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Enhancement in seed yield and quality attributes due to different seed priming treatment in field Pea

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Abstract
Field pea is an important winter season annual crop in India grown in semi-arid and tropical regions. The major problem which limits the field pea production is crop establishment under rainfed condition. The aim of present investigation was to find out the effect of seed priming treatment of seed yield and quality attributes of field pea. Seeds of Arkel variety were used for seed enhancement treatments like fungicidal, hormonal priming, nutrient priming, biological agents, hydro-priming. It was observed that seed priming with molybdenum as sodium molybdate @ 500 ppm in combination with *T. harzianum* @ 15 g/kg seed followed by seed priming with sodium molybdate @ 500 ppm alone was found to significantly enhance germination %, seed vigour, plant biomass, number of pods per plant and seed yield per plant. The major constraints of good crop establishment are low quality seed in addition to lack of soil moisture.

Keywords: field pea, seed priming, sodium molybdate, gibberellic acid etc.

Introduction
Field pea (*Pisum sativum* L.) belongs to leguminous family fabaceae. It is cultivated in winter season at high elevations or in warm regions throughout the world. India is the largest producer and importer of pulses in the world whereas; productivity is low as compared to China and USSR (Singh *et al*., 2017) [15]. The major problem which limits field pea productivity is the crop establishment under rainfed environment. Other factors such as water logging and drought are the major stressors that limit the crop productivity. Use of quality seed alone has been reported to improve productivity in field pea. The most cost effective method available for better stand establishment is to sow the seed with high germination which shows quick early growth. The major constraints of good establishment are due to low quality seed in addition to lack of soil moisture (Gurumu and Naylor, 1991) [5]. These conditions result in poor emergence that may subsequently cause sparse plant stands (Saxena *et al.*, 1997) [14]. Improving the productivity of field pea uder rainfed environment is possible through seed priming treatment. Pre-sowing seed treatment including chemical, polymer coating, botanical and priming treatments plays an important role in improve seed performance. Usually priming leads to improve plant performance through enhancement in vigour, germination and drought tolerance (Kumar *et al*., 2015) [10]. The seed priming process involves soaking the seed overnight (for about 8 hrs), surface drying them upto initial seed moisture content (Musa *et al*., 2001) [12] to hasten germination, enhances crop establishment and promotes seedling vigor (Harris *et al.*, 1999) [6]. Seed coating with biological fungicides protect the seed and young seedlings from fungal invasions. The seed treatment with hormones such as gibberellic acid plays an important role in enhancing germination through increased cell division activity. Seed priming with nutrient such as Sodium Molybdate might enhance seed yield and seed quality as it is a cofactor of nitrogenase and nitrate reductase a major enzymes involved in nitrogen fixation and nitrogen assimilation respectively. In order to compete with weed species and better seed performance quick and synchronized germination is desirable to set crop successfully. This was achieved by priming, which involves controlled hydration that restricts germination but permit pre germinative physiological and biochemical changes to occur (Bradford *et al*., 1990; Khan, 1992) [2, 7]. Keeping in view the above facts, the present research work was carried out to investigate the effect of different seed priming treatments on the enhancement of seed yield and seed quality attributes in field pea.

Materials and method
The experiment was conducted during 2017-18, in Experimental Research Farm of Seed Technology Research, Department of Plant Breeding and Genetics, JNKVV Jabalpur. The

seed treatment or priming was done by soaking of required quantity of seeds of pea variety Arkel in tap water and various chemicals concentration for 8 hours. Then the seeds were shade dried to obtain the seed moisture content of 11-13%. The different seed priming treatments *viz.*, T1 (Seed priming with *Trichoderma harzianum* @ 1.5%), T2 (Seed priming with Vitavax Power @ 0.25%), T3 (Seed priming with Gibberellic Acid @ 50 ppm), T4 (Seed priming with Gibberellic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15g/ kg seed), T5 (Seed priming with Sodium Molybdate @ 500 ppm), T6 (Seed priming with Sodium Molybdate @ 500 ppm + seed coating with *T. harzianum* @ 15g/ kg seed), T7 (Seed priming with leaf extract of *Lantana camara* @ 10%), T8 (Priming with water) and T9 (Seed treatment with Bavistin @ 3g/ kg seed), T10 (Control) were prepared and given seed treatment to observe the effect on different yield components, yield and seed quality attributes. The treated seeds along with control (untreated) were examined for all the seed physiology and seed production parameters viz. Nodules/plant (No's), germination % and seed vigour, root and shoot length (cm), plant biomass per plant (gm), no. of pods per plant, 100 seed weight (gm), No. of seeds per pod, seed yield per plant (gm) and harvest index. The crop was laid out in RBD with different seed priming treatment as a factor of variation and ANOVA was carried out using OPSTAT statistical tools.

