

Impact of Gibberellic Acid on Seed Yield of Sesame (*Sesamum indicum* L) Genotypes

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ABSTRACT

Sesame (*Sesamum indicum* L.) is the fourth most important oilseed crop after rapeseed-mustard, soybean and groundnut. In West Bengal, it is cultivated during summer season and is the second most important oilseed crop. Seed, being the vital input for crop production, poor quality seed often faces problems during early growth, plant population and ultimately on seed yield. Use of growth regulators has effects on plant development and seed production. The present experiment was carried out considering four genotypes (V1: Rama, V2: Savitri, V3: Suprava, V4: Tilottama) and seven treatments viz., T1: GA₃ @ 50ppm, T2: GA₃ @ 100ppm, T3: GA₃ @ 200ppm, T4: GA₃ @ 300ppm, T5: GA₃ @ 400ppm, T6: GA₃ @ 500ppm, T7: Control (water spray) in split plot design with three replications. The results of the experiment revealed that, maximum number of capsule plant⁻¹ (99.5) was observed in T2 followed by T7 (93.1) with significant variation between them. T2 (GA₃ @100 ppm) had maximum seeds capsule⁻¹ (34.75) and seed yield (1483 kg/ha) also. Among the varieties Rama (V1) produced maximum capsule plant⁻¹ (98.5) followed by Savitri (V2). Savitri (V2) had maximum seed capsule⁻¹ (37.38) with highest 1000 seed weight (3.36 g) and seed yield (1533 kg/ha). GA₃ @ 200ppm can be used for delaying maturity. But GA₃ @ 100ppm can be applied for higher seed yield in sesame.

Keywords: GA₃, sesame, yield

INTRODUCTION

Sesame (*Sesamum indicum* L.), the queen of oil seed is the oldest oil seed crop. It is mainly known as Til, Rashi, Benne, Gingeli. Sesame seed contains 50% oil, which is rich in antioxidant and mostly used for making ghee, manufacture of soaps, in pharmaceuticals etc. Sesame oil

contains vitamin E, phytosterols, lignans, sesamol which reduces risks for developing chronic diseases. The crop was originated in Asia or East Africa. Ancient Egyptian had used sesame seeds as grain flour. Chinese used the sesame seeds at least from 5000 years ago. By the earliest human migrants from Africa, sesame was

brought into India. In Indian subcontinent sesame was domesticated 5000 years ago [2]. The trading of sesame between Mesopotamia and India occurred by 2000 B.C. In the world, the major sesame producing countries are China, Myanmar, Sudan, and India.

In India, it was cultivated in an area of 16.23 lakh ha with production of 6.58 lakh tonnes and productivity of 405 kg/ha (2019-20). West Bengal is the highest sesame producing state in India [5] with average productivity of 1200-1500 kg/ha. The other sesame producing states in India are Madhya Pradesh, Uttar Pradesh, Gujarat, and Andhra Pradesh. The productivity can be increased by management practices viz. phyto-hormones. There are several phyto-hormones that affect the plant growth. Among these, gibberellic acid which is also known as gibberellin A₃ or GA₃ is a hormone found in plants and fungi. Its chemical formula is C₁₉H₂₂O₆. Gibberellic acid is a simple gibberellin, pentacyclic diterpene acid which promotes the growth and cell elongation. GA₃ was first recognized in Japan as a metabolic by product of *Gibberella fujikuroi* in 1926. It has numerous effects in plant growth and development. It triggers the cells of germinating seeds to make mRNA enzyme which code for hydrolytic enzymes. Gibberellic acid stimulates stem and root growth, encourage mitotic division in the leaves of some plants, enhance the seed germination rate. Their external application improves the different economically important and market advantageous characteristics in flowering plants [3]. Number of flowers/plants,

number of capsules, weight of individual capsule, length of capsule, diameter of capsule, percentage of seed set, and seed yield were significantly impacted by the interaction between GA₃ level and different varieties of the crop. Therefore, the present investigation was undertaken to assess the effects GA₃ on sesame genotypes to produce high number of seed with better physiological and biochemical characters.

