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EFFECTS OF GROWTH REGULATORS ON FLOWERING PATTERN, FLOWER SUPPRESSION AND FRUIT SET IN MANGO (*MANGIFERE INDICA* L. CV. JULIE).

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ABSTRACT

The effects of growth regulator treatments on flowering pattern, flower suppression and fruit set in mature mango trees were examined. Gibberellic acid (100 ppm) suppressed flowering for six weeks, this response being delayed in one trial. Potassium nitrate (20,000 ppm) greatly increased flowering whereas Ethrel (ethephon) at 2000 ppm was not as successful. Planofix (1-naphthylacetic acid, sodium salt) at 20 ppm appeared to increase initial fruit set when applied to inflorescences but this effect was not sustained in the trial. Planofix applied to fruit (1–2cm diameter) caused an 18% reduction in fruit drop which doubled final fruit yield.

RESUMEN

Se examina los efectos de los tratamientos con reguladores de crecimiento en el patrón de floración, la supresión de flores y el cuajado de frutos en los árboles maduros de mango. El ácido giberélico, 1000 ppm, suprimió la floración durante dos meses; sin embargo, hubo una reacción retardada en un ensayo. El nitrato de potasio, 20 000 ppm, aumentó considerablemente la floración, mientras que el Ethrel (etefón), 2 000 ppm, no fue tan exitoso. El Planofix (1-ácido naftilacético, sal de sodio 20 ppm) aumentó el cuajado inicial de los frutos, cuando se lo aplicó a las inflorescencias, pero este efecto no se mantuvo durante el ensayo. La aplicación del Planofix a los frutos (1 - 2 cm de diámetro) resultó en una reducción del 18% en la incidencia de la caída de frutos, lo que dobló el rendimiento final de frutos.

Keywords: Mango; Growth regulators; Flowering; Fruit-set.

The major commercial cultivar of mango in Trinidad is Julie. This cultivar is established in small orchards and is very popular for home planting because of its slow growth rate, good fruit quality and capacity to be quite prolific. However, average production is low at Centeno (150 fruit per tree or 12,552 kg ha^{-1} on 250 trees ha^{-1}) and may be almost nil in very wet areas of the island. Good producing trees average over 500 fruit per tree per year.

Low fruit production is thought to be due to two reasons:- low initial fruit-set taken at 2mm dia. and young fruit fall (< 2cm dia.). A major cause of low initial fruit-set is the ravaging effect of blossom blight (anthracnose disease) caused by *Colletotrichum gloeosporioides* which destorys most inflorescences especially in high rainfall areas.

Two approaches can be taken in solving the problem of low fruit production. The first is to limit flowering to the period of low relative humidity and rainfall when there is a reduced incidence of blossom blight and fruit drop due to anthracnose. Prevention of flowering may be accomplished by the use of growth regulators. The second approach involves the use of growth regulators to increase flowering and fruit-set and to reduce fruit fall.

Studies on mango in India have shown that NAA sprays have increased fruit-set (Singh *et al.*, 1965) and reduced fruit fall (Singh *et al.*, 1959). Both Ethrel (ethephon) (Chacko *et al.*, 1974; Vazquez and de los Santos de la Rosa, 1982) and KNO_3 (Bondad and Linsangan, 1979; Vazquez and de los Santos de la Rosa, 1982) have been used to induce flowering in mango whereas GA_3 has caused flowering suppression in citrus (Monselise and Halevy, 1964). Preliminary trials (unpublished) on mango shoots were done in 1982 by the authors using these three last named regulators with encouraging results.

In this study trials were conducted with growth regulators applied to whole trees. Flowering suppression, inflorescence production and fruit-set were examined in separate trials during the period March 1983 to May 1985.

Materials and methods

All trials were conducted on twenty-year old 'Julie' trees at Centeno. These had been cut back to a 2m height in October 1981. Spray treatments with one exception were all single applications which included a surfactant/sticker, Agral 90.

A system was devised for taking weekly data without counting the same inflorescences in two consecutive weeks. Young inflorescences which were characterized by small size, unopened flowers and absence of a purple tinge on the main stalk were not counted. Inflorescences that had many enlarged ovaries without petals and that had started drying were also excluded. The remainder were designated 'mature inflorescences' and counted. This 'mature inflorescence' stage did not last longer than one week.

