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Intensity of Pink Bollworm (*Pectinophora gossypiella* Saunders). Damage for the Evaluation of Yield in Cotton

by

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Introduction: The pink bollworm, *Pectinophora gossypiella* Saunders. is an internationally important pest of cotton. Its incidence is so far being recorded in terms of percentage with reference to the total number of flowers or bolls examined. The bollworm incidence taken during initial stages of boll formation showed slight variation between treatments, but when peak infestation was reached there was practically no difference between the treatments. Yet there was difference in *kapas* yield, indicating the possible existence of differential efficacy between the various treatments. Under such circumstances much difficulty was experienced in interpreting results and giving plausible explanation. In order to find out the reasons, an experiment was made on the intensity of damage due to pink bollworm and this method of approach is explained in this paper.

Materials and Methods: An insecticidal trial was laid out during 1967, summer with MCU 4 (E. L. 123) cotton at the Regional Research Station, Kovilpatti. The objective was to fix a schedule of effective treatments and also the optimum number of applications required for controlling the major pests of cotton. The trial was of a split plot pattern with insecticides as main treatments and the number of applications as subtreatments. The treatments were the following *viz.*, (1) Carbaryl 10% dust, (2) Carbophenothion 2% dust, (3) Carbaryl 0.1% spray, (4) Endrin 0.02% – Parathion 0.025% alternate sprays, (5) Carbophenothion 0.06% spray, (6) Carbaryl 0.1% – Parathion 0.025% alternate sprays, (7) Carbaryl 0.1% – Endrin 0.02% alternate sprays, (8) Phosphamidon 0.02% spray, (9) Carbophenothion/DDT (1 oz/4 galls) spray, (10) Metacid combi (2 lit/100 galls) spray and (11) Control (untreated). Six and eight applications of the above treatments were given as subtreatments. The extent of damage was recorded twice in the trial on 18th July and 14th August, 1967. The damage was recorded as (1) incidence of healthy bolls, (2) mere incidence of external bore hole but without internal damage, (3) incidence of one and two locules damage, (4) three locules damage and (5) complete boll damage. The percentage of bollworm incidence was also recorded for comparison On the above mentioned dates, yield trend was also recorded and correlated with incidence.

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Results: (a) *Incidence:* The percentage of incidence of pink bollworms in bolls did not vary much between treatments and it did not give any clue to their relative effectiveness in controlling the pink bollworm damage and thereby the yield. It was also seen in this variety of *Hirsutum* cotton that majority of the treatments including control did not exhibit any pest free bolls or bolls with external damage alone. The data on intensity of damage as, (a) one or two locules damage, (b) three locules damage and (c) whole boll damage were transformed as angular sines and analysed. It was seen that the three aforesaid categories significantly differed as also the interaction of the categories with treatments, thereby revealing that the treatments had a check on the incidence and they varied among themselves in potency.

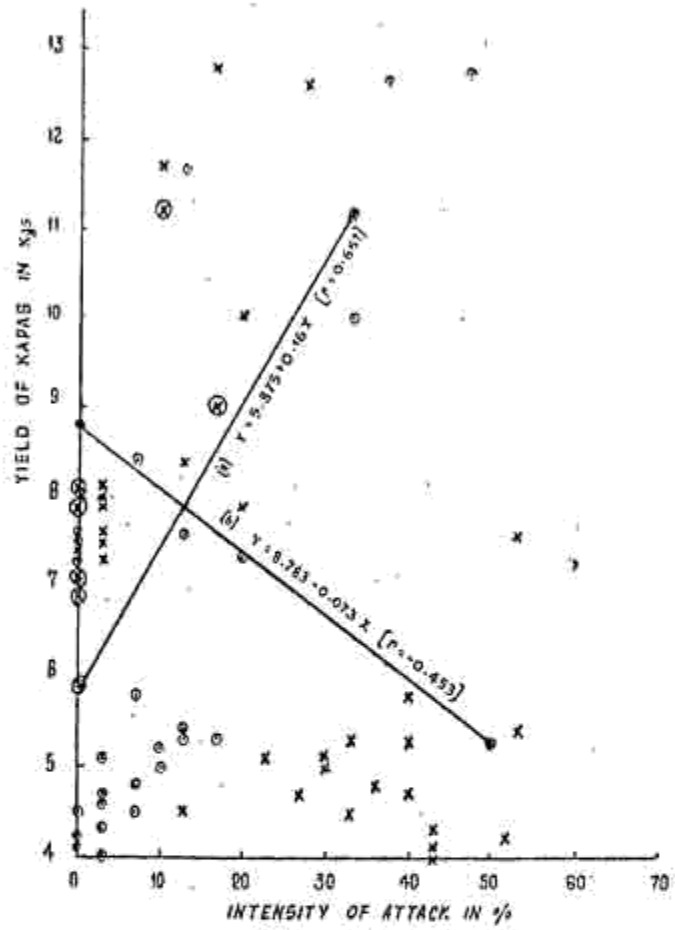
Carbaryl 10% dust (8 rounds) recorded a greater percentage of healthy bolls and 2 locules attack. Moreover, the three locules damage was comparatively low, thus indicating the effectiveness of the chemical in checking more severe types of damage. The treatments, carbaryl 10% dust (6 rounds), carbaryl 0.1% spray (8 rounds), carbaryl 0.1% and Parathion 0.025% alternate sprays (8 rounds) and Carbaryl 0.1% - Endrin 0.02% alternate sprays (8 rounds) were also on par with Carbaryl 10% dust (8 rounds), but slightly varying from the yield analysis. Carbophenothion 0.6% spray (8 rounds) recorded the lowest percentage of one and two locules damage, a comparatively higher degree of three locules damage and also a high percentage of whole boll attack.

