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EFFECTS OF ALPHA NAPHTHALENE ACETIC ACID ON FRUITING PATTERNS AND YIELD OF IRRIGATED COTTON IN CENTRAL QUEENSLAND

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SUMMARY

The effects of single and multiple applications of 10 p.p.m. of alpha naphthalene acetic acid were tested over the squaring and flowering period in four trials. Results indicate that although retention of squares or immature bolls may result from application two weeks after the peak count of squares on the plant, this effect is transitory and boll counts return to normal within two weeks. No differences in total fallen fruit forms, fruit form production, number of harvestable bolls or yield were observed in any trials. It is concluded that treatment with this chemical has no place in Central Queensland.

I. INTRODUCTION

Natural loss of fruiting forms by the cotton plant has been studied for many years. Recently, a number of authors have reported experiments attempting to reduce this loss by the application of very small quantities of hormone-like chemicals. In India, Bhatt and Date (1955), Negi and Singh (1956) and Malkami-Akana (1958) all reported increases in yields from applications of 10–30 p.p.m. alpha naphthalene acetic acid (NAA). Dasture and Prakash (1954) increased yields with NAA and two similar chemicals, while Mathur (1959) retained more bolls with regular treatments with beta-naphthoxy acetic

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acid. In the U.S.A., Walhood (1958) had similar results. As a contrast, African opinion is divided. Dale and Milford (1961) in Uganda reported no increases in yield or final boll numbers with NAA, Dransfield (1961) did not affect yield or lint characters with gibberellic acid, but Collins (1961) reported increases with NAA when the crop was not sprayed for insect control.

At Biloela Research Station, four trials have been carried out under irrigation to test these chemicals under Central Queensland conditions. Trial 1 (1958-59) involved one and two applications of 10 p.p.m. NAA as part of a factorial trial involving applications of insecticide and fertilizer. Trial 2 (1959-60) and Trial 3 (1960-61) involved single applications of NAA at periods around peak squaring. Trial 4 (1961-62) included treating 1, 2, 3 and 4 times with NAA over peak squaring.

II. MATERIALS AND METHODS

Miller 43-9-0 variety was used in Trials 1, 2 and 4. Empire variety was used in Trial 3.

Spray material (10 p.p.m. concentration) was applied to run-off by power-driven twin-nozzle hand applicators or by knapsack spray at rates of 150–200 gal per ac. The material was a 2 per cent. w/v aqueous solution.

Trial 1 involved three fertilizer levels (nil, 53 lb N and 113 lb N per ac) as part of the factorial design. Trial 2 was unfertilized, Trial 3 fertilized uniformly with 46 lb N per ac, and Trial 4 fertilized uniformly with 94 lb N per ac over all plots.

In all except Trial 4, attention was given to the fruiting behaviour of the plant. According to the method used by Passlow and Trudgian (1960), four (Trials 1 and 3) or five (Trial 2) plants were selected for counts of fruit on the plant at weekly intervals. Three inter-row areas each 14 ft long in Trial 1, one inter-row area 20 ft long in Trial 2, and one inter-row area 30 ft long in Trial 3 were used for fallen fruit form counts.

Harvested plot sizes were two rows (42 in. apart) each 50 ft long in Trial 1 and 20 ft long in Trial 2. In Trial 3, four rows of 20 ft, and in Trial 4, three rows of 20 ft, were harvested for yield.

III. RESULTS

(a) Trial 1. 1958–59. 3 x 3 x 3 Factorial Design

The trial was planted on October 14. Fertilizer treatments were: F0, no fertilizer; F1, basal NPK dressing 54 lb N + 81 lb P_2O_5 + 81 lb K_2O per ac applied in a furrow on October 14; and F2, basal dressing as in F1 plus

a side-dressing (60 lb N per ac) applied at peak squaring on December 22. Insecticide treatments were: D0, no insecticide; D1, four fortnightly DDT 0·1 per cent. spray applications from the first burst of squaring; and D2, eight weekly DDT sprays (0·1 per cent.) over the same time. Hormone treatments were: H0, no hormone; H1, one application of 10 p.p.m. NAA to wet all fruit forms at major square production on December 22; and H2, two applications of NAA used as in H1 on December 22 and January 14. The hormone spray was applied at 124 gal per ac.

