

Original Research Article

<https://doi.org/10.20546/ijcmas.2019.808.130>

Growth, Yield and Seed Quality Parameters of Sesame (*Sesamum indicum* L.) as Influenced by Seed Priming and Pinching

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ABSTRACT

A field experiment was conducted during pre kharif (summer) season of 2018 to study the effects of terminal bud and priming of seeds with different chemicals in Sesame (*Sesamum indicum* L.) for growth, yield and seed quality parameters. The harvested seeds under different combination pinching and seed priming were studied for different seed quality parameters. The seed priming chemicals were considered in main plots and pinching of terminal buds was considered in sub plots. The individual plant performance for growth parameters, yield contributing parameters as well a seed yield plant⁻¹ revealed that seed priming with followed by $\text{KH}_2\text{PO}_4@200$ mM followed by $\text{KH}_2\text{PO}_4@50$ mM had maximum effect on increasing seed yield. Effect of pinching and seed priming treatments revealed that germination percentage was not significantly influenced but pinching of terminal bud with seed priming ($\text{KH}_2\text{PO}_4@100$ mM) had an effective role in root length, seedling dry weight and seedling fresh weight, for increasing oil and protein content KNO_3 had an important role.

Keywords

Pinching, Sesame,
Seed priming, Seed
quality

Article Info

Accepted:
10 July 2019
Available Online:
10 August 2019

Introduction

Among oilseed crops, sesame (*Sesamum indicum* L.) is one of the oldest crop known to humans, which is under cultivation from ancient times (Bisht *et al.*, 1998) and extensively cultivated in several countries of Asia and Africa. It is grown under environment stress with low management by resource poor small farmers (Cagirgan, 2006 and Bedigian, 2010). The comparison between

China, India and Ethiopia indicated that India has the lowest productivity. It is grown in different season in India and covers all agro ecological zones. The crop experiences moisture stress to varying degree in different stages of crop growth. It also faces other stress such as water logging, fluctuation in temperature, photo period and salt concentration. The climatic factors such as precipitation, humidity and soil factor will influence the growth. The productivity can be

enhanced if cultivated under favourable condition with proper management practices and use of quality seeds. Management practices like seed priming plays an important role for production of quality seed. It is a simple and low cost hydration technique in which seeds are partially hydrated to a point where pre germination metabolic activities start without actual germination, and then re-dried until close to the original dry weight. Among the different seed priming treatments potassium nitrate (KNO₃) is involved in the physiological process of stomatal movement, osmo-regulation, cell wall and membrane permeability. Potassium Dihydrogen Phosphate (KH₂PO₄) is utilized as a constituent of phospholipids, nucleotides and sugar phosphate. Osmo-priming with PEG (Polyethylene glycol) not only improves seed germination but also enhance crop performance under non-saline or saline condition. Seed priming in combination with removal of apical bud by pinching promotes development of lateral buds; thereby resulting more number of branches plant⁻¹ (Pathania *et al.*, 2000) and ultimately increase the seed yield and seed quality. This study was accomplished with the aim of investigating the effect of different pre-treatments with chemicals along with pinching of terminal bud on morphological, yield contributing and seed quality parameters in sesame.

Materials and Methods

The field experiment was conducted during the pre kharif seasons of 2017-2018 in sesame variety Savitri at AB Block farm, Bidhan Chandra Krishi Vishwavidyalaya, Kalyani (23.5° North Latitude and 89.0° East Longitude with an altitude of 9.75 m above the mean sea level) in West Bengal. After ploughing for a good seed bed preparation, fertilizers were applied as N: P₂O₅:K₂O @ 40:40:40 kg/ha as basal and another 40 kg N was applied 30 days after sowing. Seeds were

sown at a row spacing of 30 cm and 15 days after sowing thinning was done, maintaining plant to plant spacing of 10 cm. The recommended agronomic practices and plant protection measures were adopted for raising a good crop. Experiment was laid out in split plot design with 3 replications. Ten schedules of seed priming *viz* T₁ (KNO₃ @ 10 mM), T₂ (KNO₃ @ 20 mM), T₃ (KNO₃ @ 50 mM), T₄ (KH₂PO₄ @ 50 mM), T₅ (KH₂PO₄ @ 100 mM), T₆ (KH₂PO₄ @ 200 mM), T₇ [Polyethylene glycol (PEG) 6000 @ -0.4 MPa], T₈ [Polyethylene glycol (PEG) 6000 @ -0.3 MPa], T₉ [Polyethylene glycol (PEG) 6000 @ -0.2 MPa], T₁₀ Distilled water (Hydro priming) along with control T₁₁ (Dry seed) were treated as main plot treatment and pinching/without pinching of terminal bud was considered as sub plot treatment.