Flower suppression

Trial 1. GA 1000 ppm was sprayed to drip on five non-flowering trees using a knapsack sprayer. Five control trees received no spray. Treatment date was 23 November 1983.

Trial 2. Four treatments (a control, GA 100 ppm, GA 500 ppm and GA 1000 ppm) were each applied to five non-flowering trees. Application was done with a mist-blower on 28 February 1985. The five control trees received no spray. Mature inflorescences were counted weekly in both trials. Fruit counts were taken for final vield in Trial 1 and for fruit-set in Trial 2.

Flower induction

Ethrel 2000 ppm and KNO_3 20,000 ppm were each sprayed onto ten non-flowering trees using a knapsack sprayer on 8 November 1983. Ten control trees received no spray. Mature inflorescences were counted weekly and a final fruit count for yield done at the mature green stage.

Fruit-set

Planofix (NAA) at the equivalent of 20 ppm NNA was sprayed on 15 'Julie' trees with a mist blower on 8 March 1983 and repeated after 17 days. Fifteen control trees received no spray. These trees were all carrying fruit of pea to marble size (1-2cm dia.). Three panicles, two with fruit and one not yet set, were selected on each tree at application. These panicles were monitored for data on fruit-set and loss.

Results and discussion

Flower suppression

'Julie' undergoes several flushes of flowering beginning around September. Flowering is light at first, becoming profuse from January onwards and ends around April.

A flowering flush occurred within two weeks from treatment date in both trials. GA_3 1000 ppm suppressed and delayed flowering for six weeks in Trial 1 (Fig. 1).

In contrast all GA_3 treatments including GA 1000 appeared not very effective initially in Trial 2 (Fig.2). However, the effect was significant by the third week after treatment (Fig.2). It is suspected that this delayed response occurred because treatment was applied late into the flowering period when the stimulus to flower had already taken effect.