Results & Discussion

Seed priming treatments and its association with yield, yield component and seed quality attributes.

Significant difference was observed for seed priming treatments *viz.*, T1 (Seed priming with *Trichoderma harzianum* @ 1.5%), T2 (Seed priming with Vitavax Power @ 0.25%), T3 (Seed priming with Gibberellic Acid @ 50 ppm), T4 (Seed priming with Gibberellic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15g/ kg seed), T5 (Seed priming with Sodium Molybdate @ 500 ppm), T6 (Seed priming with Sodium Molybdate @ 500 ppm + seed coating with *T. harzianum*@15g/ kg seed), T7 (Seed priming with leaf extract of *Lantana camara* @ 10%), T8 (Priming with water) and T9 (Seed treatment with Bavistin @ 3g/ kg seed), T10 (Control) for all the yield, yield attributing and post harvest seed quality attributes. Similar findings were supported by Aflaq *et al*. (2012) [1]; Saeedipour (2013) [13]; Kumar *et al.* (2014) [11], El-Mohamedy *et al.* (2015) [4] and Singh *et al*. (2017) [15].

Table 1: Effects of Seed Priming Treatments on Seed Quality, yield and Yield components of Field Pea (*Pisum sativum* L.).

Treatment	Germination %	Root length	Shoot length	Vigour index I	Nodules/plant	No. of pods/plant	No. of seeds /pod	100 seed weight	Biomass (g)/plant	Seed yield (g) /plant	HI
T1	91.11	10.77	40.57	4659.23	61.55	20.96	7.20	18.88	31.48	11.23	35.67
T2	93.53	12.59	38.09	4633.49	52.21	19.75	7.39	18.80	28.32	11.90	42.04
T3	93.18	13.21	40.08	4920.75	54.26	21.87	6.28	17.39	32.59	12.51	38.42
T4	94.90	13.79	41.12	5148.64	57.40	22.64	6.59	17.70	32.77	13.59	41.50
T5	95.86	14.08	41.15	5351.00	59.88	23.56	6.18	20.28	34.56	12.88	37.27
T6	98.57	14.07	42.79	5573.23	61.37	27.27	7.15	22.62	39.14	13.94	35.63
T7	93.98	13.59	40.43	5028.44	49.88	19.24	7.99	20.61	30.03	11.66	38.85
T8	93.42	14.55	39.15	4919.71	45.80	20.83	6.41	21.21	28.31	10.80	38.17
T9	90.87	13.07	38.98	4695.93	44.19	20.07	7.35	19.92	34.45	11.93	34.63
T10	82.22	10.62	21.00	2530.72	36.58	14.16	5.26	16.57	25.09	9.12	36.38
C.D.	1.669	1.149	0.858	0.838	1.082	1.540	0.141	0.567	0.178	0.300	1.061
SE (m)	0.514	0.354	0.264	0.258	0.333	0.475	0.044	0.175	0.055	0.092	0.327
C.V.	0.784	3.843	0.975	0.008	0.901	3.192	0.909	1.275	0.245	1.093	1.221