Ten plants from each replication and in each treatment were selected at random to record data on morphological and yield attributing characters. Seeds were soaked for 6 hours in priming solution then washed with distilled water and dried to original moisture at room temperature. The seed quality characters were estimated at the laboratory of department of Seed Science and Technology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia by following the method as prescribed by ISTA. Data on various characters were analysed by analysis of variance (Panse and Sukhatme 1985) and OPSTAT software programme (Sheoran *et al.*, 1998)

Results and Discussion

Effect of pinching and seed priming on growth, yield and yield contributing characters

The effect of pinching and seed priming on growth yield and yield contributing characters under field condition (Table 1) showed pinching of terminal bud had significant effect

on all characters except seed siliqua⁻¹ and 1000 seed weight. The characters days to 1st flowering and days to 50% flowering were not significantly influenced by seed priming. Days to 1st flowering and 50% flowering were statistically at par and ranges from 35.35 to 37.80, 39.77 to 42.52 respectively. Plant derived from T₁₀ (Hydro priming) showed maximum days to first flowering and T₂ (KNO₃ @ 20 mM) showed lowest value. In case of days to 50% flowering T₁₁ (Dry seed) took maximum days. Plant height was significantly influenced by pinching as well as priming. Higher plant height was observed in the treatment without pinching and it was significantly higher than the pinching treatment. The reduction in the height with pinching treatment was due to the effect of breaking the apical dominance and hence consequential increase in number of lateral branches. Pinching of terminal bud at 30 days after sowing recorded more number of branches per plant. In plants, the developments of auxiliary buds are inhibited normally by Indole Acetic Acid (IAA) produced in the apical meristem. If the source of auxin is removed by excising the apical meristem, the lateral branching gets accelerated. Moreover, under pinching of terminal bud, the utilization of photosynthates by the crop for the production of lateral branches would be higher and this might be the reason for increased number of branches per plant. Imayavaramban *et al.*, (2004) reported more number of branches with manual clipping of leaves, leaving two pair of leaves above cotyledonary leaf in sesame. The increased number of branches and production of more leaves which alter the crop canopy that in turn increased the value of leaf area index. The clipping practice might have efficiently altered the crop architecture, which in turn increased the lateral branches that led to greater chance for development of source and sink features in sesame. The characters primary branch and secondary branch both

had a significant effect on pinching but in case of seed priming there was no significant differences noticed in secondary branch. T₄ (KH₂PO₄ @ 50 mM) recorded maximum number in primary branch followed by T₆ (KH₂PO₄ @ 200 mM) and T₅ (KH₂PO₄ @ 100 mM), likewise in case of secondary branch T₁₀ (Hydro priming) recorded maximum number of secondary branches followed by T₂ (KNO₃ @ 20 mM) and T₆ (KH₂PO₄ @ 200 mM). This is because the apical dominance was broken due to pinching of terminal bud. Removal of apical dominance might have promoted the development of lateral buds thereby resulting in increased branches per plant (Pathania *et al.*, 2000). The terminal bud pinching practice might have efficiently altered the crop architecture by activating the lateral dormant buds through arresting the terminal growth which in turn increased the lateral branches that led to greater development of source and sink features in sesame and thereby facilitating the significant increase in yield (Singh *et al.*, 2013, Kokilavani *et al.*, 2007). Effect of pinching and seed priming revealed that number of Siliqua per plant was significantly influenced by both pinching and priming. Maximum number of siliqua per plant was observed in pinching treatment which was significantly higher than the without pinching treatment. T₄ (KH₂PO₄ @ 50 mM) showed maximum number of siliqua (130.48) followed by T₆ (120.23) and T₇ [Polyethylene glycol (PEG) 6000 @ -0.4 MPa] (110.30). T₂ (KNO₃ @ 20 mM) recorded lowest number of siliqua per plant (97.28). The effectiveness of pinching may probably be due to the change induced in the rate of cell division in the meristematic region (Ahmad *et al.*, 2007) thereby reducing the plant height promoting the development of increased number of healthy branches and flowers (Pathania *et al.*, 2000) which ultimately increased the siliqua number per plant. Further, the effectiveness of chemicals on siliqua production might be due to their retarding effect on apical growth,