The results and discussion of the insecticide and fertilizer portions of this trial were given by Passlow (1961).

Counts of total fallen fruit forms, total fruit production and number of plants per plot are given in Table 1. Applications of NAA did not affect the number of fallen fruit forms but the controls produced slightly more fruit forms than the treated plots at the higher fertilizer level only.

TABLE 1

TRIAL 1: FALLEN FRUIT FORMS, FRUIT FORM PRODUCTION AND NUMBER OF PLANTS

Treatment	Total Fallen Fruit Forms per Plot			Total Fruit Form Production per Plant			Plants per Plot		
	F0	F1	F2	F0	F1	F2	F0	F1	F2
D0	1,344	1,876	2,301	26·4	38·0	48·0	399	406	407
D1	1,238	1,881	2,631	27·7	38·1	45·5	399	396	415
D2	1,243	1,932	2,565	27·0	37·9	48·7	400	404	402
	H0	H1	H2	H0	H1	H2	H0	H1	H2
D0	1,740	1,823	1,958	40·0	37·1	35·2	401	400	411
D1	1,986	1,828	1,936	38·7	34·0	38·7	404	406	400
D2	1,904	2,024	1,812	38·9	39·4	35·3	401	413	392
F0	1,253	1,212	1,359	30·5	26·8	33·8	390	411	398
F1	1,860	1,972	1,857	36·9	39·8	37·3	406	403	396
F2	2,516	2,491	2,489	50·2	43·9	38·1	410	404	410
Mean	1,877	1,892	1,902	39·2	36·9	36·4	402	406	401
	Marginal	Individual		Marginal	Individual				
Necessary differences for significance 5%	179	311		2·3	4·0		No significant differences		
Necessary differences for significance 1%	272	471		3·5	6·0				

Yields per plot expressed as lb seed cotton per ac are given in Table 2 as the sum of four hand harvests on March 9-11, March 24-25, April 27 and July 31. Numbers of bolls harvested from the areas associated with the counts of fallen fruit forms appear in Table 3. There were no significant differences due to treatment with NAA in either yield or number of bolls harvested.

TABLE 2

TRIAL 1: YIELDS (LB SEED COTTON/AC)

Treatment	1st Pick			1st and 2nd Picks			1st, 2nd and 3rd Picks			Total Pick		
	F0	F1	F2	F0	F1	F2	F0	F1	F2	F0	F1	F2
D0	753	839	731	1,167	1,681	1,553	1,428	2,268	2,673	1,640	2,448	2,830
D1	1,117	786	1,059	1,746	1,846	2,210	1,950	2,386	3,152	2,102	2,447	3,266
D2	757	1,157	1,357	1,547	2,210	2,691	1,851	2,559	3,311	1,995	2,677	3,487
	H0	H1	H2	H0	H1	H2	H0	H1	H2	H0	H1	H2
D0	926	690	708	1,667	1,362	1,372	2,275	2,085	2,008	2,448	2,275	2,195
D1	898	1,070	994	1,867	1,987	1,948	2,489	2,466	2,515	2,591	2,579	2,645
D2	1,164	1,154	953	2,227	2,179	2,042	2,662	2,587	2,472	2,795	2,745	2,620
F0	831	904	893	1,529	1,522	1,409	1,802	1,801	1,626	1,949	1,973	1,815
F1	1,124	852	805	2,112	1,781	1,845	2,529	2,265	2,401	2,656	2,408	2,508
F2	1,033	1,158	957	2,121	2,226	2,108	3,095	3,073	2,969	3,229	3,218	3,136
Mean	996	971	885	1,920	1,876	1,787	2,475	2,379	2,332	2,611	2,533	2,486
	Marginal	Individual		Marginal	Individual		Marginal	Individual		Marginal	Individual	
Necessary differences for significance 5%	220	380		201	349		162	280		154	267	
Necessary differences for significance 1%	333	576		305	528		245	425		233	404	

