AATCC Review

05 November 2022: Received
19 February 2023: Revised
22 April 2023: Accepted
02 May 2023: Available Online

www.aatcc.peerjournals.net

Research Article Open Access

Seed encapsulation and supplemental nutrition for enhancing the productivity of summer sesame *[Sesamum indicum L.]*

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ABSTRACT

Sesame (Sesamum indicum L.), of the Pedaliaceae family, is one of the traditionally grown oilseed crop. There are certain limitations in the crop field establishment due to the small seed size with poor germination rate. Hence, to address the limitations field experiments were carried out to study the effect of seed encapsulation and supplemental nutrition for enhancing the productivity of summer sesame during two consecutive years summer of 2019 and the Summer of 2020. The treatment involves seed encapsulation as the main factor and six foliar nutrition as a subfactor. Field experiment was laid out in a factorial randomized block design replicated thrice. The pooled data from two consecutive years shows that seed encapsulation with organics recorded a yield increase of 5 % higher yield to the non-pelleted seed. Among the foliar spray, combined nutrient spray (1.5%) followed by19:19:19 NPK @ 1 % recorded higher values in plant height (120.9 cm), number of branches/plant (7.4), number of capsules/plant (135.5), number seeds/capsule (72.9) and seed yield (900 kg/ha). Thereby, the pelleted seed enabled better crop establishment and supplemental foliar nutrition facilitated higher sesame seed yield.

Keywords: *Sesame, seed encapsulation, foliar nutrition, vigor index*

INTRODUCTION

Sesame *(Sesamum indicum L.)* is a vital ancient oilseed crop of India, which holds remarkable importance in the world's oil production due to its high quality. Sesame seeds have numerous health benefits and many vital nutrients, hence known nutritional gold mine. With the multi-beneficial benefits, the demand for sesame is increasing; however, the production of sesame did not satisfy the requirement. The productivity and production of sesame are hindered by several constraints. Sesame being a short-day plant requires fairly hot weather for its optimum growth and yield [7]. In addition, there is a tremendous amount of variability in the vegetative, reproductive, ripening, and maturity phases of sesame. Hence is required adequate fertilization then and there through the soil and foliar spray in order to ensure higher crop productivity in terms of higher biomass and yield. Besides timely sowing, thinning, and weeding favoring good crop stand [6].

The tiny seeds and their germinated seedlings is often facing environmental factors such as rain that will create crusts before emergence, a sudden cold front that will reduce the growth rate before emergence, winds that will blow sand and damage or cover them, insects at the seedling stage, etc. Additional seed is the only alternative and a form of insurance for a crop stand, however obtaining even growth good crop is still questionable, and because there is no agronomic practice that can improve a poor stand other than replanting. The slow growth during the seedling stage makes the plant susceptible to various biotic and abiotic factors, which leads to an uneven plant stand low in vigor and yield potential [9]. The sesame crop is poorly adapted to abiotic constraints [2] due to the following possible reasons Seed encapsulation will be a solution for the production constraint of tiny seeds. With the adoption of proper technologies improved seed yields and oil quality can be achieved [8]. Therefore, there is scope for yield improvement in sesame through crop management technologies. Hence, keeping these facts in view present investigation was carried out to study the effect of seed encapsulation and supplemental nutrition for yield maximization in summer irrigated sesame.

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DOI: https://doi.org/10.58321/AATCCReview.2023.11.03.06

MATERIALS AND METHODS

Description of the study area

Field experiments were conducted during two consecutive years Summer of 2019 and the Summer of 2020 at Regional Research Station, Tamil Nadu Agricultural University, Vridhachalam (110 30′ N, 790 26′ E, and 42.67 m altitude) to study the effect of seed encapsulation and supplemental nutrition for yield maximization in sesame (Summer irrigated). The soil of the experimental field was sandy loam with a pH of 6.5 and organic carbon of 0.20 %.

