EFFECTS OF GIBBERELLIC ACID ON THE FLOWERING OF *SESAMUM INDICUM* L.

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ABSTRACT

Gibberellic acid (GA) in the concentrations of 1, 10 and 100 ppm. of aqueous solution was applied as pre-sowing soaking treatment of seeds and also as foliar sprays and drops of different durations at three stages in the life-cycle of *Sesamum*, an annual plant with a single phase of growth. In none of the treatments, however, there was any early induction of flowering. On the contrary, a significant delay in the process was recorded when plants both 10 and 24 days old received a repeated treatment with 100 ppm. of GA.

It appears that the chemical has no florigenic property and its effect in bringing about an early termination of the vegetative cycle in certain annual and biennial plants with two distinct phases of growth,—one of rosette formation and the other of stem elongation and flowering, is secondary.

INTRODUCTION

In recent years a number of papers has appeared dealing with growth and flowering responses of plants subjected to the treatments of gibberellins and gibberellic acid (Brian and Grove, 1957 ; Bukovac and Wittwer, 1957 ; Bünsow and Harder, 1956*a*, *b*, 1957 ; Gray, 1957 ; Lang, 1956, 1957 ; Marth *et al.*, 1956, Wittwer and Bukovac, 1957*a*, *b* and Wittwer *et al.*, 1957). In addition to the general effect of bringing about an extension growth, these chemicals also bring about an earliness in flowering in a number of plants like carrot, lettuce, endive, mustard, cabbage, henbane etc. In almost all the plants referred above, there are two distinct phases of growth, one leading to the formation of a rosette of leaves and the other to that of stem elongation and flowering. As in these plants onset of the reproductive phase and stem elongation go hand in hand, the effect of gibberellic acid in bringing about an earliness in flowering might be an indirect one i.e., by the way of causing an extension-growth of the stem. In order to subject the above suggestion to experimental test, a detailed investigation has been undertaken with *Sesamum indicum* L. which is an annual plant with a single phase of growth.

EXPERIMENTAL PROCEDURE

Two sets of experiments were carried out. In the first, 1, 10 and 100 parts per million of aqueous solution of gibberellic acid* was applied as 12 hours' pre-sowing soaking treatment of the seeds. In the second, these solutions were applied as foliar sprays to runoff and as droppings on the leaf whorl. Spraying treatments were commenced when the plants were 10 and 24 days old, while that

* Sample of gibberellic acid used in this experiment was obtained through the kind courtesy of Eli Lilly and Company, Indianapolis, Ind., USA.

of dropping at an age of 30 days. In the case of 10 day old plants, the chemical was applied once in the life-cycle and also five times at both daily and weekly intervals. In plants 24 day old, five sprayings were done at the interval of three days and the rest two treatments were the same as in the previous case. Dropping on the leaf whorl was done by delivering approximately 0.05 c.c. of the solution with a micropipette.

Seeds of the variety T. 10 were sown in 9″ pots containing well manured garden soil. Four pots were allotted to each of the variables with a final stand of three to four plants per pot. Dates of opening of the first flower from the first-formed bud were recorded for individual plants and the average time taken for anthesis by the plants of each treatment calculated. Number of leaves developed on these plants below the node of floral initiation including the cotyledonary ones has also been recorded.

The method of analysis of variance has been used to determine the statistical validity of the experiments.

Results and Discussions

Data collected have been presented in Tables I and II.

Table I

Effect of 12 *hours' pre-sowing soaking treatments of seeds of* Sesamum indicum *L. with different concentrations of gibberellic acid (GA) on the time taken for anthesis and the number of leaves at floral initiation. Number of plants are shown within brackets.*

Date of sowing : 11-7-57. Error mean sq ; Anthesis : 0.32
Leaf number : 0.97

Concentration of GA	Time taken for anthesis	Earliness over control	Leaf No.	Decrease over control	Remarks
Control	33.66 days (15)	—	11.46	—	None of the
1 ppm.	33.53 „ (15)	0.13	10.66	0.80	differences
10 „	33.60 „ (15)	0.06	10.93	0.53	are
100 „	33.66 „ (15)	0.00	11.20	0.26	significant.

It would be seen that in none of the treatments there has been an early induction of flowering. On the contrary, when gibberellic acid in the concentration of 100 ppm. was sprayed once a week for five times commencing at an age of ten days and also daily for five consecutive days and five times once every third day commencing at an age of twenty four days, there has been a significant delay in the time taken for anthesis and also a significant increase in the number of leaves developed prior to floral initiation. Treatments given late in the life-cycle is more effective in bringing about this delay in flowering than the ones given early. In almost all the treated plants there was an extension growth due to elongation of the internodes.

Marth *et al.* (1956), while working with a number of plants failed to record any evidence that gibberellic acid could induce them to initiate flower primordia. On the other hand, both these authors and Gray (1957) found an inhibition of flower bud development in *Capsicum* for about 3 to 4 weeks after treatment with this chemical. Thimann (personal communication) could record no earliness in flowering in treated *Chenopodium* plants. Absence of response has also been noticed in onion by Rappaport (1956). Wittwer *et al.* (1957), while working with beans and tomatoes observed an early flowering in the early or strongly determinate

varieties without any reduction in the node number preceding the first flower and came to the conclusion that gibberellin did not specifically influence the flowering process.