which in turn encouraged side branches (Ahmad *et al.*, 2007). Pinching of terminal bud and seed priming had non-significant effect on number of seed per siliqua. The length-breadth ratio of the seed is specific for a particular cultivar. The ratio was slight higher in without pinching plants compared to the pinched plants. The seed priming treatments also showed significant effect for this character. Maximum length breadth ratio was observed in T₂ (KNO₃ @ 20 mM) followed by T₇ [Polyethylene glycol (PEG) 6000 @ -0.4 MPa] treatment. Data pertaining to 1000 seed weight (test weight) of the produce obtained from sesame crop as influenced by pinching of terminal bud revealed no significant effect, but seed priming treatments showed significant effect for the characters. Numerically higher 1000 seed weight was observed in without pinching treatment than pinching one. Among treatments T₂ (KNO₃ @ 20 mM) showed maximum 1000 seed weight (3.63). Similar observations were also recorded by Tripathi *et al.*, (2013) where different topping practices in sunn hemp did not exert any significant influence on number of seeds per pod and test weight.

A significantly higher seed yield per plant was recorded in pinching treatment than without pinching treatment. T₆ (KH₂PO₄ @ 200 mM) recorded highest seed yield (25.33 g plant⁻¹) among treatments which was significantly better than the other treatments and T₂ (KNO₃ @ 20 mM) showed the lowest value (19.42 g plant⁻¹). The increased seed yield was due to pinching of plants which may be attributed to the proportionate increase in yield contributing characters *i.e.*, more number of productive branches and more number of flowers per plant. Similar results were reported by Venkata Reddy *et al.*, (1997) in okra, Malik *et al.*, (1999) in onion, Vyakarnahal *et al.*, (2001) in sunflower, Sajjan *et al.*, (2002) in okra.

Effect of pinching and seed priming on seed quality parameters

The harvested seeds under different treatment combinations *viz.* P₀T₁, P₀T₂, P₀T₃, P₀T₄, P₀T₅, P₀T₆, P₀T₇, P₀T₈, P₀T₉, P₀T₁₀, P₀T₁₁ and P₁T₁, P₁T₂, P₁T₃, P₁T₄, P₁T₅, P₁T₆, P₁T₇, P₁T₈, P₁T₉, P₁T₁₀, P₁T₁₁ were evaluated in seed testing laboratory of department of Seed Science and Technology, Bidhan Chandra Krishi Viswavidyalaya during 2018 for analysis of different seed quality parameters *viz.* Root length, Shoot length, Seedling fresh weight, Seedling dry weight, Vigour index, Germination percentage, Oil content (%), Protein content (%), and Electrical conductivity. The data were analysed and the results have been presented in Table 2. Which revealed that seedling parameters (Root length, Shoot length, Seedling fresh weight, Seedling dry weight, Vigour index) had significant effect due to pinching and seed priming chemical but Germination percentage had non-significant effect. Among seed quality parameters P₁T₅ (Pinching+ KH₂PO₄ @ 100 mM) recorded maximum effect on root length seedling fresh weight and seedling dry weight. Yagmur and Kaydan (2008) reported that hydropriming induced three-four times more growth for root and shoot length in comparison with seedlings obtained from non-primed seeds.

Improved seedling fresh and dry weight might be due to increased cell division within the apical meristem of seeding roots, which caused an increase in plant growth. Seedling dry weight enhancement may be one of the reasons that drive positive effects of priming on seed performance under adverse environmental conditions. P₀T₉ [Non pinching+ Polyethylene glycol (PEG) 6000 @ -0.2 MPa] had also better result in seedling shoot length and vigour index as vigour index showed the most important seedling quality parameters.

Table.1 Effect of pinching and seed priming on growth, yield and yield contributing characters