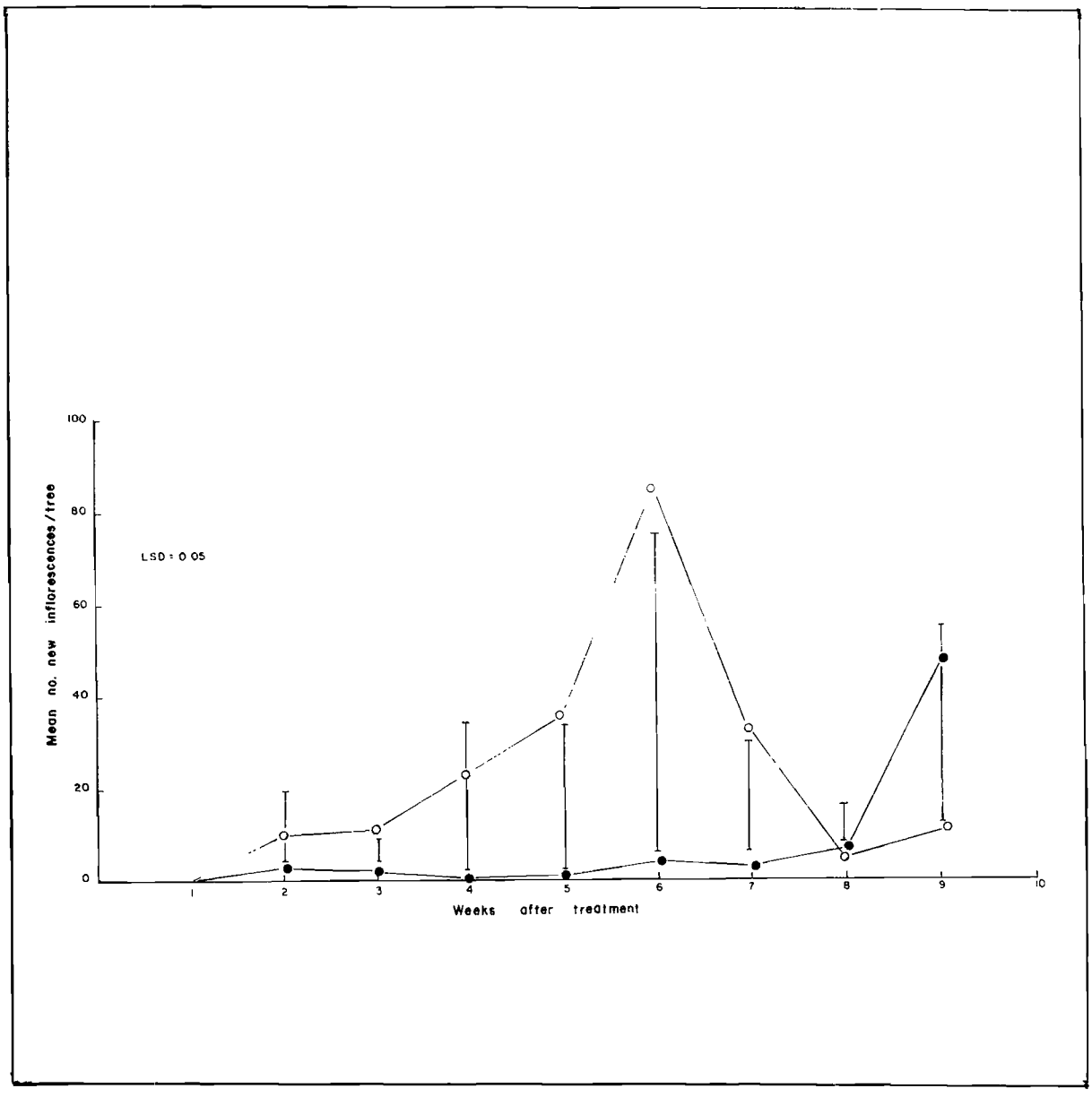

Figure 1: Flowering pattern of 'Julie' Mango in response to Gibberellic acid (GA) spray. ●, GA 1000 ppm; O, no spray. Treatment date 83. 11. 23.

The GA 100 ppm treatment was no longer effective by week 7 in contrast to the other GA treatments (Fig. 2). It may therefore be possible to control length of suppression period by varying GA concentration of the spray treatment. It appears that GA 100 ppm treatment must be used earlier than 28 February (Trial 2) for subsequent heavy flowering to occur naturally.

There was no statistical difference in final fruit yield between treatments in Trial 1. However, fruit-set data in Trial 2 (Fig. 2) shows better yielding in the control. This may be as a result of flowering suppression on the GA_3 treated trees. No subsequent flowering occurred for that production season in contrast with Trial 1 where treatment was applied early the season.

