 EC	600	Bollworm pests	06.9.2001
		Polytrin-C 440 EC	600	Bollworm pests	19.9.2001
		Polytrin-C 440 EC	600	Bollworm pests	29.9.2001
		Polytrin-C 440 EC	600	Bollworm pests	13.10.2001
		Polytrin-C 440 EC	600	Bollworm pests	27.10.2001
T_8 check	-	-	-	-	-

Results and Discussion

Results (Table 2) indicate that all the plots with different number of sprays were significant regarding number of bolls/plant, boll weight and seed cotton yield. Maximum number of bolls/plant (34.33) was recorded from plots sprayed 8 times, while minimum (9.33) from check plots. Number of bolls/plant increased with increase in number of sprays and shows directly proportional trend. Maximum boll weight (3.55) was recorded from plots sprayed 3 times, while minimum (2.94) from check plots. The boll weights were almost decreased with increase in number of sprays.

Table 2: Effect of number of sprays on the physiomorphic features and yield of cotton

Treatments	No. of sprays	No. of bolls/ plant	Boll weight (g)	Seed cotton yield (kg ha^{-1})
T_1	5	26.33c	3.52a	2583a
T_2	3	15.67d	3.55a	1449b
T_3	4	24.33c	3.51a	1453b
T_4	5	26.67c	3.53a	2554a
T_5	6	30.33b	3.41b	2581a
T_6	7	31.67ab	3.36bc	2605a
T_7	8	34.33a	3.33c	2677a
T_8	Untreated	9.33e	2.94d	991.7c

Means followed by different letters differ significantly at $p < 0.05$

It is a negative influence, as the boll weight increases, the number of bolls/plant and yield decreases. Maximum seed cotton yield (2677 kg ha^{-1}) was recorded from plots sprayed 8 times, while lowest (991.7 kg ha^{-1}) from check plots. Seed cotton yield decreased with reduction in number of sprays and shows directly proportional trend. The results are in conformity with those of Gupta *et al.* (1999) and Kalroo *et al.* (2001) as they reported yield increase with increase in number of sprays. The results are not in conformity with Korejo *et al.* (2000) as they reported maximum yield with 3 sprays.

Data (Table 3) revealed that maximum pesticide consumption and cost (Rs. 7641.98) was counted for plots with eight sprays. Consumption and cost of pesticides increased with increase in number of sprays and shows directly proportional trend. These findings are in agreement with the findings of Gupta *et al.* (1999) and Korejo *et al.* (2000). The maximum net benefit (Rs. 27352.16) over control was obtained with 5 sprays (based on pests economic threshold levels), while lowest (Rs. 4503.00) with 4 sprays (Table 4). The results are not in conformity with Gupta *et al.* (1999) as they obtained maximum net return with 9 sprays, while Korejo *et al.* (2000) obtained highest net return over control with 2 sprays. Economic analysis showed that present cotton production is not economical. The number of sprays can be reduced from 8 to 5 or less without significantly affecting seed cotton yield and quality. This statement is in conformity with that of Ahmad (1986) who reported reduction of sprays upto 4 from 10-14. The recommendations are contradictory to that of Shafi (1993), who recommended 2-3 sprays at an interval of 12-15 days based on ETL. The recommendations are also not in conformity with Amer *et al.* (1999) who recommended 6 sprays of polytrin-C 440 EC at 14 days interval. The variations may be due to cultivars used under different climatic conditions. Five sprays at an interval of 13-15 days based on damage threshold which are cost effective, affordable for farmers and safer for the environment are recommended.

Table 3: Consumption and cost of pesticides on cotton cultivar gomal-93

Treatments	No. of sprays	Curacron 500EC		Polytrin-C 440EC		Total cost of chemical/plot (Rs)	Total cost of chemical in ha (Rs)
		Consumption (ml)	Cost/plot (Rs)	Consumption (ml)	Cost/plot (Rs)		
T_1	5	35.7	18.5	31	21.7	40.2	4962.96
T_2	3	35.7	18.5	11	07.7	26.2	3234.57
T_3	4	35.7	18.5	21	14.7	33.2	4098.77
T_4	5	35.7	18.5	31	21.7	40.2	4962.96
T_5	6	35.7	18.5	42	29.4	47.9	5913.58
T_6	7	35.7	18.5	52	36.4	54.9	6777.78
T_7	8	35.7	18.5	62	43.4	61.9	7641.98
T_8 check	-	-	-	-	-	-	-

Table 4: Cost benefit ratio of cotton cultivar gomal-93 during 2001

Treatments	No. of sprays	*Cost of chemicals (Rs)	**Cost of spray (Rs)	Total Cost (Rs)	Total cost per ha + Income from control (Rs)	*** Total income per ha (Rs)	Net benefit/loss over control (Rs)
T_1	5	4962.96	1500	6462.96	27536.59	54888.75	27352.16
T_2	3	3234.57	900	4134.57	25208.2	30791.25	5583.05
T_3	4	4098.77	1200	5298.77	26372.4	30876.25	4503.85
T_4	5	4962.96	1500	6462.96	27536.59	54272.50	2673591.00
T_5	6	5913.58	1800	7713.58	28787.21	54846.25	26059.04
T_6	7	6777.78	2100	8877.78	29951.41	55356.25	25404.84
T_7	8	7641.98	2400	10041.98	31115.61	56886.25	25770.64
T_8	Nil	-	-	-	-	21073.63	-

*: Rate of pesticides: Curacron 500EC, 250 ml = Rs. 130/- and Polytrin-C 440EC, 250ml = Rs. 175/-
: Rate of one spray application Rs. 300 per hectare *: Cost of seed-cotton Rs. 850 per 40 kg

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