Experiment materials and arrangement of the experiment

The field experiment was laid out in FRBD design with three replications. The main plot consisted of two treatments viz., A1 - Pelleted seed: Seed pelleting with neem leaf powder @ 760 g + 120 g Azospirillum + 120 g phosphobacteria for 1 kg of seed using rice gruel as adhesive, A2 - Non-pelleted seed. The subplot consisted of six foliar nutrition technique treatments viz., S1 - Urea @ 1 %, S2 - DAP @ 1 %, S3 - 19:19:19 (NPK) @1 %, S4 - MnSO4 @ 0.5 %, S 5 -MAP @ 0.5 %, S6 - Combined nutrients spray. The foliar spray was done in the early morning using a knapsack sprayer with a spray fluid of 500 liters per hectare.

Data Collection: The number of seeds germinated was counted every day and the count of a total number of seeds germinated was recorded after 14 days and the final germination was determined [4]. The final count of the emerged seedlings was taken at the second week from the start of emergence with respect to each treatment and calculation was done in relation to the number of seeds that were put for germination and the percentage value was obtained by using the formula mentioned below.

The root and shoot length was measured at 14 days after sowing and the vigor index was calculated using the formula given below.
Vigour index = Germination (%) x (Root length + Shoot length)

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 LAI were also recorded. The crop matured in 75 days and was harvested. After harvesting, the capsules present in the tagged plants were counted and the 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 produced were taken and they're weight was estimated and expressed in grams. Cleaned and sun-dried grains of net plot area were weighed and sesame seed yield was computed and expressed in kg/ha. The recorded data were analyzed statistically and critical differences were calculated using the standard procedures.

Statistical analysis

Data were statistically analyzed following the procedure given by Gomez and Gomez, 2010 [1]. A two-way ANOVA was used to determine the significant difference between an intercropping system and nutrient management. Wherever the results were significant, critical differences were worked out at a five percent level and non-significant results were noted as N.S.

RESULTS AND DISCUSSION

The effect of seed pelleting and supplemental nutrition showed a significant effect on the growth and yield of sesame (Table 1). The seedling characteristics like germination percentage and population/ha recorded a significant difference in pelleted and non-pelleted seeds. The results revealed that the seed pelleting on growth characters such as plant height (113.1cm), number of branches/plant (7.2), plant population (1.02 lakhs/ha), and vigor index (2352) showed significant values as compared to non-pelleted. Planting pelleted seeds produced a higher rate of emergence [10]. A similar result of a higher vigour index in pelleted seed was observed by [5]. Among the foliar spray, combined nutrient spray (1.5%) recorded higher values in plant height (120.9 cm), number of branches/plant (7.4)) and higher plant population (1.02 lakhs/ha).

Eventually, as per the growth attributes, sesame seed pelleted with neem leaf powder and biofertilizers produced significant yield attributes (Table 2.) with a higher number of capsules/plant (116.9), number of seeds/capsules (62.1) and seed yield (758 kg/ha). The combined nutrient spray (1.5%) recorded higher values on the number of capsules/plant (132.9), number of seeds/capsule (72.9), and seed yield (900 kg/ha). The foliar spray would have facilitated enhancing the number of floral buds and reducing the flower drop resulting in a higher number of capsules per plant and number of seed per capsule [3] [11].

The technology will be viable not only on the superiority in yield but also on the economics. The results of the experiment reveal that the pelleted seeds recorded a higher B:C ratio of 2.32 as against 2.26 in non-pelleted seeds. Likewise, the combined nutrient spray @ 1.5 % recorded the highest B:C ratio of 2.77 as compared to control and other treatments.

CONCLUSION

The results of the field experiment reveal that seed encapsulation through organics produces uniform germination with higher vigor index resulting in higher sesame seed yield. Foliar spray of combined nutrient spray @ 1.5 % at flowering and capsule formation stage recorded a higher number of capsules and sesame seed yield as compared to the control.