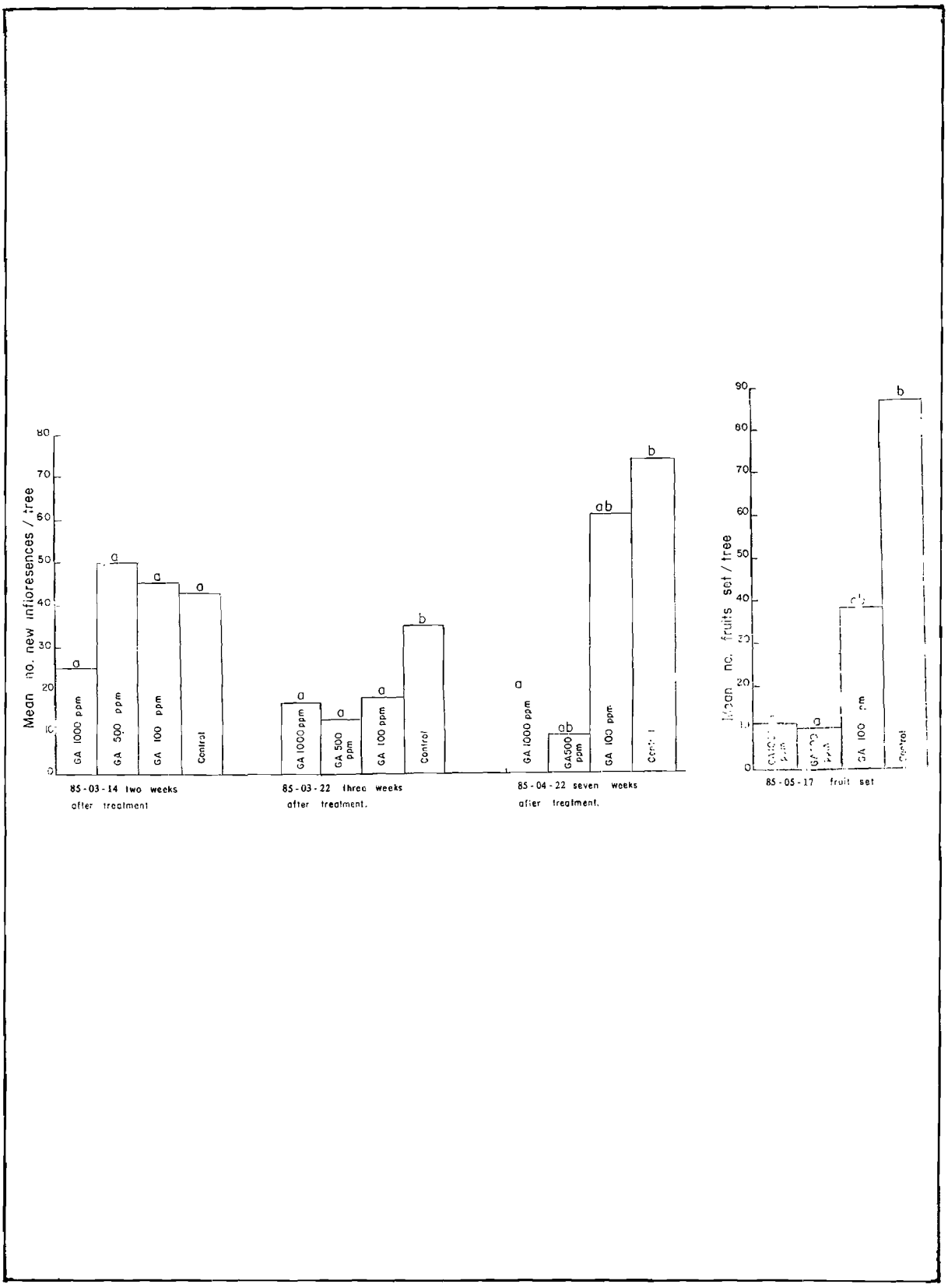

Figure 2: Flower production at intervals in 'Julie' Mango in response to treatment with Gibberellic acid (GA) and subsequent fruit set. Mean separation for flower production at each interval and for fruit set by Duncans mutiple range test, 5% level.

Flower induction

A significant increase in production of inflorescences was obtained with KNO_3 but not with Ethrel within two weeks of treatment (Fig. 3). This superior performance of KNO_3 supports the results on mango reported by Vazquez and de los Santos de la Rosa (1982) although repeated Ethrel treatment is known to give very good results in juvenile mango seedlings (Chacko *et al.*, 1974). Final fruit count showed no advantage of the increased flowering early in the season.