MATERIALS AND METHODS

The present experiment was conducted during pre-kharif season of 2022 at Jaguli Instructional Farm, Mohanpur, and Nadia. The farm is situated in new alluvial zone at 22°55'N latitude and 88°33'E longitude. The test site is located in Eastern India's subtropical sub humid climate zone. Experimental soil consisted of almost neutral pH (7.04), organic carbon of 0.70%, available nitrogen of 205.12 kg ha⁻¹, available phosphorus of 29.49 kg ha⁻¹ and available potassium of 186.48 kg ha⁻¹. GA₃, a plant growth regulator was applied at six different concentrations at 35 days after sowing. The six concentrations were 50 ppm, 100 ppm, 200 ppm, 300 ppm, 400 ppm, 500 ppm along with control (Water spray). The concentration of 50 ppm was prepared by mixing few drops of ethanol with 5 mg of GA₃ followed by volume makeup with distilled water to 100 ml. Similarly, other concentrations were prepared by mixing small amount of ethanol followed by volume makeup with desired quantity of distilled water. The field experiment was conducted in split plot design with 4 sesame varieties viz. Rama (V1), Savitri (V2), Suprava (V3), Tilottoma(V4) in main plot and seven

treatments (foliar application of GA₃ including control) in sub plots. Different morphological characters viz. capsules plant⁻¹, seeds capsule⁻¹, 1000 seed weight (g), seed yield (Kg ha⁻¹), maturity (days), capsule length (cm), capsule breadth (mm) were studied. Data collected from field were arranged for statistical analysis of variance method as suggested by Panse and Sukhatme (1985).[7] Statistical analysis was conducted through OP-STAT software programme [8]. Treatment means were compared through critical difference (C.D.) values at 5 % level of significance [6].

RESULTS AND DISCUSSION

Effect on yield contributing characters

The capsule number per plant showed significant effect due to treatments, varieties (Table 1) and interaction between treatment and varieties (Table 2). The treatment over varieties, maximum number of capsule plant⁻¹ (99.5) was observed in T2 followed by T7 (93.1) with significant variation between them (Table 1). Among the varieties over treatments, Rama (V1) produced maximum capsule plant⁻¹ (98.5) followed by Savitri (V2), Tilottoma (V4) and Suprava (V3) although Rama and Savitri had non-significant variation. Similar results were found by Singh *et al.*, (2021) by application of GA₃ @ 200 ppm.

The production of dry matter within seed is an important step of producing higher yields. Individual seed development is controlled by the seed itself. It is typically indicated by the speed and length of growth. Seed capsule⁻¹ showed non-significant variation due to treatments

since seed capsule⁻¹ is a genetic character which is usually not affected by the treatments. There was significant variation between the varieties over treatments but the treatment over varieties and interaction had non-significant value (Table 1). Among the varieties over treatments, Savitri recorded maximum seed capsule⁻¹ (37.38) and Tilottoma had minimum seeds capsule⁻¹ (31.28). Rama and Suprava had non-significant variation for this character. Although there was no difference statistically between the treatments over varieties, but numerically T2 (GA₃ @100 ppm) had maximum seeds capsule⁻¹ (34.75) and T1 (GA₃ @50ppm) recorded minimum number of seed capsule⁻¹ (33.08). This is in the line with the findings of Ahmed (2017) in mustard.[1]

The thousand seed weight (g) is an important indicator of seed quality (Hossein *et al.*, 2011) since it has an impact on germination, seedling growth, and vigour when sown in the field. The size of the embryo and the quantity of stored nutrients influence germination and growth. The quality of the seed can be examined by randomly selecting 1000 seeds from a seed lot. In present study, 1000 seed weight showed significant variation due to treatments over varieties and variety over treatments. The variety over treatments, Savitri had the highest 1000 seed weight (3.36 g) while Rama had the lowest 1000 seed weight (3.07 g). Treatment over varieties, T6 (GA₃ @500 ppm.) recorded highest 1000 seed weight (3.33 g) and T1 (GA₃ @50 ppm.) recorded lowest 1000 seed weight (3.15g). Among the interactions T5V2

(GA₃@400ppm.+Savitri) recorded highest 1000 seed weight (3.46g) and T7V4 (Control + Tilottoma) showed lowest 1000 seed weight (2.83g) as presented in Table 2.