Future scope of the study

Mechanization is the need of the hour, hence, seed encapsulation is prerequisite for mechanized sowing. The study will support for seed pelleting technology and for better crop establishment. Further, demand for sesame is high because of its multiple usages, hence the supplemental foliar nutrition techniques address solution for improving the productivity of sesame.

ACKNOWLEDGEMENT

My sincere gratitude to my alma mater Tamil Nadu Agricultural University, Coimbatore for giving me the opportunity for carrying out this field investigation. I express my bountiful thanks to the research team involving Agronomist, Crop Physiologist and Seed technologist for their technical support.

Conflict of interest

There is no conflict of interest. The authors had full access to all set of data and take complete responsibility for the accuracy of the data analysis.

Table 1. **Effect of seed pelleting and supplemental nutrition on growth attributes of sesame (Pooled data of Summer 2019 and Summer 2020)**

Treatments	Plant height (cm)	Plant population (000 ha)	Root length (cm)
Seed treatment			
A_1 - Pelleted seed	113.1	102.7	41.7
A_2 - Non Pelleted seed	110.7	86.9	41.1
S.Ed	4.05	1.75	1.5
CD(P=0.05)	NS	3.62	NS
Foliar nutrition			
B_1 - Urea @ 1 %	114.9	93.0	41.3
B_2 - DAP @ 1 %	113.1	95.0	41.0
B_3 - 19:19:19 (NPK) @1 %	118.1	99.9	42.2
B_4 - $MnSO_4$ @ 0.5 %	110.5	89.9	41.4
B_5 - MAP @ 0.5 %	111.3	97.1	40.6
B_6 - Combined nutrients spray (1.5 %)	120.9	101.8	42.4
B_7 - Control	94.4	86.9	40.7
S.Ed	7.6	3.27	2.8
CD(P=0.05)	15.7	6.77	NS

Table 2. **Effect of seed pelleting and supplemental nutrition on yield attributes of sesame (Pooled data of Summer 2019 and Summer 2020)**

Treatments	No.of branches /plant	No of capsule /plant	No. of seeds/ capsules	Seed yield (kg/ha)
Seed treatment				
A_1 - Pelleted seed	7.2	116.9	62.1	758
A_2 - Non Pelleted seed	6.2	111.8	56.9	721
S.Ed	0.25	2.1	2.0	13.8
CD(P=0.05)	0.51	4.2	4.3	28.6
Foliar nutrition				
B_1 - Urea @ 1 %	6.9	112.8	55.5	676
B_2 - DAP @ 1 %	6.7	114.5	58.8	735
B_3 - 19:19:19 (NPK) @1 %	7.1	122.6	67.6	819
B_4 - $MnSO_4$ @ 0.5 %	6.3	109.9	49.6	670
B_5 - MAP @ 0.5 %	6.5	117.2	66.7	778
B_6 - Combined nutrients spray (1.5 %)	7.4	132.9	72.9	900
B_7 - Control	5.9	90.7	47.9	599
S.Ed	0.46	7.7	3.9	25.8
CD(P=0.05)	0.95	15.9	8.0	53.5

Table 3. **Effect of seed pelleting and supplemental nutrition on economics of sesame (Pooled data of Summer 2019 and Summer 2020)**

Treatments	Gross Income (Rs./ha)	Net Income (Rs./ha)	B:C ratio
Seed treatment			
A_1 - Pelleted seed	53060	30276	2.32
A_2 - Non Pelleted seed	50470	28136	2.26
S.Ed			
CD(P=0.05)			
Foliar nutrition			
B_1 - Urea @ 1 %	47320	24570	2.08
B_2 - DAP @ 1 %	51450	28500	2.24
B_3 - 19:19:19 (NPK) @1 %	57330	34580	2.52
B_4 - $MnSO_4$ @ 0.5 %	46900	24150	2.06
B_5 - MAP @ 0.5 %	54460	31710	2.39
B_6 - Combined nutrients spray (1.5%)	63000	40250	2.77
B_7 - Control	41930	20680	1.97

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