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Effect of Seed Priming Techniques on Seed Yield and its Attributes characters in Field Pea (*Pisum sativum* L.) under rainfed Condition

Maneesh Kumar[1], Alok Kumar[2*], Dheeraj Katiyar[3], Abhishek Pati Tiwari[1] and Shivani Kaundal[4]
[1]Department of Seed Science and Technology,
Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (Uttar Pradesh), India.
[2]Department of Genetics & Plant Breeding, School of Agriculture,
Abhilashi University, Chail Chowk, Mandi (Himachal Pradesh), India.
[3]Acharya Narendra Deva University of Agriculture and Technology,
Kumarganj, Ayodhya (Uttar Pradesh), India.
[4]Department of Crop Physiology School of Agriculture,
Abhilashi University, Chail Chowk, Mandi (Himachal Pradesh), India.

(Corresponding author: Alok Kumar)*
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ABSTRACT: In order to study the "Effect of seed priming techniques on seed yield and its attributes characters in field pea (*Pisum sativum* L) under rainfed condition" an experiment was carried out in Split Plot Design with three replications. The two field pea variety viz, KPMR-522 (Jay) and KPMR-400 (Indra) having fourteen seed priming treatments during the *Rabi* season of 2019-20 and 2020-21 at Oil Seed Farm, CSA University, Kanpur. The data of analysis of variance of pooled data revealed that variety KPMR-522 was significantly superior in yield and yield related aspects as compared to variety KPMR-400. The seed priming techniques i.e. seed coating with Bio-NPK and drought alleviating bacteria resulted in maximum yield and yield components as compared to other treatments. Thus, from this experiment it may be concluded that seed coating with drought alleviating bacteria + Bio-NPK can be used to increase pea seed yield while being both environmentally and economically feasible.

Keywords: Bio-grow, Bio-NPK, Bio-Phos, Pea, Seed Priming Yield.

INTRODUCTION

A cool-season crop is the pea (*Pisum sativum* L.). Pea plays a significant part in human nutrition for its great protein quality with a high dietary benefit. These days, legumes give 33(%) of the whole amount of protein for human utilization, addressing a significant source of fodder and forage for animals and production of edible and industrial oils (Philips *et al*., 1980). Field pea is a basic economic and nutritive harvest and is frequently called "poor man's meat" because of its high protein, nutrient and mineral and pre biotic starch content yet reasonableness for poorer people. All the more explicitly, field pea is naturally rich in iron and zinc and in this way could deal with two of the most well-known micronutrient deficiencies in the world (Amarakoon *et al*., 2012). The cultivation of pea maintain soil richness through organic nitrogen fixation in relationship with symbiotic rhizobium common in its root nodules and in this way assumes a crucial part in encouraging feasible horticulture (Negi *et al*., 2006). Seed priming is one the superior seed fortification strategies are utilized in the world to decrease the germination time, to synchronize germination, to further develop germination rate and increment generally plant stand (Lee and Kim 2000) different types of seed priming techniques have been created and utilized effectively to stimulate the seed germination and invigorate the seed. Seed priming helps in better seedling development and assures uniformity in germination. A crop's potential yield may rise as a result of uniform emergence, which helps to maximize harvesting effectiveness. Additionally, seed priming can increase a seed's germination rate, mean germination time, germination index, seedling vigor, and other seed-related metrics. When compared to unprimed seeds, primed seeds produced a larger yield in a variety of situations, especially when sowing under challenging conditions like temperature extremes and excess wetness. Additionally, it was noted that increased resistance to environmental stimuli aids in overcoming dormancy (Caseiro *et al*., 2004).

MATERIALS AND METHOD

The experiment was carried out at Oil Seed Farm, Kalyanpur, Kanpur during 2019-20 and 2020-21 in *Rabi* season for the assessment of planting value and seed yield attributes in the field pea. The seeds were harvested individually from each plot and examined for the evaluation of seed quality parameters in the laboratory of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur. The primed seeds were sown in sub-plot with three replications and the variety KPMR-522 (V_1) and KPMR-400 (V_2) were placed in the main plot using Split Plot Design. Fourteen treatments were used in this study *i.e.* **T_1-**Control**,** **T_2-**Control (Specific recommended seed treatments for each crop and area in accordance with a package of practices), **T_3-** Seed priming with water, **T_4-** Seed priming with KNO_3 @ 0.3(%) solution, **T_5-** Halopriming with KH_2PO_4@ 0.3(%) + $MnSO_4$ @ 0.5(%) solution, **T_6-** Halopriming with Zn_2SO_4 @ 0.3(%) + $MnSO_4$ @ 0.5(%) solution, **T_7-** Seed coating (on dried seeds) with *T. harzianum* @ 15g/kg seed, **T_8-** Seed coating (hydroprimed seeds) with *T. harzianum* @ 15g/kg seed, **T_9-** Seed coating (hydroprimed seeds) with Bio-NPK (contain 1x 109 cfu), **T_{10}-** Seed coating (on hydroprimed seeds) with Bio-grow (contain 1×109 cfu), **T_{11}-** Seed coating (hydroprimed seeds) with Bio-phos (contain 1x109 cfu), **T_{12}-** Seed coating (hydro-primed seeds) with DAB + Bio-NPK, **T_{13}-** Seed coating (hydroprimed seeds) with DAB + Bio-grow and **T_{14}-** Seed coating (hydroprimed seeds) with Drought Alleviating Bacteria + Bio-Phos.