In addition to being heavily influenced by environmental factors and being controlled by numerous genes, seed yield is a quantitative feature. Three key factors make up seed yield: the number of plants per hectare, the number of seeds per plant, and the weight of one thousand seeds. Maximum seed yield with good quality is the primary goal of seed production, and this is tied to a plant's ability to partition its photosynthates. Here, the treatments had a considerable impact on the variety (Table1). The variety Savitri produced highest seed yield (1533 kg/ha) and the variety Tilottoma recorded minimum seed yield (1253 kg/ha). Among the treatments over varieties, T2 (GA₃@ 100 ppm) showed maximum yield (1483 kg/ha) and T7 (Control: water spray) produced minimum yield (1352 kg/ha). The maximum yield was shown by the interaction T2V2 (GA₃@100ppm+Savitri) i.e.1544 kg/ha and T7V4 (Control+Tilottoma) produced lowest seed yield(1216 kg/ha) as depicted in table 2.

A sesame capsule is mature, accordance to Tewolde *et al.*, 1994,[9] when the subtending leaf defoliates as a result of typical senescence. For sesame, the earliest day to maturity is a favorable trait. Information about character development as impacted by GA₃ application revealed that it was significantly influenced by variety, treatment and interaction between variety and treatment. Tilottoma had the

earliest maturity (77.5 days), and Savitri had the longest maturation period (87.4 days). Among the treatments T3 (GA₃@200ppm) showed maximum days to maturity (85.2 days) and T7 recorded minimum days to maturity (83.3 days). Similar findings were reported by Das *et al.* (2009).[4] Among the interaction effects T7V4 (Control+ Tilottoma) recorded earliest maturity (75.7 days) and T3V2, T3V3, T4V2, T6V2 took maximum days for maturity (88.3 days) as revealed in Table 2.

Capsule length recorded significant variation due to varieties. There was no significant difference due to treatments over varieties and interaction between treatments and varieties. Among the varieties Rama recorded the maximum capsule length (2.78 cm) and Suprava showed the lowest value (2.39cm). Despite non-significant effects of the treatments, T2 (GA₃@ 100 ppm) showed the maximum capsule length of 2.63 cm and T5 (GA₃@ 400 ppm) showed the minimum capsule length of 2.48 cm.

The character capsule breadth (mm) at maturity was non-significantly influenced due to treatments over varieties (Table 1). Among the treatments T1 (GA₃@50ppm) recorded minimum capsule width (5.22 mm) and T7 (control) showed maximum capsule width at maturity (5.53 mm). The variety Savitri recorded maximum capsule width (5.67 mm) and Suprava had the minimum capsule breadth (4.94 mm). Among the interactions (Table 2), T2V2 (GA₃@100ppm+Savitri) showed maximum capsule width (5.87 mm) and

T5V3(GA₃@400ppm+Suprava) recorded minimum capsule width(4.70mm).

CONCLUSION

Effects of treatments, varieties and interaction between treatments and varieties revealed that maturity was influenced by treatments. T3 (GA₃ @ 200ppm) delayed the maturity significantly for all the varieties. Seed yield was found maximum in case of Savitri, over treatments and for treatment over varieties, T2 was best for improving the seed yield. Considering the above discussion, it can be concluded that for delayed maturity GA₃ @200ppm had maximum effect. For seed yield T2 (GA₃ @100ppm) had maximum effect.

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Table 1: Seed yield and ancillary characters as influenced by GA₃ in different sesame genotypes.

