Effect of seed pelleting and foliar spraying on sesame productivity

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ABSTRACT

Investigations on the effect of seed pelleting and foliar spraying on physiology and productivity in sesame were done at the Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu during the year 2016-17. The study was conducted to understand the physiological basis for yield improvement in sesame. Sesame seeds were pelleted using TNAU pelleting mixture. Foliar treatments included urea 1 per cent, diammonium phosphate (DAP) spray 1 per cent, NPK (19:19:19) 1 per cent, manganese sulphate ($MnSO_4$) 0.5 per cent, monoammonium phosphate (MAP) 0.5 per cent, nutrient consortium 2 per cent and salicylic acid 100 ppm. Foliar sprays were given on 30 and 45 DAS. In general pelleted seeds gave better seedling characters such as germination percentage and vigour. Plants that received two sprays of nutrient consortium were taller at physiological maturity followed by foliar spray of NPK (19:19:19). Nutrient consortium and NPK (19:19:19) treatments also recorded a higher CGR and TDM content. The plants that received nutrient consortium 2 per cent on 30 and 45 DAS showed superiority in recording higher seed yield per plant followed by NPK (19:19:19) in both the factors (non-pelleted and pelleted seeds). Control plants recorded least seed yield compared to other treatments in both the factors.

Keywords: Sesame; seed pelleting; foliar spraying; physiology; productivity

INTRODUCTION

Sesamum is an often cross-pollinating crop and its fruits are oblong, pubescent capsules containing numerous small oval seeds. Usually sesamum seeds vary in size, shape and colour which lead to difficulty in precision seeding and uniform plant spacing. Seed pelleting increases the size and weight of the seeds particularly in very small seeds like sesame and permits precisions planting and uniform plant population which can eliminate the need for crop thinning (Robinson and Mayberry 1976, Schisler et al 2004). Seed pelleting is the process of adding inert materials to seeds to change their size and shape for improved plantability.

Foliar application of nutrients and growth regulators at pre-flowering and flowering stage resulted in reduced percentage of flower drop in green gram (Ganapathy et al 2008). Foliar nutrition can help to maintain a nutrient balance within the plant which may not occur strictly with soil uptake (Meena et al 2007). The effectiveness of foliar applied nutrients is determined by the type of formulation and the time of application. Foliar spray of nutrients and growth regulators stimulate an increase in chlorophyll production, cellular activity and respiration. Foliar application results in greater absorption, assimilation and translocation of nutrients for increased photosynthesis. Increased production of dry matter and its efficient translocation to its economic parts ultimately reflects the final pod yield. The role of foliar application of nutrients on physiology of crop plants is well established.

MATERIAL and METHODS

The present investigations were conducted to study the effect of seed pelleting and foliar spraying of nutrients and salicylic acid on yield attributes. Sesame variety VRI 2 seeds were obtained from Regional Research Station, Viruthachalam, Tamil Nadu as the variety possessed the desirable characters such as branching type, seed weight and adaptability to summer.

There were two factors: Factor P (seed treatment) that included non-pelleted seed (P1) and pelleted seed (pelleting with neem leaf powder 760 g + 120 g *Azospirillum* + 120 g phosphobacteria for 1 kg of seed using carboxymethyl cellulose (CMC) 2 per cent as adhesive (P2) and Factor T (foliar treatment) that included urea 1 per cent, diammonium phosphate (DAP) spray 1 per cent, NPK (19:19:19) 1 per cent, manganese sulphate ($MnSO_4$) 0.5 per cent, monoammonium phosphate (MAP) 0.5 per cent, nutrient consortium 2 per cent and salicylic acid 100 ppm. Foliar sprays were given on 30 and 45 DAS.

Germination: The number of normal seedlings in each replication was counted on final count day and the per cent germination was calculated (Anon 2007).

$$\text{Germination (\%)} = \frac{\text{Number of germinated seeds}}{\text{Number of seeds kept for germination}} \times 100$$

Root length: At the time of germination count, ten normal seedlings were selected at random from each replication and used for measuring the root length of seedlings. Root length was measured from the point of attachment of seed to the tip of primary root.