TABLE 3

TRIAL 1: TOTAL NUMBERS OF BOLLS HARVESTED

Treatment	Number of Bolls Harvested		
	F0	F1	F2
D0	1,137	1,586	1,836
D1	1,215	1,442	1,792
D2	1,187	1,485	1,907
	H0	H1	H2
D0	1,549	1,450	1,561
D1	1,502	1,413	1,535
D2	1,572	1,533	1,475
F0	1,214	1,184	1,142
F1	1,539	1,412	1,563
F2	1,869	1,800	1,867
Means	1,541	1,465	1,524
	Marginal	Individual	
Necessary differences for significance 5%	84	145	
Necessary differences for significance 1%	127	220	

(b) Trial 2. 1959–60. 4 x 5 Randomized Block

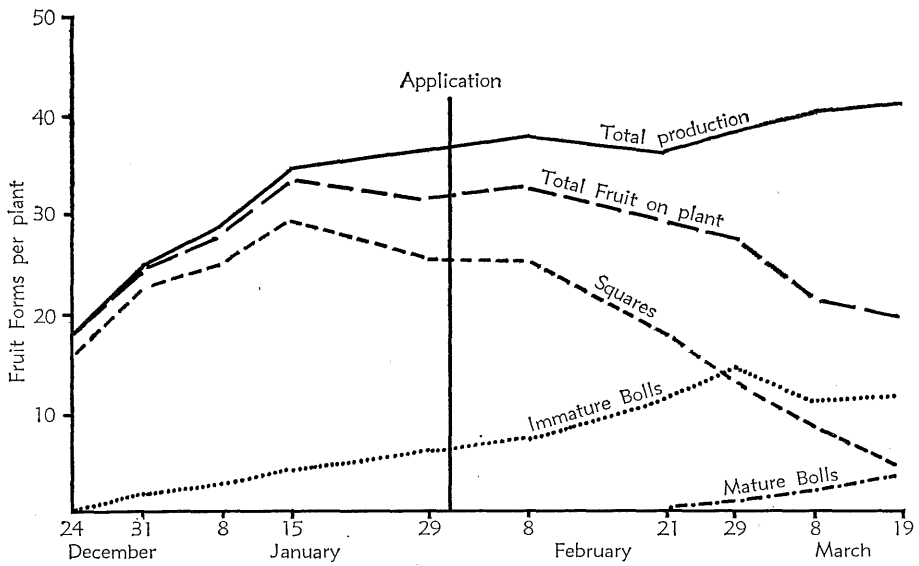

Fig. 1.—Trial 2. Production and fruit forms per plant. 10 p.p.m. NAA 2 weeks after peak square.

This trial was planted on October 22. NAA was applied at approximately 200 gal per ac on January 31, February 8 and March 4. These dates coincided with one week before peak flowering, at peak flowering and four weeks after peak

flowering. Peak flowering was estimated by finding peak square production and moving forward three weeks. Attack by *Heliothis armigera* (Hubn.) was severe over peak squaring and flowering. At this time Heliothis was not considered of great importance and so no attempt was made to control the insect at this stage.

Fruit form production on numbers of fruit forms on the plant at each count were graphed for each treatment. There were no differences in the general pattern of these graphs except for the treatment one week before peak flowering. The graph for this treatment is presented in Figure 1 and for the control treatment in Figure 2.

