# Studies on the Effect of Growth Regulators on Flowering and Fruit-setting in *Sesamum Indicum*

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## Introduction

*Seamum Indicum* L. known as Sesame or gingelly is an oil seed which furnishes one of the most important oils of domestic consumption in India. Application of growth regulators in plant tissues, either by seed treatment or by spraying at different stages of growth has been found to have striking effect on growth, general vigour and final production of the plant. The present investigation has been undertaken to study the effect of three growth regulators viz., Naphthalene acetic acid (NAA), Gibberellic acid (G A) and 2,4–dichlorophenoxy acetic acid (2,4-D) on flowering and fruit-setting in *Sesamum indicum L.*

## Review of Literature

Numerous reports had been published concerning the effect of growth regulators on flowering and fruit-setting of many crop plants, when applied as seed treatment or as spray application. Mazzani and Gonzalez (1959) reported the effect of GA on sesame, bean, tomato and papaw. Germination of sesame, bean, tomato and papaw seeds was unaltered by seed treatment with gibberellin, but seedling growth was accelerated and seedling heights were roughly proportional to the concentration of gibberellin which caused elongation of internodes, but repeated treatments had cumulative effects and very high concentrations were phytotoxic.

Choudhury and Singh (1960) studied the effect of seed treatment with NAA at 25, 50, 100 and 150 ppm, 2,4-D at 0, 5.5, 1, 2 and 2.5 ppm and GA at 5, 10, 15 and 20 ppm on tomato seeds. Lower concentrations of 2, 4-D resulted in better germination, quicker growth and higher yield of fruits. GA at all concentrations gave significantly higher growth of the main stem and yield of fruit than the control.

Clark and Kerns as early as (1942), Cooper (1942) (cited by Skoog) and subsequently Van Overbeek (1946) reported that flowering in Pine apple can be induced with certain synthetic growth regulators such as 50 ml of NAA or 2,4-D at a concentration of 5ppm. Leopald and Thimann

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(1949) were able to increase by as much as 35% the number of flowers in barley by applying a weak solution of NAA. Chakravarthi and Abraham (1959) studied the effect of GA at 1, 10 and 100 ppm on *Sesamum indicum* as pre-soak treatment and as foliar sprays. Flower induction was not hastened by any of these treatments. However induction was significantly delayed when plants 10 and 24 days old received repeated treatment with 100 ppm of GA. Thorup (1959) found that treatment with GA advanced flowering in *Cleome monophylla*, *Tagetespatula* and *Pelargonium zonale* and favoured fruit set in *Ricinus communis*.

Itakura, Shiraki and Shiraki (1959) reported that vegetative growth was stimulated and flowering was accelerated in horticultural plants like petunia, pansy, hydrangia, eyelaman, narcissus, primula and adonis by spray application cf GA at 25, 50 and 100 ppm.

Growth regulators had been found to be useful in supplementing normal pollination in the setting of fruits. Luckwill (1953) found that NAA is useful in effecting fruit-set in apples. Crane and Bradley (1956) observed that in Stewart appricots aqueous sprays containing 100 ppm of NAA and 2, 4-D has hastened fruit maturity and increased the fruit size. Ueno (1956) working in straw berries noticed that NAA applied at higher concentrations before flower formation inhibited flowering and fruiting considerably. Kepkowa (1959) found that application of NAA in tomato increased the early yields and percentage of small fruit was considerably reduced, but the spray had only slight favourable effect on the total yield of tomatoes. Marsh, Southwick and Weeks (1961) found that sprays of NAA after petal fall reduced fruit-set in apples. Wittwer and Bukovac *etal* (1957) reported that treatment with gibberellin hastened flowering and maturity and setting of fruits in tomato and beans. Krimbas, Davidas and Michailidis (1959) found that spray application of GA at 10, 20 or 30 ppm to black corinth grapes, 3 days after full bloom increased fruit size and approximately doubled the yield of fresh fruits as compared with control. Krishnamurthi, Randhawa and Singh (1959) observed that in Pusa seedless variety of grapes GA at 10 and 25 ppm sprayed to the flower clusters increased fruit-set by 76 5% and 59.1% respectively and at 50 ppm reduced fruit-set by 15.41%. Randhawa, Singh and Dhuria (1959) working with sweet lime found that GA at 10 ppm and 2,4-D at 10 and 15 ppm increased fruit-set and reduced fruit-drop. Dukovac, Larsoen and Bell (1960) found that in concord grapes fresh and dry weight and number of berries per cluster were not significantly affected by GA sprays at 10, 25 and 100 ppm. Stewart and Parker (1954) reported that in grapes 2,4-D is effective for increasing yield, size and quality of graps fruit. Krishnamurthy and Subramoniyan (1954) in *Solanum melongena* found that application of 2,4-D as a paste at 0.0025 to 0.01% or as water sprays at 0.0005% increased fruit-set as a whole by 50 to 60%. Muthukrishnan (1957) found that application of 2,4-D at 5 ppm as water spray to the flowers of brinjal resulted in increased fruit-set by 25% more than the control. Srinivasan, Meenakshi and Jambulingam (1963) while studying the effect of phytohormones on pod-set in *Dolichos lab-lab*, observed that NAA and GA at 10 and 50 ppm increased the percentage of pod-set. The GA foliar-cum-inflorescence