Shoot length: The seedlings used for measuring root length were also used for measuring shoot length. The shoot length was measured from the point of attachment of seed to tip of the leaf.

Crop growth rate (CGR): The CGR was worked out by using the formula of Watson (1958):

$$CGR = \frac{W_2 - W_1}{P\,(t_2 - t_1)}$$

where W_1 and W_2= Whole plant dry weight at t_1 and t_2 respectively, $t_2 - t_1$= Time interval in days, P= Ground area occupied by the plant

Total dry matter production: Uprooted plant samples after washing the root portion were first shade-dried and then oven-dried at 80^{O}C for 48 hours. The dry weight of the plant parts at different phenophases was recorded.

Seed yield and yield: Seed yield was recorded after hand threshing and air drying. After recording the seed yield of the randomly selected five plats, seed yield was worked out at nine per cent moisture content.

RESULTS and DISCUSSION

The results obtained in the present investigations are described hereunder:

Germination percentage: The germination data are presented in Table 1. Higher germination (96.1%) was recorded in seeds pelleted with TNAU pelleting mixture and the lower value (92.2%) was registered in non-pelleted seeds. Seed pelleting increased the germination percentage by 3.4 per cent. Seed germination is one of the most important phases of the plant life cycle (Kuriakose and Prasad 2007). Ahmad et al (2009) asserted that germination and seedling establishment are very critical stages in the life cycle of a plant. Seed pelleting showed a positive response on shoot length. Higher shoot length (7.0 cm) was recorded in seeds pelleted with TNAU pelleting mixture and the lower value (5.5 cm) was registered in non-pelleted seeds. Seed pelleting increased the shoot length by 1.5 cm. The higher root length was observed in the pelleted seeds (4.2 cm) and the lower root length was measured in control (3.9 cm). The effect of seed pelleting on shoot length was more pronounced than root length. Arati (2000) reported similar results that Bengal gram seeds treated with neem leaf powder recorded higher shoot and root length.

Crop growth rate (CGR): The data on CGR indicated significant differences due to foliar spraying of nutrients and salicylic acid (Table 2). It is evident that irrespective of the treatments, as growth advanced there was a decline in CGR. In general seed pelleting slightly increased the CGR at vegetative stage. The CGR gradually decreased from vegetative stage to physiological maturity as per the data shown. Maximum value (0.095 g/cm) was recorded in nutrient consortium received plants when the plants were between vegetative to early bloom stage. The drastic reduction in CGR at physiological maturity stage was due to senescence. CGR is a linear function of intercepted irradiance and maintaining higher LAI which has positive effect for higher dry matter production by increased CGR thus giving higher yield (Shibles and Weber 1966). In general CGR has a highly significant positive correlation with seed yield. In the present study nutrient consortium and NPK (19:19:19) treatments recorded a higher CGR. Similar results were also

Table 1. Effect of seed pelleting on seedling characteristics

Treatment	Germination (%)	Root length (cm)	Shoot length (cm)
Non-pelleted seeds	92.2	3.9	5.5
Pelleted seeds	96.1	4.2	7.0

Table 2. Effect of seed pelleting and foliar spray on crop growth rate (g/cm) at different growth stages in sesame

Treatment	Vegetative stage – reproductive (early bloom)		Reproductive (early bloom) – reproductive (mid bloom)		Reproductive (mid-bloom) – physiological maturity	
	P1	P2	P1	P2	P1	P2
T_1	0.075	0.084	0.068	0.068	0.017	0.018
T_2	0.083	0.090	0.082	0.083	0.029	0.031
T_3	0.085	0.092	0.084	0.097	0.033	0.034
T_4	0.081	0.088	0.071	0.089	0.018	0.017
T_5	0.080	0.086	0.078	0.076	0.027	0.028
T_6	0.086	0.095	0.088	0.081	0.035	0.038
T_7	0.074	0.081	0.063	0.061	0.008	0.009
T_8	0.071	0.081	0.053	0.054	0.002	0.004
Mean	0.08	0.09	0.073	0.076	0.021	0.022
	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$
P	0.0011	0.0023	0.0060	0.001	0.0042	0.0085
T	0.0022	0.0046	0.0012	0.002	0.008	0.0017
P × T	0.0032	0.0065	0.0016	0.0034	0.001	0.0024

T_1: Urea 1%, T_2: DAP 1%, T_3: NPK (19:19:19) 1%, T_4: $MnSO_4$ 0.5%, T_5: MAP 0.5%, T_6: Nutrient consortium 2%, T_7: Salicylic acid 100 ppm, T_8: Control

reported by Sarkar et al (1999) that foliar application nutrients increased the crop growth rate in groundnut.