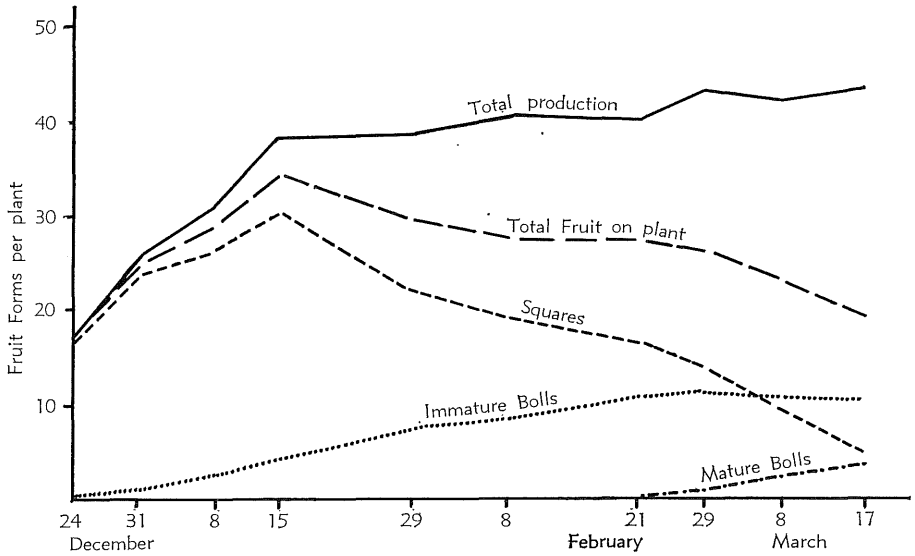

Fig. 2.—Trial 2. Production and fruit forms per plant. Untreated.

Harvesting was done by hand in two picks on March 30-31 and June 10. Total yields are tabulated in Table 4. There were no significant differences in yield.

TABLE 4

TRIAL 2: YIELDS AND NUMBER OF PLANTS

Treatment	Yield (lb/ac)	Plants per Plot
1 week before peak flower ..	734·3	64
At peak flower	740·5	67
4 weeks after peak flower ..	709·4	62
Control—untreated	709·4	62

(c) Trial 3. 1960–61. 5 x 4 Randomized Block

The trial was planted on October 27. NAA was applied on January 10, 18 and 26 and February 6 at 160 gal per ac. These times correspond with 0, 1, 2 and 4 weeks after peak counts of squares on the plant. An untreated control was included. Insect activity was slight and control was effected when insects had become noticeable.

Fruit form production and number of fruit forms on the plant at each count were again graphed. Most graphs were similar in pattern, only that for two weeks after peak square count differing from the others. This difference occurs in counts of immature bolls on the plant and this is shown in Figure 3.

Yields were taken by hand-harvesting in one pick on May 5-12. These figures are shown in Table 5 with the mean number of fallen fruit per plant in each treatment. There were no significant differences in yields and very little difference in the mean number of fallen fruit.

TABLE 5

TRIAL 3: YIELDS AND FALLEN FRUIT FORMS

Treatment	Yield (lb/ac)	Fallen Fruit per Plant
At peak squaring	1,821	25·0
1 week after peak square ..	1,915	22·8
2 weeks after peak square ..	1,964	24·2
3 weeks after peak square ..	1,859	24·5
Control—untreated	1,884	22·4

No significant differences

(d) Trial 4. 1961–62. 5 x 4 Randomized Block

The trial was planted on October 10. In contrast to the other trials, where the chemical was applied once only for each treatment, this trial involved treatments once, twice, three and four times at weekly intervals. Applications were made at 150 gal per ac on February 5, 16 and 22 and March 1. February 5 coincided with peak flower production.

Insect activity was light during the fruiting period but a very severe infestation of pink spotted bollworm (*Pectinophora scutigera* (Hold.)) later in the season caused considerable loss in yield. This loss was uniform over all plots.

Yields were taken by hand in two picks on April 18 and June 13. Total yield figures are given in Table 6. No significant differences were recorded.