spray gave the maximum pod-set of 34.6%, while the untreated control registered only 24.4%.

## Materials and Methods

The investigations reported here were carried out in the year 1962-1963 in the Division of Agricultural Botany. Agricultural College and Research Institute, Vellayani. An early maturing variety of sesame of 3 months' duration provided the experimental material for the present studies.

The following growth regulators at different concentrations were used for the studies.

1. Naphathalene accetic acid (NAA) — 0, 15 and 30 ppm
2. Gibberellic acid (GA) — 0, 25 and 50 ppm
3. 2, 4-dichlorophenoxy actic acid (2,4-D) — 0, 2 and 5 ppm

Application of the above growth regulating substances were made at three different stages in the life cycle of the plant viz. seed, seedling and at the time of flowering.

### Layout of the experiment

Design — Randomised block
Replication - 5
Treatments — 27

| | | | |
|---|---|---|---|
| 1 | NAA | 0 level | Seed treatment |
| 2 | ,, | ,, | Seedling spray |
| 3 | ,, | ,, | Flower spray |
| 4 | ,, | 15 ppm | Seed treatment |
| 5 | ,, | ,, | Seedling spray |
| 6 | ,, | ,, | flower spray |
| 7 | ,, | 30 ppm | seed treatment |
| 8 | ,, | ,, | seedling spray |
| 9 | ,, | ,, | flower spray |
| 10 | GA | 0 level | seed treatment |
| 11 | ,, | ,, | seedling spray |
| 12 | ,, | ,, | flower spray |
| 13 | ,, | 25 ppm | seed treatment |
| 14 | ,, | ,, | seedling spray |
| 15 | ,, | ,, | flower spray |
| 16 | ,, | 50 ppm | seed treatment |
| 17 | ,, | ,, | seedling spray |
| 18 | ,, | ,, | flower spray |
| 19 | 2, 4-D | 0 level | seed treatment |
| 20 | ,, | ,, | seedling spray |
| 21 | ,, | ,, | flower spray |
| 22 | ,, | 2 ppm | seed treatment |
| 23 | ,, | ,, | seedling spray |
| 24 | ,, | ,, | flower spray |
| 25 | ,, | 5 ppm | seed treatment |
| 26 | ,, | ,, | seedling spray |
| 27 | ,, | ,, | flower spray |

The experiment was conducted as pot culture. The seeds receiving treatments were soaked in the growth regulators for 12 hours before sowing. Treatments receiving spray application at the seedling stage was given on the 20th day and spray at the time of flowering was given on the 14th day after sowing.

## Experimental Results

(i) *Flower production*

Opened flowers were counted daily in the morning. The mean number of flowers produced under different treatments is given in Table I. The total number of flowers produced by different treatments have been statistically analysed and all the treatments are found to be significant.