Plant-to-plant and row-to-row distances were maintained at 30 cm and 10 cm, respectively, in field conditions. Fertilizers were applied as a basal dose at the time of planting, at a rate of 20:40:20 (kg ha^{-1}) N:P:K @ 50(%). Standard agronomic techniques were used to develop the field pea crop under sub-optimal condition. The different observations were recorded like plant height (cm), number of branches/plant number of seeds/pod, number of pods/plant, 100 seed weight and seed yield $plant^{-1}$ (g).

Methods used in seed priming. In hydro-priming seed was soaked at 8 hours in water at 25^0C and shade drying for 48h at room temperature but in case of halopriming seed was soaked with KH_2PO_4@ 0.3(%) + MnSO4 @ 0.5(%) solution and dried the seed and but in case of biopriming used 15g *T. harzianum* mixed with 50 ml of water for 1 kg of seed. Before sowing, dry the seeds in the shade for 20 to 30 minutes. Different methods of seed priming have been developed which invigorate the seed.

Hydro-priming: The simplest method of seed priming is hydro-priming. It is an easy method of soaking seeds in water for a set amount of time. The areas of dry farming and dry land framing benefit most from this method. Seeds are either soaked in water with or without aeration during hydro priming (Taylor *et al*., 1998).

Halo-priming: Halo priming is the process of treating seed with inorganic solutions like calcium chloride ($CaCl_2$), sodium chloride (NaCl), potassium nitrate (KNO_3), and sodium sulfate ($CaSO_4$) to enhance germination. Halo priming is well established to be crucial to plant growth at all phases of development, including germination and seedling emergence (Rehman *et al.,* 2020).

Bio-priming: Bio-priming is a seed treatment for biotic and abiotic stress management that combines seed inoculation with helpful microorganisms (biological aspect) with seed moisture adjustment (physiological aspect) (Bisen *et al*., 2015).

RESULT AND DISCUSSION

Mean performance. All the pooled mean performance of 14 treatments for 6 parameters and two varieties KPMR-522 and KPMR-400 was shown in Table 1.

In the study, seed priming treatments were found to have the greatest impact on significantly increasing the plant height (cm) in both the varieties *viz.*, KPMR-522 and KPMR-400 during both the years. The highest pooled mean (60.93) found with treatment T_{12}- Seed coating with Bio-NPK + DAB (on hydroprimed seed for 8 hrs and dried for 48 hrs) variety KPMR-522 (59.38) and KPMR-400 (62.47) followed by T_6- Halo-priming (Soaked seed in Zn_2SO_4 @ 0.3(%) + $MnSO_4$ @ 0.5(%) solution and dried) (58.53 and 60.68) and T_{13} - Seed coating with Bio grow + DAB (on hydroprimed seed for 8 hr and dried for 48 hr) (57.63 and 59.85). All together, nitrogen encourages plant height by lengthening and increasing the amount of internodes, which results in a progressive increase in plant height (Gasim, 2001).

The data analysis revealed that the different seed priming treatments on both varieties extensively influenced the number of branches per plant during all the period of investigation on pooled basis and the maximum number of branches $plant^{-1}$ pooled mean (5.03) was found in T_{12}- Seed coating with Bio NPK + DAB (on hydro-primed seed for 8 hours and dried for 48 hrs) 5.17 and 4.90 followed by T_6- Halo-priming (seed soaked in Zn_2SO_4 @0.3(%) + MnSO4 @ 0.5(%) solution and dried) 5.10 and 4.77 and T_{13}- Seed coating with Biogrow + DAB (on hydroprimed) 4.70 and 4.63 in variety KPMR-522 and KPMR-400, respectively. While the bio fertilizers increased the number of branches per plant, improved root nodulation, and provided a better soil environment, which increased nitrogen fixation and phosphorous solubilization and ultimately may have led to increased plant growth results are in accordance with the findings of (Singh *et al.*, 2009) in soybean.