(b) *Yield:* The yield data showed significant differences with reference to harvest dates and treatments (*vide* Table). Between the treatments Carbaryl 10% dust (8 rounds), proved to be significantly superior to the rest, followed by Carbaryl 10% dust (6 rounds), Carbaryl 0.1% spray (8 rounds) and Carbaryl 0.1% – Parathion 0.025% alternate sprays. The latter three were on a par. The minimum yield of *kapas* was realised in Carbophenothion 0.06% spray (8 rounds).

(c) *Relationship between incidence and yield:* In order to have an idea of the relationship between the three categories of incidence and the yield over all the treatments, correlations were worked out between the three types of damage and yield over both the harvest dates of 18th, July and 14th August, 1967. The result showed a high possitive correlation of $r=0.667$ (significant at 1%) between one and two locules attack and yield, whereas, it was highly negative ($r=-0.453$; significant at 1%) in respect of three locule damage and yield. But no significant correlation was seen with regard to whole boll damage and yield, though it tended to be negative at the level of $r=0.201$. The correlations are dipicted in Fig.

REGRESSION OF YIELD ON PERCENTAGE LOCULE DAMAGE

⊗ Two Locules damage [a] Y=5.875+0.16 X
× Three ,, ,, [b] Y=8.783−0.073 X



(d) *Grading for pink bollworm damage*: Based on the observations made in respect of the intensity of damage, grading of varieties of cotton in *Hirsutum* for pink bollworm infestation is suggested as follows:

Grade	Corresponding intensity of damage	Description
0	Free	Un-infested and healthy bolls.
I	Light	Bolls exhibiting mere presence or symptoms of bore hole but no internal damage
II	Moderate	One and two locules in a boll damaged
III	Heavy	Three locules in a boll damaged
IV	Severe	All the locules in a boll damaged and the boll is unfit for picking

In *Arboreum* varieties of cotton there will be only three locules in a boll and in such cases the intensity can be taken as moderate when one locule is attacked and heavy if two locules are attacked. The rest of the grades can be the same.

TABLE. *Comparison of intensities of incidence in different treatment with yield*

Treatments		INTENSITIES			Yield of kapas kg/plot
		One and two locules damage (a)	Three locules damage (b)	Complete boll damage (c)	
1. Carbaryl 10% dust -	6 rounds	34.9	37.5	27.8	9.50
2. Carbaryl 10% dust -	8 rounds	37.2	24.1	19.7	13.16
3. Carbophenothion 2% dust -	6 rounds	5.3	20.8	68.2	5.97
4. Carbophenothion 2% dust -	8 rounds	5.3	20.6	68.5	5.82
5. Carbaryl 0.1% spray -	6 rounds	21.2	32.7	49.0	7.13
6. Carbaryl 0.1% spray -	8 rounds	29.4	39.0	32.1	10.18
7. Endrin 0.02% - Paration 0.025% alternate sprays	6 rounds	—	25.9	64.1	5.80
8. Endrin 0.02% - Parathion 0.025% alternate sprays	8 rounds	10.7	22.9	63.1	6.70
9. Carbophenothion 0.06% spray -	6 rounds	9.2	16.6	70.4	6.56
10. Carbophenothion 0.06% spray -	8 rounds	5.3	29.8	59.3	5.58
11. Carbaryl 0.1% - Parathion 0.025% alternate sprays -	6 rounds	—	36.0	52.3	6.07
12. Carbaryl 0.1% - Parathion 0.025% alternate sprays -	8 rounds	18.2	28.8	54.0	8.78
13. Carbaryl 0.1% - Endrin 0.02% alternate sprays -	6 rounds	19.6	30.3	52.3	6.85
14. Carbaryl 0.1% - Endrin 0.02% alternate sprays	8 rounds	19.9	32.7	49.4	8.30
15. Phosphamidon 0.02% spray -	6 rounds	5.3	19.7	69.2	6.54
16. Phosphamidon 0.02% spray -	8 rounds	5.3	27.3	61.7	6.49
17. Carbophenothion/DDT (1 oz/4 galls.)	6 rounds	5.3	16.6	72.4	6.52
18. Carbophenothion/DDT (1 oz/4 galls.)	8 rounds	7.5	23.9	64.2	6.19
19. Metacid Combi (2 lit/100 galls)	6 rounds	7.5	17.6	70.4	5.66
20. Metacid Combi (2 lit/100 galls)	8 rounds	5.8	24.9	62.0	6.29
21. Control (Untreated)	—	—	10.8	79.3	6.30