From the table, it is seen that the application of growth regulators has a striking

TABLE 1

Mean Number of Flowers per Plant.

| Growth regulators. | Stage of application | | | Mean |
|---|---|---|---|---|
| | Seed | Seedling | Flowering time. | |
| Control | 36 5 | 36.5 | 36.5 | 36.5 |
| NAA 15 ppm | 41.3 | 44.6 | 41.4 | 42.4 |
| NAA 30 ppm | 29.6 | 46.9 | 47.2 | 41.2 |
| Mean | 35.5 | 45.8 | 44.3 | 41.8 |
| GA 25 ppm | 38.8 | 40.7 | 41.9 | 40.4 |
| GA 50 ppm | 42.5 | 42.3 | 43.1 | 42.4 |
| Mean | 40.7 | 41.5 | 42.5 | 41.4 |
| 2,4-D 2 ppm | 46.7 | 45.0 | 41.5 | 44.6 |
| 2,4-D 5 ppm | 44.8 | 45.3 | 47.3 | 45.7 |
| Mean | 45.8 | 45.6 | 44.4 | 45 2 |
| General mean | 45.8 | 45.6 | 44-4 | |

Critical difference (5 percent level)

| | | | |
|---|---|---|---|
| (i) | Treatment combinations | — | 1.808 |
| (ii) | Growth regulators | — | 0 738 |
| (iii) | Stages of application | — | 0.738 |
| (iv) | Levels of a growth regulator | — | 1.043 |
| (v) | Stages of application within a growth reguator | — | 1 282 |

effect in producing greater number of flowers. Of the three growth regulators 2, 4–D evokes a better response by producing more flowers than NAA or GA the difference in effect among these being significant. However, there is an indication that NAA is better than GA, but the superiority is not significant. Comparing the different levels of 2,4-D, 5 ppm is found to be significantly superior to 2 ppm in flower production. NAA at 15 ppm gives significantly superior results than 30 ppm. Of the different levels of GA, 50 ppm shows significantly better response by producing more flowers than 25 ppm. Application of growth regulators at different stages has increased the number of flowers significantly. Seeds respond with the production of the largest number of flowers and is followed by seedlings, the difference in effect being significant. The effect of different concentrations of the growth regulators at different stages is revealed from the table itself.

(ii) *Fruit–set*

The number of fruits corresponding to different treatments has been analysed statistically and all the treatments are found to be significant. The mean number of fruits under each treatment is given in Table II.

TABLE II

Mean Number of Fruits per Plant

| Growth regulators | Stage of application | | | Mean |
|---|---|---|---|---|
| | Seed, | Seedling | Flowering time | |
| Control | 27.2 | 27.2 | 27.2 | 27.2 |
| NAA 15 ppm | 34.8 | 36.5 | 32.5 | 34.6 |
| NAA 30 ppm | 21.4 | 36,0 | 37.4 | 31.6 |
| Mean | 28.1 | 36.3 | 34.9 | 33.1 |
| GA 25 ppm | 32.1 | 34.6 | 34 6 | 33.5 |
| GA 50 ppm | 32.6 | 34.8 | 36 9 | 34.8 |
| Mean | 32.4 | 34.0 | 35.8 | 34.1 |
| 2,4-D 2 ppm | 36.6 | 40.9 | 37.2 | 38.2 |
| 2,4-D 5 ppm | 36.8 | 30.6 | 43.0 | 38.8 |
| Mean | 36.7 | 38.8 | 40.1 | 38.5 |
| General Mean | 32.3 | 36.5 | 36.9 | |

Critical difference (5 per cent level)

(i) Treatment combinations – 1.661
(ii) Growth regulators – 0.654
(iii) Stages of application – 0.654
(iv) Levels of a growth regulator - 0.924
(v) Stages of application within a growth regulator- 1.136

The table reveals that the application of growth regulators increased the number of fruits. The greatest increase was produced by 2,4-D followed by GA and NAA the differences in effect among the treatments being significant. Comparing the different levels of 2,4-D, 5 ppm is superior to 2 ppm in increasing the number of fruits, but the difference in effect is not significant. Of the different levels of GA, 50 ppm is significantly superior to 25 ppm. Among the different levels of NAA, 15 ppm has produced greater number of fruits than 30 ppm the difference in effect being significant. Comparing the effect of applications of the growth regulators at different stages it is found that the greatest number of fruits has been obtained from plants receiving treatments at flowering lime, followed by plants receiving treatments at seedling stage and seeds in the order of their response.