The result of seed priming treatments under study was found significant in increasing the number of pods per plant in both varieties *viz.*, KPMR-522 and KPMR-400 during both the years of pooled data. The highest pooled mean (19.21) with treatment T_{12}- Seed coating with Bio-NPK + DAB (on hydroprimed seed for 8 hours and dried for 48 hrs) (19.63 and 18.8) followed by T_6- Halo-priming (Seed soaked in Zn_2SO_4 @ 0.3(%) + $MnSO_4$ @ 0.5(%) solution and dried) (17.83 and 18.36) and T_{13} -Seed coating with Bio grow + DAB (on hydro-primed seed for 8 hrs and dried for 48 hrs) (17.83 and 17.33) in both of the variety KPMR-522 and KPMR-400, respectively. The treatment will also be used commercially and for research.

Table 1: Effects of seed priming technique on six characters in field pea.

Treatments	Plant height (cm)			Number of branches			No. of Pod /Plant		
	KPMR-522	KPMR-400	Mean	KPMR-522	KPMR-400	Mean	KPMR-522	KPMR-400	Mean
T_1	43.92	51.35	47.63	3.50	3.43	3.47	11.75	9.67	10.71
T_2	44.93	52.45	48.69	3.60	3.57	3.58	12.03	10.53	11.28
T_3	45.87	53.95	49.91	3.77	3.63	3.70	12.60	11.60	12.10
T_4	47.73	55.83	51.78	3.83	3.77	3.80	14.73	13.50	14.12
T_5	48.03	57.00	52.52	4.10	4.03	4.07	15.67	14.50	15.08
T_6	58.53	60.68	59.61	5.10	4.77	4.93	18.83	17.83	18.33
T_7	46.08	52.77	49.43	3.67	3.57	3.62	13.40	12.43	12.91
T_8	47.42	53.57	50.49	4.17	3.67	3.92	14.17	13.13	13.65
T_9	52.55	56.12	54.33	4.10	4.03	4.07	16.67	15.72	16.20
T_{10}	55.45	58.28	56.87	4.30	4.23	4.27	17.17	16.28	16.73
T_{11}	54.28	56.85	55.57	4.40	4.30	4.35	16.77	15.65	16.21
T_{12}	59.38	62.47	60.93	5.17	4.90	5.03	17.83	17.33	17.58
T_{13}	57.63	59.85	58.74	4.70	4.63	4.67	19.63	18.87	19.25
T_{14}	56.65	58.70	57.68	4.60	4.57	4.58	17.33	16.43	16.88
Mean	51.32	56.42		16.01	15.79		15.61	14.54	
Factors	SE(m) ±	C.D. at 5(%)		SE(m) ±	C.D. at 5(%)		SE(m) ±	C.D. at 5(%)	
Variety	0.13	0.82		0.02	0.10		0.12	0.75	
Treatments	0.30	0.85		0.09	0.25		0.26	0.75	
Var × Treat	0.47	1.34		0.06	N/A		0.43	NS	
Treat. Var.	0.43	1.35					0.38	NS	

Treatments	Number of Seed/Pod			100 Seed Weight(g)			Seed Yield (q/h)		
	KPMR-522	KPMR-400	Mean	KPMR-522	KPMR-400	Mean	KPMR-522	KPMR-400	Mean
T_1	5.77	5.23	5.50	14.6	14.22	14.41	17.72	15.73	16.73
T_2	6.00	5.30	5.65	14.89	14.46	14.67	18.23	15.90	17.07
T_3	6.23	5.37	5.80	15.15	14.94	15.05	18.57	16.15	17.36
T_4	6.57	6.00	6.28	15.27	15.12	15.2	19.45	16.71	18.08
T_5	6.83	5.67	6.25	15.33	15.29	15.31	19.54	17.14	18.34
T_6	7.20	6.67	6.93	17.16	17.12	17.14	20.60	19.80	20.20
T_7	6.37	5.40	5.88	15.55	15.4	15.48	18.38	16.51	17.45
T_8	6.80	5.87	6.33	15.72	15.62	15.67	18.60	16.71	17.65
T_9	6.93	6.00	6.47	15.96	15.84	15.9	19.06	18.21	18.64
T_{10}	7.17	6.10	6.63	16.08	16.03	16.06	19.53	18.70	19.12
T_{11}	6.90	5.90	6.40	16.27	16.2	16.24	19.18	18.44	18.81
T_{12}	7.13	6.40	6.77	18.63	17.49	18.06	20.00	18.93	19.46
T_{13}	7.40	6.93	7.17	16.86	16.7	16.78	21.80	20.52	21.16
T_{14}	7.00	6.30	6.65	16.63	16.31	16.47	19.34	18.95	19.14
Mean	6.74	5.94		16.00714	15.76714		19.29	17.74	
Factors	SE(m) ±	C.D. at 5(%)		SE(m) ±	C.D. at 5(%)		SE(m) ±	C.D. at 5(%)	
Variety	0.08	0.50		0.08	N/A		0.11	0.73	
Treatments	0.09	0.26		0.21	0.597		0.23	0.66	
Var xTreat	0.29	NS		0.297	N/A		0.42	1.07	
Treat. Var.	0.15	NS					0.34	1.09	