TABLE 6

TRIAL 4: YIELDS

Treatment	Yield (lb/ac)
5/2	1098·7
5/2 + 16/2	1037·1
5/2 + 16/2 + 22/2	1089·0
5/2 + 16/2 + 22/2 + 1/3 ..	1102·0
Control—Nil	1098·7

No significant differences

IV. DISCUSSION

The results of Trial 1 indicate that applications of 10 p.p.m. NAA did not affect total fruit fall. There was an indication, however, that under high fertilizer levels, NAA actually may have reduced total fruit form production. There were no differences in yield, however, at any stage during harvesting, nor were there any differences in total number of bolls harvested from the treatments. All other trials confirmed that there were no differences in yield from treatment with NAA. This agrees with the work of Dale and Milford (1961) and is in complete contrast to Indian results. The results do not agree with those of Collings (1961), who found differences only when control of insects was not good. Trial 1 contained unsprayed and sprayed plots and there was no evident interaction. Trial 2 was unsprayed, Trial 3 was sprayed, but still no differences occurred.

Trials 2 and 3 show, however, that a change in fruiting pattern has been achieved by NAA. Figures 1 and 2 indicate a levelling off in the downward progress of squares on the plant coinciding with a rise in total fruit on the plant when application is made one week before peak flower counts. This suggests that either more fruit forms were held on the plant or that production of fruit forms was stimulated. There is no appreciable rise in fruit form production at this stage, showing that this levelling off is due, in fact, to retention of more squares in the treated plot. This is supported by a rise in immature boll numbers commencing just three weeks later. This rise in boll counts was followed almost immediately by a drop to the level of the controls, indicating that the plants were unable to support the extra load of bolls.

Figure 3, similarly, shows that an application at the same stage on the faster maturing Empire variety increased the number of bolls retained on the plant. These were held for only a short period, boll counts being similar to all the other treatments within two weeks of application. This supports the result of Trial 3, that increasing the retention of fruit forms, particularly bolls, places too great a strain on the plant, which eventually sheds them.

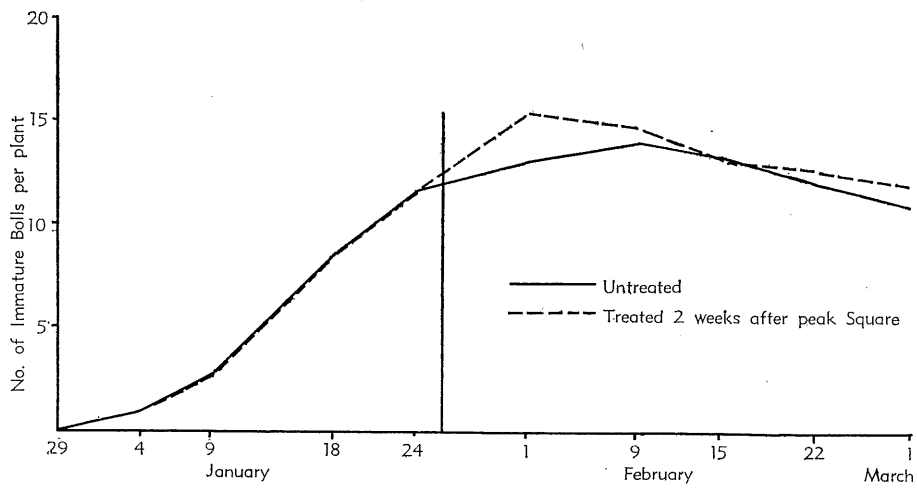

Fig. 3.—Trial 3. Immature bolls on plant.

Trial 4 was established to see if consistent weekly applications would continue to hold fruit to maturity and raise yields. This did not occur.

In one trial, a greater number of squares was retained after treatment with NAA two weeks after peak counts of squares on the plant. This resulted in higher boll counts three weeks later. In another trial, treatment at the same stage resulted in the retention of a greater number of bolls. In both cases the effect was transitory and counts returned to normal. This was effected through a decline in boll numbers in both trials, boll counts returning to normal in less than two weeks. This indicates that the plant cannot support the increased boll numbers. No significant differences in yield, harvested boll numbers or fallen fruit forms were obtained with single applications of NAA. Continued weekly applications for four weeks over this period did not increase yields. Insect control or lack of it appeared to exert no significant influence on the effects of the chemical. It is concluded that treatments with NAA have no place in cotton-growing in Central Queensland.

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