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Research Article
Effect of Altered Crop Canopy and Plant Growth Promoters on Sesame Productivity

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Abstract

Background and Objective: Sesame is an ancient important edible oil seed crop cultivated throughout the world. Excessive vegetative growth and poor source sink partitioning in sesame are the main constraint for very low yield in sesame. Study on the effect of altered crop canopy and plant growth promoters on productivity of sesame were taken up. **Materials and Methods:** The treatments are T_1-Control, T_2-Terminal nipping at 30 Days After Sowing (DAS), T_3-Foliar spray of 100 ppm Salicylic Acid (SA) at 30 DAS, T_4-DAP 2% spray at 30 DAS, T_5-T_2+T_3, T_6-T_2+T_4, T_7-T_2+T_3+T_4. The experiment was conducted in randomized block design with three replication. **Results:** Altering crop canopy and plant growth promoters showed significant response in terms of yield attributes and seed yield of sesame. Altering crop canopy by terminal nipping and foliar spray of 100 ppm Salicylic Acid (SA) spray followed by 2% DAP foliar spray at 30 DAS recorded higher seed yield (894 kg ha^{-1}) and B:C ratio (2.51). **Conclusion:** Nipping vertical growth and foliar spray of 100 ppm Salicylic Acid (SA) spray followed by 2% DAP foliar spray at 30 DAS may be recommended for higher sesame seed yield.

Key words: Sesame, nipping, plant growth, promoter, salicylic acid, foliar spray, salicylic acid

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Sesame is an important edible oilseed cultivated in India. It occupies about 3.6% of area and 10.8% of production of the total oilseeds production in India[1]. In India, sesame is cultivated in an area of 13.9 lakh ha with production of 41.8 lakh t and productivity[2] of 291 kg ha^{-1}. However, the average productivity of sesame in India is far less than the world average. To cope up with the increasing demand for edible oil, the area and productivity of sesame has to be increased[3]. Sesame has a yield potential upto 2.0 t ha^{-1}, which can be achieved by altering the crop canopy and growth regulation. Owing to the excess vertical growth of the plant, the easily available solar radiation could not be harnessed which lead to a static yield of sesame. Hence, the crop canopy architecture should be altered to harness the solar radiation efficiently, so as the yield potential of the crop could be increased.

Plant growth substances play a key role in different physiological processes related to growth and development of crops. Phytohormones are physiological intercellular messengers that are needed to control the complete plant lifecycle, including; germination, rooting, growth, flowering, fruit ripening, foliage and death. Salicylic acid is one among the growth promoter which contributes the regulation of plant growth. Salicylic acid involved in the plant metabolism especially in the xylem and phloem loading of source by regulating the ion channels and buffering the plant temperature[4]. Similarly, crop canopy management by nipping terminal growth is one of the practices which are followed in pulses and spice crops to improve the productive branches for the higher yield[5]. Hence, the present field investigation was conducted to study the effect of altering crop canopy and plant growth promoter on productivity of sesame.

MATERIALS AND METHODS

Description of study area: The field experiment was conducted for three consecutive years during kharif season 2016, 2017 and 2018 at Regional Research Station, TNAU, Virudhachalam, Tamil Nadu of Southern India under All India Coordinated Research Project on Sesame (AICRP on Sesame). The soil of experimental field was sandy loam with a pH of 6.5 and organic carbon of 0.20%.

Experimental materials: Sesame variety VRI 2 with duration of 80-85 days was used for the field study. Seeds were sown at a row spacing of 30 cm and later thinned out to maintain plant to plant spacing of 30 cm. The entire recommended dose of fertilizer (35:23:23 kg NPK/ha) were applied basally. Foliar spray of salicylic acid at 100 ppm and 2% DAP was done at early morning using a knapsack sprayer with a spray fluid of 500 L ha^{-1}. During the crop season, light irrigations were given and inter-culture operations viz., thinning and weeding were done on 15 and 25 DAS irrespective of treatments.