Pinching of terminal bud	1st flowering (Days)	50% flowering (Days)	P.H (cm)	P.B (No)	S.B (No)	Siliqua plant ⁻¹ (No)	Seed Siliqua ⁻¹ (No)	Siliqua L/B ratio	1000 SW (g)	Seed yield plant ⁻¹ (g)
P₀	35.10	38.70	105.70	4.11	3.70	88.80	52.61	3.10	3.44	19.81
P₁	37.60	42.52	33.78	4.65	7.18	127.91	52.52	2.95	3.42	26.16
SE(m±)	0.14	0.25	0.43	0.06	0.11	0.41	0.09	0.01	0.02	0.22
CD at 5%	0.40	0.74	1.26	0.18	0.33	1.21	N/A	0.02	N/A	0.66
Treatments										
T₁	35.66	40.44	63.66	4.12	5.45	103.18	52.67	2.84	3.28	21.82
T₂	35.35	40.90	59.62	4.45	5.77	97.28	52.83	2.89	3.63	19.42
T₃	36.77	41.21	82.40	4.33	5.07	102.92	52.33	3.01	3.51	23.50
T₄	36.72	40.12	69.77	4.68	5.40	130.48	52.67	2.95	3.23	25.08
T₅	36.10	40.09	70.80	4.60	5.47	106.88	52.50	3.07	3.44	23.77
T₆	36.71	40.95	71.13	4.67	5.63	120.23	53.00	3.15	3.57	25.33
T₇	36.45	39.77	71.71	4.20	5.23	110.30	52.67	3.15	3.61	23.08
T₈	35.49	40.47	69.69	4.35	5.20	109.25	52.50	3.10	3.36	24.33
T₉	35.43	40.83	70.50	4.50	5.40	108.32	52.33	3.06	3.56	23.02
T₁₀	37.80	40.33	63.35	4.25	5.85	101.60	52.33	3.05	3.36	21.89
T₁₁	37.18	41.41	74.84	3.98	5.33	101.37	52.33	2.99	3.37	21.57
SE(m±)	0.53	0.50	0.76	0.12	0.27	0.85	0.19	0.01	0.05	0.60
CD at 5%	NS	NS	2.26	0.37	NS	2.53	NS	0.05	0.14	1.78
Interaction										
SE(m±)	0.75	0.71	1.08	0.18	0.38	1.20	0.28	0.02	0.07	0.85
CD at 5%	1.34	2.46	4.17	0.59	1.11	4.02	NS	0.06	0.18	2.20

P.H-Plant height, P.B-Primary branch plant⁻¹, S.B-Secondary branch plant⁻¹, Siliqua L/B-Siliqua length breadth ratio, 1000 SW- 1000 seed weight
 Legend: T₁ (KNO₃ @ 10 mM), T₂ (KNO₃ @ 20 mM), T₃ (KNO₃ @ 50 mM), T₄ (KH₂PO₄ @ 50 mM), T₅ (KH₂PO₄ @ 100 mM), T₆ (KH₂PO₄ @ 200 mM), T₇ [Polyethylene glycol (PEG) 6000 @ -0.4 MPa], T₈ [Polyethylene glycol (PEG) 6000 @ -0.3 MPa], T₉ [Polyethylene glycol (PEG) 6000 @ -0.2 MPa], T₁₀ Distilled water (Hydro priming), T₁₁ (Dry seed)

Table.2 Effect of pinching and seed priming on seed quality parameters

	Treatments (T)	RL(cm)	SL(cm)	Seedling FW(g)	Seedling DW(g)	VI	Germination % (Tr value)	Oil content (%)	Protein content (%)	E.C (dsm ⁻¹)
P₀	T₁	8.55	3.12	0.31	0.12	1,031.35	71.20	27.67	27.12	1.28
	T₂	7.65	2.96	0.28	0.11	866.67	65.07	32.06	20.13	1.44
	T₃	9.11	3.05	0.38	0.13	1,094.40	72.05	38.67	22.60	1.13
	T₄	8.27	3.05	0.34	0.13	980.65	69.10	27.33	27.69	1.48
	T₅	9.16	2.85	0.33	0.15	981.60	65.19	29.06	20.29	1.65
	T₆	8.18	3.11	0.29	0.11	922.03	65.07	27.22	27.72	1.29
	T₇	8.26	2.84	0.31	0.12	998.40	72.05	31.39	23.51	1.75
	T₈	8.95	2.78	0.32	0.12	1,055.67	72.47	35.28	18.39	1.84
	T₉	8.93	3.19	0.31	0.12	1,131.50	75.85	28.94	11.84	1.42
	T₁₀	9.07	2.91	0.33	0.12	959.90	63.91	27.11	19.31	1.67
	T₁₁	8.45	2.99	0.31	0.11	936.48	65.39	28.11	20.04	1.49
P₁	T₁	9.15	2.73	0.37	0.15	1,054.12	71.94	29.17	29.56	1.64
	T₂	8.89	2.92	0.33	0.12	983.40	66.34	35.06	19.48	1.54
	T₃	8.14	2.99	0.28	0.11	1,001.10	72.05	36.50	23.01	1.57
	T₄	9.05	2.66	0.32	0.11	1,014.65	69.10	27.55	18.06	1.22
	T₅	9.34	2.74	0.39	0.17	988.30	65.19	29.56	22.11	1.46
	T₆	7.72	2.43	0.30	0.11	847.60	66.54	26.50	27.92	1.33
	T₇	7.40	2.85	0.28	0.11	850.43	67.07	30.89	22.38	1.37
	T₈	7.79	2.81	0.28	0.11	989.63	75.85	31.05	20.34	1.81
	T₉	9.00	2.27	0.34	0.13	977.32	70.04	28.61	13.87	1.48
	T₁₀	8.77	2.82	0.31	0.12	926.87	63.93	27.39	25.15	1.54
	T₁₁	8.64	2.57	0.30	0.11	918.93	65.39	28.17	21.02	1.49
	CD at 5%	0.57	0.40	0.02	0.01	139.93	NS	1.57	1.77	0.29
	SE(m±)	0.20	0.14	0.01	0.01	48.93	2.85	0.55	0.62	0.10
	CV	4.00	8.47	4.49	6.66	8.67	7.19	3.16	4.87	11.78