Total dry matter production: The total dry weight increased from vegetative to physiological maturity in all the treatments (Table 3) and the rate of increase was very high from flowering to pod maturity stage. All the nutrients and growth regulators produced higher total dry weight as compared to control in both factors (non-pelleted plants and pelleted plants). The treatment T_6 (nutrient consortium) registered highest reproductive parts dry weight value (40.19 g/plant), at physiological maturity stage followed by NPK (19:19:19) (T_3) while the lowest value was recorded in control. The same treatment maintained its superiority at all growth stages and least value was found in control.

All the plants developed from pelleted seeds showed better performance as compared to plants developed from non-pelleted seeds. Statistically the interactions between seed pelleting and various foliar sprays on crop growth rate were significant starting from vegetative stage to physiological maturity. The superior treatment T_6 (nutrient consortium) was on par with T_2 and T_5 at all growth stages except at vegetative stage.

Seed yield per plant (Table 4): At harvest the treatment T_6 (nutrient consortium) was found to have maximum seed yield per plant (6.05 g). This was followed by foliar spray of NPK (19:19:19) 1 per cent on 30 and 45 DAS and least value was recorded in control (4.83 g). In general pelleted plants showed better performance as compared to non-pelleted plants. Yield is the ultimate economic product of crop production. The crop yield depends on the accumulation of photo-assimilates during the growing period and the way they are partitioned between the desired storage organs of the plants. The seed yield per plant was found to be higher in plants received nutrient consortium 2 per cent on 30 and 45 DAS.

Table 3. Effect of seed pelleting and foliar spraying on leaf, stem, reproductive part dry weight (g/plant) at different growth stages in sesame

Treatment	Vegetative stage (P1)						Reproductive (early bloom) stage (P2)							
	LDW	SDW	TDW	LDW	SDW	TDW	LDW	SDW	RDW	TDW	LDW	SDW	RDW	TDW
T_1	3.42	3.62	8.31	3.61	3.74	8.53	5.92	5.96	1.73	13.8	5.74	5.92	1.88	13.61
T_2	3.62	3.78	8.41	3.68	3.78	8.56	7.42	7.89	2.78	17.48	6.82	7.59	2.86	17.32
T_3	3.65	3.85	8.42	3.72	3.92	8.62	7.54	8.46	3.82	19.66	7.84	8.62	3.88	19.34
T_4	3.55	3.75	8.34	3.63	3.75	8.54	6.12	6.92	1.78	14.86	5.76	6.56	1.92	13.87
T_5	3.56	3.72	8.38	3.65	3.76	8.59	6.38	7.77	2.75	15.96	6.79	7.58	2.84	16.23
T_6	3.68	3.88	8.45	3.75	3.95	8.69	7.56	8.49	3.98	19.86	7.86	8.64	3.99	21.58
T_7	3.36	3.53	8.20	3.58	3.71	8.64	5.82	5.88	1.33	12.74	5.74	5.33	1.48	12.85
T_8	3.26	3.36	8.25	3.56	3.60	5.73	5.11	5.18	1.14	15.73	4.72	5.11	1.32	11.73
Mean	3.51	3.69	8.35	3.65	3.78	8.24	6.48	7.7	2.41	15.72	6.41	6.98	2.52	15.8
	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$
P	0.028	0.058	0.06	0.13	0.060	0.128	0.056	0.11	0.09	0.18	0.113	0.23	0.18	0.37
T	0.030	NS	0.057	NS	0.13	0.27	0.05	0.11	0.02	0.04	0.10	0.22	0.04	0.08
P x T	0.081	0.08	0.19	0.166	0.17	0.39	0.16	0.15	0.26	0.59	0.33	0.31	0.53	0.122

Table 3. Contd.....