Design and arrangement of experiment: The experiment was conducted in randomized block design replicated thrice with each plot size of 5 × 4.2 m. The experiment consisted of seven treatments viz., T_1-Control, T_2-Terminal nipping at 30 DAS, T_3-Foliar spray of 100 ppm Salicylic Acid (SA) at 30 DAS, T_4-DAP 2% spray at 30 DAS, T_5-T_2+T_3, T_6-T_2+T_4, T_7-T_2+T_3+T_4.

Data collection: Observation on growth and yield parameters were recorded. The height of tagged plants from the ground to the tip of the main stem was measured and the mean values were expressed in cm. The data on growth attributes viz., plant height, number of branches/plant and Leaf Area Index (LAI) were also recorded. The crop matured in 80 days and was harvested. After harvesting, the capsules present in the tagged plants were counted and average was calculated to obtain the number of capsules per plant. The number of seed per capsule were counted and recorded. One thousand seeds from each net plot produce were taken and their weight was estimated and expressed in gram. Cleaned and sun dried grains of net plot area were weighed and sesame seed yield was computed and expressed in kg ha^{-1}.

Statistical analysis: The recorded data were statistically analyzed following the procedure given by Gomez and Gomez[6]. Wherever, the results were significant, critical differences were worked out at 5% level and non-significant results were noted as N.S.

RESULTS AND DISCUSSION

Growth parameters: The growth attributes viz., plant height, number of branches per plant and leaf area indeed were found to be significantly influence by nipping and foliar spray of salicylic acid spray (Table 1). Terminal nipping along with foliar spray of salicylic acid at 100 ppm and 2% DAP at 30 DAS (T_7) recorded more number of branches per plant (9.3) and higher leaf area index (1.56). Terminal nipping arrests the vertical growth and activates the dormant lateral buds to produce higher number of branches and leaf area index[7]. Similar results of increased lateral branches were also

Table 1: Effect of nipping and growth regulator on growth attributes of sesame at harvest stage (Pooled mean of three years)

Treatments	Plant height (cm)	Number of branches per plant	LAI
T_1-Control	136.0	1.08	4.4
T_2-Terminal nipping at 30 DAS	95.0	1.28	6.4
T_3-Salicylic Acid (SA) spray 100 ppm at 30 DAS	144.0	1.16	5.2
T_4-DAP 2% spray at 30 DAS	150.0	1.24	5.3
T_5-T_2+T_3	116.0	1.39	7.0
T_6-T_2+T_4	130.0	1.43	7.2
T_7-T_2+T_3+T_4	127.0	1.56	9.3
S.Ed	7.6	0.07	0.5
CD (0.05)	20.8	0.16	1.2

DAS: Days after sowing, SA: Salicylic acid, DAP: Diammonium ammonium phosphate, LAI: Leaf area index

Table 2: Effect of nipping and growth regulator on yield attributes and sesame seed yield (Pooled mean of three years)

Treatments	No. of capsules per plant	No. of seeds per capsule	Test weight (g)	Seed yield (kg ha^{-1})
T_1-Control	58.0	44.9	3.05	617
T_2-Terminal nipping at 30 DAS	81.0	58.9	3.18	749
T_3-Salicylic Acid (SA) spray 100 ppm at 30 DAS	75.0	55.1	3.16	704
T_4-DAP 2% spray at 30 DAS	70.0	50.5	3.12	693
T_5-T_2+T_3	84.0	73.9	3.24	828
T_6-T_2+T_4	83.0	66.5	3.19	789
T_7-T_2+T_3+T_4	97.0	79.4	3.29	901
S.Ed	7.5	3.28	0.07	46
CD (0.05)	16.2	7.23	NS	100

DAS: Days after sowing, SA: Salicylic acid, DAP: Diammonium ammonium phosphate

observed[8,9]. The horizontal expansion of canopy instead of vertical expansion would have paved way for easy harnessing of solar radiation and increased photosynthetic rate. The promoting effect of salicylic acid on the leaf area was attributed to its important roles on activating cell division and the biosynthesis of organic foods.