Treatments	Capsules plant ⁻¹	Seeds Capsules ⁻¹	1000 seed weight (g)	Seed yield Kg ha ⁻¹	Maturity (Days)	Capsule length (cm)	Capsule breadth (mm)
T-1	87.7	33.08	3.15	1370	83.5	2.52	5.22
T-2	99.5	34.75	3.18	1483	84.8	2.63	5.38
T-3	81.4	34.16	3.22	1388	85.2	2.53	5.30
T-4	73.9	33.83	3.28	1397	84.9	2.53	5.29
T-5	80.9	34.08	3.29	1398	84.9	2.48	5.24
T-6	82.3	33.75	3.33	1310	85.0	2.54	5.38
T-7	93.1	33.58	2.96	1352	83.3	2.59	5.53
SEm (±)	2.011	0.34	0.01	4.3	0.28	0.04	0.09
CD (P=0.05)	5.736	NS	0.03	12.1	0.80	NS	NS
Varieties							
V1	98.5	33.57	3.07	1400	86.0	2.78	5.41
V2	88.1	37.38	3.36	1533	87.4	2.41	5.67
V3	79.7	33.33	3.23	1356	87.2	2.39	4.94
V4	81.8	31.28	3.14	1253	77.5	2.61	5.31
SEm (±)	3.303	0.32	0.01	3.5	0.30	0.01	0.13
CD (P=0.05)	11.654	1.15	0.04	12.3	1.08	0.06	0.46
Interaction							
S.Em (±)	4.98	0.11	0.0001	14.9	0.08	0.001	0.01
CD (P=0.05)	15.67	NS	0.0012	43.5	0.24	NS	NS

T-1=GA₃@50ppm, T-2=GA₃@100ppm, T-3=GA₃@200ppm, T-4=GA₃@300ppm, T-5=GA₃@400ppm, T-6=GA₃@500ppm, T-7=Control). V1=Rama, V2=Savitri, V3=Suprava, V4=Tilottoma.

Table 2: Interaction effects on seed yield and ancillary characters as influenced by GA₃ in different sesame genotypes.

Treatments	Capsules plant ⁻¹	Seeds Capsules ⁻¹	1000 seed weight (g)	Seed yield Kg ha ⁻¹	Maturity (Days)	Capsule length (cm)	Capsule breadth (mm)
T1 V1	131.7	33.33	3.02	1380	85.7	2.84	5.58
T1V2	142.0	35.33	3.33	1530	85.3	2.36	5.25
T1V3	96.3	38.66	3.18	1335	86.3	2.38	4.87
T1V4	102.7	31.66	3.07	1235	76.7	2.53	5.20
T2 V1	130.3	33.66	2.98	1376	86.7	2.82	5.76
T2V2	124.7	36.66	3.40	1544	87.3	2.53	5.87

T2V3	97.0	31.33	3.27	1357	87.3	2.44	4.90
T2V4	65.7	30.66	3.09	1259	77.7	2.72	5.33
T3 V1	112.3	34.00	3.02	1419	86.0	2.88	5.57
T3V2	102.0	38.00	3.34	1526	88.3	2.36	5.57
T3V3	112.0	33.33	3.29	1350	88.3	2.39	4.87
T3V4	75.0	31.33	3.24	1256	78.0	2.49	5.20
T4 V1	107.3	33.66	3.15	1423	85.7	2.82	5.48
T4V2	94.3	37.66	3.39	1540	88.3	2.40	5.47
T4V3	90.0	32.33	3.34	1366	87.7	2.36	4.92
T4V4	75.7	31.66	3.23	1257	78.0	2.53	5.28
T5 V1	95.3	32.66	3.19	1407	86.3	2.58	5.79
T5V2	98.0	39.33	3.46	1543	87.7	2.30	5.19
T5V3	84.0	32.66	3.33	1383	87.3	2.32	4.70
T5V4	129.0	31.66	3.19	1259	78.3	2.74	5.31
T6 V1	109.7	34.66	3.24	1429	86.3	2.78	5.67
T6V2	82.7	37.00	3.43	1539	88.3	2.45	5.44
T6V3	97.3	33.00	3.34	1382	87.3	2.34	5.03
T6V4	120.0	30.33	3.31	1287	78.0	2.61	5.41
T7 V1	122.3	33.00	2.92	1367	85.3	2.77	5.53
T7V2	103.5	37.66	3.20	1509	86.3	2.48	5.47
T7V3	121.7	32.00	2.90	1317	86.0	2.50	5.33
T7V4	109.0	31.66	2.83	1216	75.7	2.64	5.46