Lindstrom *et al.* (1957) have reported hastening in flowering varying from 10 days to 4 weeks in annual plants like stocks, petunia, larkspur, English daisy, China aster and gerbera when grown during the fall and winter in the green house. However, as no record of the amount of vegetative growth expressed as leaf numbers preceding the first flowers has been taken, it is not possible to decide whether gibberellin did actually influence the process of flowering in these plants.

TABLE II

Effect of different modes of application of gibberellic acid (GA) on the time taken for anthesis and the number of leaves at floral initiation of Sesamum indicum *L. Number of plants are given within brackets.*

Date of sowing : 1-7-57. Error mean Sq.; Anthesis : 13.1, Leaf number : 4.8

Age of commencement of treatment	Mode of application	Conc. of GA	Time taken for anthesis in days	Earliness over control	Leaf No.	Decrease over control
Control			42.13 (15)	—	12.66	—
10 days	Single spray	1 ppm.	41.72 (11)	0.41	12.54	0.12
,, ,,	,, ,,	10 ,,	42.63 (11)	−0.50	12.72	−0.06
,, ,,	,, ,,	100 ,,	42.72 (11)	−0.59	12.72	−0.06
,, ,,	5 sprays, once a day	1 ,,	24.46 (15)	−0.33	12.40	0.26
,, ,,	,, ,, ,, ,,	10 ,,	43.90 (10)	−1.77	13.00	−0.34
,, ,,	,, ,, ,, ,,	100 ,,	43.25 (8)	−1.12	12.75	−0.09
10 days	5 sprays, once a week	1 ppm.	42.55 (9)	−0.42	12.66	0.00
,, ,,	,, ,, ,, ,,	10 ,,	44.25 (12)	−2.12	12.66	0.00
,, ,,	,, ,, ,, ,,	100 ,,	†57.25 (8)	−15.12**	18.00	−5.34**
24 days	Single spray	1 ,,	41.38 (13)	0.75	12.15	0.51
,, ,,	,, ,,	10 ,,	41.23 (13)	0.90	12.00	0.66
,, ,,	,, ,,	100 ,,	43.91 (12)	−1.78	15.00	−2.34
,, ,,	5 sprays, once a day	1 ,,	42.07 (14)	0.06	12.85	−0.19
,, ,,	,, ,, ,, ,,	10 ,,	43.00 (12)	−0.87	13.66	−1.00
,, ,,	,, ,, ,, ,,	100 ,,	53.08 (12)	−10.95**	19.50	−6.84**
,, ,,	5 sprays, once in 3 days	1 ,,	42.30 (13)	−0.17	12.61	0.05
,, ,,	,, ,, ,, ,,	10 ,,	42.63 (11)	−0.50	12.18	0.48
,, ,,	,, ,, ,, ,,	100 ,,	47.33 (9)	−5.20*	18.44	−5.78**
30 days	5 drops, one per day	1 ,,	41.80 (10)	0.33	12.30	0.36
,, ,,	,, ,, ,, ,,	10 ,,	42.30 (10)	−0.17	12.40	0.26
,, ,,	,, ,, ,, ,,	100 ,,	42.60 (10)	−0.47	12.70	−0.04

† Several plants failed to flower.
* Significant at 5 per cent level.
** Significant at 1 per cent level.

There exists a fundamental difference in the growth characteristics of plants like *Sesamum* on the one hand and on the other the biennial and annual forms of plants like carrot, lettuce, endive, mustard, cabbage, henbane etc., which have in almost all the cases given a positive flowering response to gibberellic acid and gibberellin treatments. In the biennial and annual plants referred above, the process of flowering follows a rapid stem elongation after the formation of a rosette during the vegetative condition, while in *Sesamum* it is not so. Failure of gibberellic

acid to bring about an earliness in flowering in *Sesamum indicum* and a number of other plants suggests that this chemical does not have any florigenic property. It seems quite probable that induction of early flowering in these annual and biennial plants is brought about in an indirect way i.e., by causing the stems to elongate, a phenomenon which normally accompanies their flowering. Lang (1957) while working with several biennials, winter annuals, long-day and short-day plants, came to the conclusion that the effect of gibberellin on flower-formation might be a secondary one and the present findings support the view.

In several biennial plants gibberellic acid and gibberellins have been found to replace vernalization treatment of seeds (Blaney, 1957 ; Bukovac and Wittwer, 1957 ; Lang, 1957 and Wittwer and Bukovac, 1957*c*). However, this question does not arise in *Sesamum* as prechilling of seeds has no effect on its flowering (Chakravarti, 1956). It would be of great interest to determine the effect of gibberellic acid and gibberellins on the flowering of plants with a single phase of growth and giving a positive response to the vernalization treatment.

Summary and Conclusions

In the present investigation effect of 1, 10, and 100 ppm. of aqueous solution of gibberellic acid (GA), when applied as pre-sowing soaking treatment of seeds and also as foliar sprays and drops of different durations at three stages in the life cycle of *Sesamum indicum* on its flowering behaviour has been studied. Data of the time taken for anthesis from the date of sowing and also of the amount of vegetative growth expressed as leaf numbers preceding the first flower have been collected.

In none of the cases, however, there has been, an early induction of flowering. On the contrary, in spraying treatments of 10 day old plants with 100 ppm. of GA once a week for five times and of 24 day old plants with the same concentration daily for five consecutive days and five times once every third day, there has been a significant delay in flowering as determined by both the criteria referred above.

It is concluded that GA does not have any florigenic property and it brings about an earliness in flowering in biennial and annual plants with two distinct phases of growth, one of rosette formation and the other of stem elongation and flowering, in an indirect way.

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