Treatment	Reproductive (mid bloom) stage (P1)								Physiological maturity (P2)							
	LDW	SDW	RDW	TDW	LDW	SDW	RDW	TDW	LDW	SDW	RDW	TDW	LDW	SDW	RDW	TDW
T_1	7.22	8.52	11.48	27.23	7.52	9.01	11.65	28.82	1.92	5.46	23.64	31.06	2.63	6.69	23.67	32.66
T_2	8.46	10.79	13.74	33.01	9.88	10.83	13.78	34.05	3.74	7.58	25.36	36.69	3.85	7.86	25.83	37.16
T_3	10.59	11.83	14.84	37.38	10.92	11.92	14.83	37.78	4.82	8.68	26.43	39.94	4.92	8.92	26.86	40.10
T_4	8.32	9.55	12.73	30.6	8.64	9.67	12.89	31.4	2.55	6.51	24.74	33.9	2.92	6.73	24.72	34.27
T_5	8.37	11.65	13.84	33.92	9.74	10.74	13.66	34.08	3.69	7.57	25.22	36.48	3.65	7.81	25.79	37.01
T_6	10.66	11.86	14.9	37.51	10.96	11.98	14.94	37.93	4.85	8.76	26.56	40.19	4.96	8.96	26.94	40.50
T_7	6.51	10.43	10.98	27.7	7.43	8.43	11.96	27.91	1.33	5.33	23.78	30.23	1.92	5.55	23.61	31.02
T_8	5.67	8.11	10.33	26.16	6.88	8.90	10.23	27.03	1.16	3.62	22.78	26.18	1.43	4.38	21.53	27.31
Mean	8.69	10.47	12.86	31.06	9.25	10.13	12.99	32.38	3.01	6.69	24.8	30.24	3.29	7.11	24.87	31.00
	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$	SEd	$CD_{0.05}$
P	0.07	0.15	0.09	0.18	0.14	0.30	0.18	0.37	0.53	1.09	0.18	0.38	0.05	0.11	0.37	0.76
T	0.84	0.16	0.026	0.54	0.016	0.33	0.029	0.059	0.05	0.11	0.021	0.44	0.11	0.23	0.43	0.89
P x T	0.21	0.23	0.26	0.75	0.43	0.47	0.53	0.08	1.54	0.16	0.52	0.61	0.16	0.33	1.08	1.26

T_1: Urea 1%, T_2: DAP 1%, T_3: NPK (19:19:19) 1%, T_4: $MnSO_4$ 0.5%, T_5: MAP 0.5%, T_6: Nutrient consortium 2%, T_7: Salicylic acid 100 ppm, T_8: Control

CONCLUSION

In this study emphasis was given mainly to understand the physiological basis for yield improvement in sesame. The treatments were evaluated in terms of changes in morpho-physiological attributes, enzyme activity, nutrient status, flowering, yield and yield attributes. In general pelleted seeds gave better seedling characters such as germination percentage and vigour. Two sprays of nutrient consortium received plants were taller at physiological maturity followed by foliar spray of NPK (19:19:19).

Among the treatments the plants that received nutrient consortium 2 per cent on 30 and 45 DAS showed their superiority in recording higher value followed by NPK (19:19:19) in both the factors (non-pelleted and pelleted seeds). Control plants recorded least value compared to other treatments in both the factors.

Table 4. Effect of seed pelleting and foliar spraying on seed yield per plant (g) in sesame

Treatment	P1	P2
T_1	4.51	5.83
T_2	5.37	5.89
T_3	5.41	5.92
T_4	5.13	5.69
T_5	5.21	5.77
T_6	5.72	6.05
T_7	4.37	5.48
T_8	5.37	4..83
Mean	4.41	5.80
	SEd	$CD_{0.05}$
P	0.089	0.080
T	0.078	0.161
P x T	18.32	NS

T_1: Urea 1%, T_2: DAP 1%, T_3: NPK (19:19:19) 1%, T_4: $MnSO_4$ 0.5%, T_5: MAP 0.5%, T_6: Nutrient consortium 2%, T_7: Salicylic acid 100 ppm, T_8: Control

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