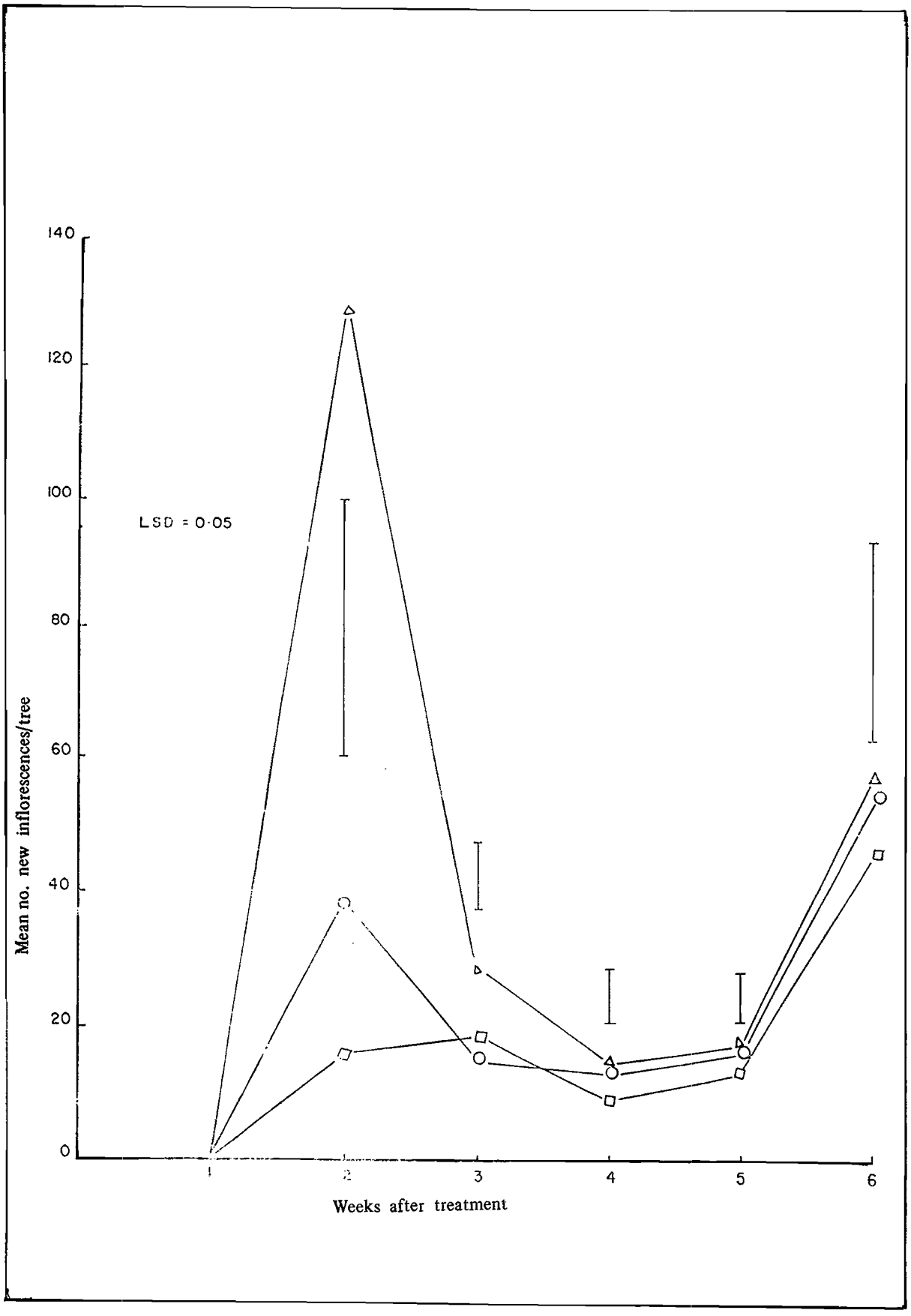

Figure 3: Flowering patternof 'Julie' Mango in response to growth regulator sprays. △, KNO_3 20,000 ppm; o, Ethrel 2,000 ppm; □, no spray. Treatment date 8. 11. 83.

Fruit-set

Initial fruit-set (just after petal loss) appeared to be increased by Planofix sprays on panicles that had been treated at the inflorescence stage. However, this effect was not significant (Table 1). Initial fruit-set is normally prone to fruit drop within six weeks after full bloom (Singh *et al.*, 1959). This fruit drop was 99% after six weeks in this study.

Treatment at the 1cm dia. stage, approximately one month after anthesis, resulted in an 18% reduction in fruit drop which doubled yield – 35% retention compared to 17% retention (Table 2). Singh *et al.*, (1959) obtained slightly higher results in their work on other cultivars using NAA at the same stage of fruit development.

Table 1 Effect of Planofix on initial fruit-set in 'Julie' mango.

No of weeks after treatment	Fruit-set		Panicles surviving	
	Treated	Untreated	Treated	Untreated
0	0	0	15	15
1	148	57 NS	13	11
2	47	10 NS	6	4
4	2	2	2	2
6	1	1	1	1

Table 2 Effects of Planofix on fruit drop in 'Julie' mango

	Treated	Untreated
Initial set before treatment (1cm. dia.)	82	103
Fruit drop after two months	53 (65%)	85 (83%)
Retained fruit	29 (35%)	18 (17%)*

* Significant at the 5% level.

Anthracnose was the major factor accounting for young fruit fall at Centeno (G. Persad, unpublished). The disease is expected to be least severe during April, the period of lowest rainfall and humidity. It may be advantageous to suppress early flowering and then later reinduce heavy flowering so that full bloom and fruit-set begins early April.

Conclusion

Data from individual trials demonstrate successful use of growth regulators on 'Julie' mango in controlling its reproductive phase in order to increase yield. Additional studies on continued suppression, subsequent reinduction of flowering and increasing fruit-set are required before the integrated use of growth regulators can be incorporated into the production system.

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