Yield attributes and yield: The yield attributes viz., number of capsules per plant and numbers of seeds per capsule are the most important parameters for yield of sesame, which was found to be significantly influenced by terminal nipping and growth regulator spray (Table 2). Terminal nipping along with foliar spray of salicylic acid at 100 ppm and 2% DAP at 30 DAS registered higher number of capsules per plant (97) and seeds per capsules (79.4) which resulted in highest sesame seed yield (901 kg ha^{-1}). However, it is on par with terminal nipping at 30 DAS and foliar spray of 100 ppm salicylic acid at 30 DAS. Altering the canopy architecture by nipping facilitates efficient utilization of solar radiation and in addition nipping is known to accumulate more photosynthates which are utilized for development of higher number flowering point and capsules[10].

As in terminal nipping practice, the apical bud is nipped and hence the utilization of the photosynthates by the crop for lateral branches could be higher and this might be the reason for higher yield attributes and sesame seed yield. Similarly, arresting the terminal growth through terminal nipping mainly activated the lateral dormant buds and it would have balanced source to sink significantly which increased the number of capsules per plant and sesame seed yield[11].

Terminal nipping is an important operation which activated the dormant lateral buds to produce higher number of branches per plant, which could be attributed to overall improvement in plant vigour leading to initiation of larger number of branches and ultimately better manifestation of yield attributes in sesame[12]. The nipping terminal growth altered the crop canopy architecture, which in turn increased the lateral branches and seed yield of sesame[13]. The higher yield attributes noticed with nipping at 30 DAS may be due to increase in photosynthetic area leading to higher photosynthetic rate, better assimilation and accumulation of more photosynthates resulting into higher seed yield.

Terminal nipping along with foliar spray of plant growth regulator salicylic acid at 100 ppm facilitated for enhancing the number of floral buds and reducing the flower drop resulting in higher number of capsules per plant and number of seed per capsule. Foliar spray of salicylic acid stimulated flowering in a range of plants, increase flower life, controls ion uptake by roots and stomatal conductivity. The valuable impact of terminal nipping and salicylic acid foliar spray are in agreement with other research findings[14]. Greater response to

canopy management allowing for increased light interception and photosynthetic rate would have resulted in higher yield attributes[15]. The beneficial effect of nipping was also reported in chickpea[16,17].

The stress created by pinching must be compensated with additional nutrient supply. Hence, 2% DAP foliar spray is endorsed with the benefit of quick and effectual utilization of nutrients, purging of losses through leaching and fixation and regulating the uptake of nutrient in crop plants[18]. Foliar application of plant growth regulators enables a rapid phenotypic change in plants. Salicylic acid would have induced the flowering by acting as a chelating agent and directly related to yield and productivity of plants[19]. Efficient mobilization of metabolites from source to sink can be the reason for higher number of capsules and seed yield[20]. Terminal nipping and foliar spray of 100 ppm salicylic acid and 2% DAP at 30 DAS increased the yield attributes and yield of sesame.

CONCLUSION

The indeterminate sesame plant type produces excessive vegetative growth, where the vegetative phase and reproductive phase coincide with each other resulting in poor source sink partitioning efficiency. Under this context field investigation was conducted to enhance the source sink partitioning efficiency of sesame. As a result of field experiment, terminal nipping and foliar spray of 100 ppm salicylic acid and 2% DAP at 30 DAS considerably increased the leaf area index, number of branches per plant, number of capsules per plant and number of seeds per capsule resulting in higher sesame seed yield.

SIGNIFICANCE STATEMENT

This study discovered that altering crop canopy by terminal nipping and foliar spray of 100 ppm salicylic acid and 2% DAP at 30 DAS significantly increases the seed yield of sesame. This study will help the researchers to uncover the critical areas of altering crop canopy and foliar spray of plant growth promoters and nutrition that many researchers were not able to explore. Thus, a new theory on altering crop canopy and foliar spray of plant growth promoters may be arrived at.

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