The percentage of fruit-set was calculated, and the mean percentage of fruit-set corresponding to different treatments is given in Table III. The growth regulators have

TABLE III

Mean percentage of Fruit-set per Plant

| Growth regulators | Stage of application | | | Mean |
|---|---|---|---|---|
| | Seed | Seedling | Flowering time. | |
| Control | 75.0 | 75.0 | 75.0 | 75.0 |
| NAA 15 ppm | 81.4 | 80.8 | 81.2 | 81 1 |
| NAA 30 ppm | 81.2 | 77.2 | 79.8 | 79.4 |
| Mean | 31.3 | 79.0 | 80.5 | 80.2 |
| GA 25 ppm | 83.4 | 83.6 | 83.4 | 83.5 |
| GA 50 ppm | 77.8 | 77,,8 | 82.0 | 79.2 |
| Mean | 80.6 | 80.7 | 82.7 | 81.3 |
| 2,4–p 2 ppm | 78.6 | 89.6 | 90,2 | 86.1 |
| 2,4–p 5 ppm | 82.0 | 81.2 | 91.2 | 34.8 |
| Mean | 80.3 | 85.4 | 90,,1 | 85.5 |
| General Mean | 80.7 | 81,7 | 84.6 | |

Critical difference (5 per cent level)

(i) Treatment Combinations – 0.421
(ii) Growth regulators – 0.172
(iii) Stages of application – 0.172
(iv) Levels of a growth regulator - 0.243
(v) Stages of application within a growth regulator. - 0.299

increased the percentage of fruit-set. The maximum with 85.3% fruit-set corresponds to 2,4–D treatments followed by GA with 81.3% and NAA with 80.2%. Comparing the effect of application of the growth regulators at different stages, spray at the time of flowering gives the maximum percentage of setting ie. 90.7%, followed by spray at the seedling stage ie. 81.7% and seed treatment with 80.7%.

**Discussion**

(i) *Flower production*

Treatment with growth regulators had increased the number of flowers in all treatments except in plants receiving pre-sowing treatment with 30 ppm NAA. The greatest increase in number of flowers had been caused by 2.4–D treatments, followed by NAA and GA. Greatest increase had been produced by treatments receiving a spray of NAA 30 ppm at the flowering time. This has been supported by Leopald and Thimann (1949) in barley. But Ueno (1956) observed a reverse effect in strawberries. However the greatest number of flowers produced by the plants receiving NAA 30 ppm at flowering time indicates that NAA promotes flowering in *Sesamum*. All the GA

and Singh (1959) in grapes and Singh and Dhuria (1959) in sweetlime. A maximum fruit-set of 91.2% had been achieved when 2,4-D at 5 ppm was sprayed at the time of flowering. This is in agreement with the findings of Krishnamurthy and Subramaniyan (1954) in brinjal. Effect of 2, 4-D, GA and NAA in increasing the percentage of fruit-set is confirmed here. Although NAA is effective in producing more flowers than GA, percentage of fruit-set had been increased by GA treatments, thus resulting tn greater number of fruits.

Summary

An experiment was conducted to study the effect of NAA at 0, 15 and 30 ppm, GA at 0, 25 and 50 ppm and 2, 4-D at 0, 2 and 5 ppm at different stages of life cycle on the flowering and fruit-setting of *Sesamum indicum* L. Observations revealed that flower production and total number of fruits were increased by treatment with growth regulators except in plants receiving pre-sowing treatment with NAA 30 ppm. Maximum production of flowers and fruits was obtained by 2, 4-D treatments. Even-though NAA produced more flowers than GA treatments, greatest number of fruits was obtained from GA than NAA. 2, 4-D treatments increased the percentage of fruit-set by 90.7% while control recorded only 75.0%.

It is, therefore, evident that all the three growth regulators employed in the present study except NAA at 30 ppm, as pre-sowing treatment have a striking effect in increasing the flower production and percentage of fruit-set thus resulting in increased number of fruits. The effect is more significant hen used as foliar sprays.

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