RL- Root length, SL- Shoot length, Seedling FW- Seedling fresh weight, Seedling DW- Seedling dry weight, VI-Vigour index, E.C- Electrical conductivity
 Legend: T₁ (KNO₃ @ 10 mM), T₂ (KNO₃ @ 20 mM), T₃ (KNO₃ @ 50 mM), T₄ (KH₂PO₄ @ 50 mM), T₅ (KH₂PO₄ @ 100 mM), T₆ (KH₂PO₄ @ 200 mM), T₇ [Polyethylene glycol (PEG) 6000 @ -0.4 MPa], T₈ [Polyethylene glycol (PEG) 6000 @ -0.3 MPa], T₉ [Polyethylene glycol (PEG) 6000 @ -0.2 MPa], T₁₀ Distilled water (Hydro priming), T₁₁ (Dry seed)

Ruan *et al.*, (2002) reported that seed priming with PEG 8000 were not able to invigorate rice seeds, but resulted in a higher energy of germination and germination index compared with untreated seeds. For wheat, primed seeds have higher vigour level, which resulted in earlier start of emergence and finally positive correlation between seed vigour and field performance. Although there was no significant difference among all treatments but P₀T₉ [Non pinching+ Polyethylene glycol (PEG) 6000 @ -0.2 MPa], and P₁T₈ [pinching Polyethylene glycol (PEG) 6000 @ -0.3 MPa] recorded highest germination percentage value. Similar findings have been reported by Shim *et al.*, (2009) where osmo-priming with PEG 6000 had improved germination percentage and germination rate in sesame. Sesame is grown primarily for its oil-rich seeds. The seed is rich in protein and the protein has disable amino acid profile with good nutritional value similar to soybean (NAERLS, 2010). In present study the oil content (%) and protein content (%) had the significant effect among all the treatments where P₀T₃ (Non pinching+ KNO₃ @ 50 mM) recorded highest value in oil content and P₁T₁ (pinching+ KNO₃ @ 10 mM) recorded maximum value in protein content. The electrical conductivity test is a promising method for assessment of seed vigour. P₀T₃ (Non pinching+ KNO₃ @ 50 mM) recorded lowest electrical conductivity value means in this case loss of electrolytes was minimum.

The present study revealed that the growth and yield contributing characters responded positively due to pinching effect. Among the treatments T₆ (KH₂PO₄ @ 200 mM) had heighest positive effect on seed yield plant⁻¹. followed by T₄ (KH₂PO₄ @ 50 mM). The higher seed yield plant in T₄ was due to highest primary branch plant⁻¹ and siliqua plant⁻¹ as well as high number of secondary branch plant⁻¹, seed siliqua⁻¹ and 1000 seed weight. For seed quality parameters treatment

combination P₁T₅ (Pinching + KH₂PO₄ @ 100 mM) had maximum effect but there was non-significant effect on seed germination. For increasing oil and protein content there is a positive effect of KNO₃. Therefore it can be concluded that for increase of seed yield and seed quality parameters KH₂PO₄ had a great role and for improvement of oil and protein content of sesame seed, KNO₃ played a significant role.

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How to cite this article:

Utpal Biswas, Rupa Das and Amitava Dutta. 2019. Growth, Yield and Seed Quality Parameters of Sesame (*Sesamum indicum* L.) as Influenced by Seed Priming and Pinching. *Int.J.Curr.Microbiol.App.Sci*. 8(08): 1112-1119. doi: <https://doi.org/10.20546/ijemas.2019.808.130>