Conclusion: S.E. = 10.0; C.D. = 20.2

(i) *Between intensities:*

(1) b, a, c; (2) a, b, c; (3) c, b, a; (4) c, b, a;

(5) c, b, a; (6) b, c, a; (7) c, b, a; (8) c, b, a;

(9) c, b, a; (10) c, b, a; (11) c, b, a; (12) c, b, a;

(13) c, b, a; (14) c, b, a; (15) c, b, a; (16) c, b, a;

(17) c, b, a; (18) c, b, a; (19) c, b, a; (20) c, b, a;

(21) c, b, a.

(ii) *Between treatments*:

(a) 2, 1, 6, 5, 14, 13, 12, 8, 9, 18, 19, 20, 17, 16, 15, 4, 3, 10, 7, 11, 21

(b) 6, 1, 11, 5, 14, 13, 10, 12, 16, 7, 20, 2, 18, 8, 3, 4, 15, 19, 9, 17, 21

(c) 21, 17, 9, 19, 15, 4, 3, 18, 7, 8, 20, 16, 10, 12, 13, 11, 14, 5, 6, 1, 2

(iii) *Yield*. S.E. = 0.881 C.D. = 1.838

2, 6, 1, 12, 14, 5, 13, 8, 9, 15, 17, 16, 21, 20, 18, 11, 3, 4, 7, 19, 10

Discussion: Ballard (1921), offered suggestions to consider the pink bollworm population along with the percentage of bolls attacked in order to have a fairly accurate idea of the degree of infestation. Lewis (1921), had taken attacked bolls percentage for his studies. In the pink bollworm's seasonal variations study conducted in Egypt, Williams (1926), considered bolls sound and undamaged. Relationship between boll damage and yield was worked out by Nangpal (1948), as 25-60% locks damaged in a boll resulted in 20-50% reduction in cotton weight. The presence of number of larvae per boll was taken as a basis for gauging the infestation by Brazzel and Gaines (1946). Insecticidal studies were conducted under caged conditions by Tsao and Lowry (1963) and they have graded the pink bollworm infestation into three groups. They have also attempted to equate the loss in yield due to the pest infestation by a simple equation.

The observations made on MCU 4 Cotton in the present study giving importance to the intensity of attack seemed to give a closer view of the yield fluctuations. The one and two locules damage seemed to have improved yield by the highly possitive correlation present between this type of damage and yield. The reason may be due to the natural forces of the plant brought into action to make up for the loss by way of increased *kapas* formation in the healthy locules. On the contrary, the three locules damage showed a highly negative relationship, connoting the adverse effect on yield due to this high infestation. This may be because such severe attacks disable the plant to recoup the loss. As far as whole boll attack is concerned no such definite trend was observed due to treatmental variability. Such variability in the intensity of attack and consequential variability on different varieties and treatments need further detailed work to effectively use grades of infestation as a measure of *kapas* yield. The data recorded show high percentage of complete boll damage in the untreated control which implies, that the variety MCU 4 is in the group, 'highly susceptible' to pink bollworm incidence.

Summary and Conclusions: As an improved assaying over the percentage incidence of pink bollworm and to obtain better information regarding the extent of damage, observation on the intensity of infestation as (1) free bolls, (2) mere bore holes with no internal damage, (3) one and two locules damage, (4) three locules damage and (5) complete boll damage is suggested. This method proved to be a far better approach to clearly understand the impact of incidence on yield. The one and two locules damage indicated improvement of yield by a possitive correlation. The three locules damage, on the other hand, exhibited a tendency to reduce yield by its negative correlation with yield. The incidence of bolls damaged completely seemed to be a variable factor and hence it did not show a definite correlatian.

The application of the observations revealed, Carbaryl 10% dust (8 rounds) to be the most effective one in checking the severity of the pest attack and thereby giving increased yield. The MCU 4 cotton was observed to be highly susceptible to the pink bollworm attack.

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