Data previously published by the synergistic influence of combined use of inorganic fertilizers and bio fertilizers has enhanced the availability of nutrients, which in turn played a crucial role in e transfer and conservation and may have contributed to an increase in the number of pods per plant Tagore *et al*. (2013) in chickpea.

On the basis of the pooled mean for both years, seed priming was found to be the most effective for significantly increasing. The maximum pooled mean (7.17) number of seed/pods with treatment T_{12}- Seed coating with Bio-NPK + DAB (on hydro-primed seed for 8 hrs and dried for 48 hrs) (7.40 and 6.93) followed by T_6- Halo-priming (seed soaked in Zn_2SO_4 @ 0.3(%) + $MnSO_4$ @ 0.5(%) solution and dried) (7.20, 6.67) and T_{13} -Seed coating with Bio grow + DAB (on hydro-primed seed for 8 hrs and dried for 48 hrs) (7.13 and 6.40) in both of the variety KPMR-522 and KPMR-400. The experiment showed these combinations are useful in increasing production and output. The availability of vital nutrients in appropriate amount increased the concentration of carbohydrates in seed which execute as a reservoir of carbohydrates this might have resulted in increased number of seeds per pod (Ahmed *et al.*, 1997) in black gram.

The effect of seed priming treatments was found significant, increasing the 100 seed weight/gm in two varieties *viz.*, KPMR-522 and KPMR-400 during both the years of pooled data. The highest pooled mean (18.06) with treatment T_{12}- Seed coating with Bio-NPK + DAB (on hydro-primed seed for 8 hours and dried 48 hrs) (18.63, 17.49) followed by T_6- Halo-priming (soaked in Zn_2SO_4 @ 0.3(%) + $MnSO_4$ @ 0.5(%) solution and dried) (17.16 and 17.12) and T_{13} -Seed coating with Bio grow + DAB (on hydroprimed seed for 8 hrs and dried 48 hrs) (16.86 and 16.70) in both of the variety KPMR-522 and KPMR-400. The treatments will further used for commercial and research purpose the data earlier reported by the higher test weight may be due to more availability of required amount of nitrogen and phosphorous due to inoculation of *Rhizobium* and PSB to the plant which resulted in the accumulation of greater metabolites and more food reserves in seeds throughout the life cycle of the crop which was able to supply the increased assimilate demand of sinks and thus resulted in higher test weight of seed (Kumar and Uppar 2007).

On the basis of the pooled mean for both years, seed priming was found to be the most effective for significantly increasing. The maximum pooled mean (21.16) seed yield q /ha. with treatment T_{12}- Seed coating with Bio-NPK + DAB (on hydro-primed seed for 8 hrs and dried for 48 hrs) (21.80, 20.52) followed by T_6- Halo-priming (seed soaked in Zn_2SO_4 @ 0.3(%) + $MnSO_4$ @ 0.5(%) solution and dried) (20.60 and 19.80) and T_{13} -Seed coating with Bio grow + DAB (on hydro-primed seed for 8 hrs and air drying for 48 hrs) (20.00 and 18.93) in both of the variety KPMR-522, KPMR-400. The experiment showed these combinations are use full in increasing production and productivity a similar type of result also reported by increase in seed yield might be due to the effect of bio fertilizer inoculations. It is well known that PSB produce vitamins and IAA, GA like growth substances (Pomurugan and Gop 2006).

CONCLUSIONS

Due to uneven rainfall, crop plants in rainfed areas frequently encounter conditions resembling water deficits, which restrict plant growth and lower potential yield. Under a variety of environmental conditions, various seed invigoration techniques, such as seed priming and seed coating bio-inoculants, have been effective in enhancing the yield-attributing characters that ultimately increased the yield. The study revealed that seed coating (on hydro primed seed) with drought alleviating bacteria and Bio-NPK was proved as most useful in increasing the yield of field pea under sub-optimal rain fed condition.

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