Seed priming with T6 (Sodium Molybdate @ 500 ppm + Seed coating with *T. harzianum* @ 15g/ kg seed) showed significantly highest germination % (98.57), shoot length (42.79 cm), Vigour Index I (5573.23), No. of pods per plant (27.27), 100 seed weight (22.62 gm), biomass per plant (39.14 gm) and seed yield per plant (13.94 gm) followed by 3rd most superior for root length (cm). These findings were in conformity with Khan and Hedge (1989) [8]; El-Hefny *et al*. (1999) [3]; Khanal *et al*. (2005) [9] and Singh *et al*. (2017) [15]. Due to T6, treatment enhancement in germination %, shoot length (cm), vigour index, no. of pods/plant, 100 seed weight, biomass per plant (gm) and seed yield per plant (gm) was found to be 19.89 %, 103.79 %, 120.22 %, 67.79 %, 92.62 %, 36.52 %, 56.03 % and 52.85 % respectively over control. Sodium Molybdate as a source of molybdenum leads to activation of enzymes involved in nitrogen fixation and nitrogen assimilation *viz.*, nitrogenase and nitrate reductase which directly leads to increase in rubisco per unit area leading to enhancement in photosynthetic rate and seed yield. *T. harzianum* in T6 leads to activation of biosynthesis of plant growth promoting hormones and induce biotic stress tolerance finally leading to enhancement in seed yield.

Seed priming with T5 (Seed priming with Sodium Molybdate @ 500 ppm) was found to be second most superior for germination % (95.86), shoot length (41.15 cm), vigour index (5351.00), no. of pods per plant (23.56) and biomass per plant (34.56 gm), whereas treatment T4 (Seed priming with Gibberellic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15g/ kg seed) was found to be second most superior in terms of seed yield per plant (13.59 gm) as compared to other treatment and 49% enhancement in seed yield per plant (gm) over control. Molybdenum as a cofactor of enzymes involved in nitrogen assimilation leads to increase in the protein content in field pea finally lading to increase in yield and seed quality attributes.

Highest root length was observed for T8 (priming with water) (14.55 cm) which was at par with T4 (Seed priming with Gibberellic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15g/ kg seed) (13.79 cm), T5 (Seed priming with Sodium Molybdate @ 500 ppm) (14.08 cm), T6 (Seed priming with Sodium Molybdate @ 500 ppm + seed coating with *T. harzianum*@15g/ kg seed) (14.07 cm) and T7 (Seed priming with leaf extract of *Lantana camara* @ 10%) (13.59 cm) treatment. Seed priming leads to enhancement in the vigour due to increase in the seed hydration status required to achieve critical and threshold water potential for germination

finally leading to rapid and uniform field crop establishment and increase in seed yield. The treatment T2 (Seed priming with Vitavax Power @ 0.25%) is highest for HI (42.04 %) which was at par with T4 (Seed priming with Gibberellic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 15g/ kg seed) (41.50%) followed by T7 (Seed priming with leaf extract of *Lantana camara* @ 10%) (38.85%). The number of seeds per pod is highest for T7 (Seed priming with leaf extract of *Lantana camara* @ 10%) (7.99) followed by T2 (Seed priming with Vitavax Power @ 0.25%) (7.39). In case of nodules per plant, treatment T1 (Seed priming with *Trichoderma harzianum* @ 1.5%) (61.55) was found to be superior which was at par with T6 (Seed priming with Sodium Molybdate @ 500 ppm + seed coating with *T. harzianum*@15g/ kg seed) (61.37). Over the treatment, the range was found to be 90.87-98.57% (germination %), 10.62-14.55 cm (root length), 21.00-42.79 cm (shoot length), 2530-5573 (Vigour index), 36.58-61.55 (nodules per plant), 14.16-27.27 (no. of pods per plant), 5.26-7.99 (number of seeds per pod), 16.57-22.62 gm (100 seed weight), 25.09-39.14 gm (biomass per plant), 9.12-13.94 gm (seed yield per plant) and 34.63-42.04 % (harvest index).

Conclusion

The poor crop establishment is one of the major constraints in field pea production. Seed priming treatment enhances the plant stand through improvement in seed health and vigour which ensure seed, food and economic security of the resource poor small and marginal farmers. The present study revealed that there is significance difference of seed priming treatment for seed yield, yield component and seed quality attributes. Seed priming treatment with sodium molybdate @500 ppm in combination of seed coating with T. harzianum @ 15gm/kg seed had significant effect in enhancing germination, vigour, shoot length, root length, plant biomass, number of pods per plant, seed weight and seed yield. Treatment with sodium molybdate @ 500 ppm alone was found to be second most superior in terms of enhancing post-harvest seed quality attributes that is germination %, vigour, plant biomass and seed yield. Thus it was concluded that seed treated with molybdenum or in combination with *T. harziannum* could be used for enhancing the planting and seed yield in field pea.

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