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Effect of pre-sowing seed priming treatments on seed yield and quality in kabuli chickpea

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Abstract
Seed germination is the major constraint in kabuli chick pea which hampers optimum plant population and yield in kabuli chick pea. Three years study was undertaken with an objective of standardization of seed priming of Kabuli chickpea for assured field emergence. Nine pre sowing priming treatments were given to the kabuli chick pea variety Vihar along with un primed control. Among the treatments seed Priming with Vitavax @ 0.25% recorded significantly higher field emergence (89.83 %) which was 17.42 % higher over control as well as higher number of root nodules (29.84/plant), lower incidence of wilt (5.11%), higher number of pods/ plant (115.42), seed yield (2.19 kg plot^{-1}), seed yield (1825.53 kg ha^{-1}) and seed quality parameters *viz.*, germination (91 %) and vigour index I (2748).

Keywords: priming, vitavax, field emergence, seed yield, germination

Introduction

Chick pea is one of the earliest food legumes cultivated by man and plays an important role in human diet and agricultural systems. It is a good protein supplement for people with cereal based diet and can complement the diet with several essential amino acids. Being a leguminous crop, chickpea improves soil fertility by fixing atmospheric nitrogen into plant available form (NH_3 and NH_4) through the phenomenon of symbiosis, it has ability to meet 80 per cent of its nitrogen requirement by symbiotic nitrogen fixation. Among the cultivated species, *Desi* and *Kabuli* types are of practical importance. Despite the high total production and more nutritive value, yields of chickpea are low due to many biotic and abiotic constraints. Among the biotic constraints more than 50 diseases have so far been reported on chickpea. Among them soil borne diseases such as Fusarium wilt (*Fusarium oxysporum* f. sp. *ciceri*), dry root rot (*Rhizoctonia bataticola*) and collar rot (*Sclerotium rolfsii*) are the major limiting factors in chickpea production. Chickpea diseases may cause yield losses of up to 100% depending on time of infection. Dry root rot and collar rot are emerging as a major threat to chickpea production due to drastic climate change (Pande *et al.*, 2010) [22] in chickpea. Ghosh *et al.*, (2013) [10] surveyed four chickpea growing states of India *i.e.* Andhra Pradesh, Karnataka, Madhya Pradesh and Chhattisgarh and reported that losses from collar rot disease ranged from 7.1 to 10.5%. The fungicide vitavax is efficacious chemical against soil and seed borne diseases which suppressed the *Fusarium* by altering and inhibiting cell metabolism. Satisfactory control of wilt with the application of vitavax has been reported by Shahzaman *et al.* (2018) [26] and Muhammad *et al.* (2011) [21] in chick pea. Seed viability is a major factor in crop stand establishment and subsequent productivity in many parts of the world. Losses in seed quality occur during field weathering, harvesting and storage due to which seeds get damaged. Seed priming is useful for improvement in seed germination it may due to completion of pre germination metabolic activities during seed priming, making the seed ready for soon germination after planting. This result might be due to an increase of the synthesis of the hormone gibberellin, which trigger the activity of α-amylase and other germination specific enzymes like protease and nuclease involved in hydrolysis and assimilation of the starch (Gholami *et al.*, 2009) [9]. Seed priming with vitavax has many benefits including early and rapid emergence by reducing Pythium damping off at the time of seedling emergence as well as higher plant stand establishment and water use efficiency due to deeper roots by increasing in root growth, uniformity in emergence, germination in wide range of temperature, break of seed dormancy, initiation of reproductive organs, better competition with weed, early flowering and maturity, resistance to environmental stresses (Khan *et al.*,2005) [20].

Material and Methods

The experiment was conducted in RBD design with kabuli chick pea variety Vihar for three years. The seeds were primed with different bio agents, growth promoters and chemicals viz.,T_1: Seed Priming with *Trichoderma harzianum* @ 1.5%, T_2: Seed Priming with Vitavax @ 0.25%, T_3: Seed Priming with Gibberellic Acid @ 50ppm, T_4: Seed Priming with Gibberellic Acid @ 50 ppm + Seed coating with *T. harzianum* @ 1.5%, T_5: Seed Priming with Sodium Molybdate @ 500ppm, T_6: Seed Priming with Sodium Molybdate @ 500ppm + Seed coating with *T. harzianum* @ 1.5%, T_7: Seed Priming with leaf extract of *Lantana camara* @ 10%, T_8: Seed hydration, T_9: Chemical Check – Seed treatment with Bavistin @ 0.3% along with T_{10}: Control. The priming treatment was given for 8 hours and primed seeds were dried upto original moisture content (12%). The wilt incidence (%), root nodulation and seed yield and quality attributes were recorded. The data was analysed through analysis of variance (ANOVA) technique for factorial controlled randomized design and presented at 5% level of significance (P = 0.05). by the procedure prescribed by Panse and Sukhatme (1967) [23].

Result and Discussion

The three years pooled data on effect of pre sowing seed priming treatment on seed yield and seed quality of kabuli chickpea are presented in table 1 to 3. From the data it is revealed that the seed yield and seed quality of kabuli chickpea influenced significantly due to pre sowing seed priming treatments.

A) Physiological Study

The pre-sowing seed priming treatment had significant effect on field emergence, root nodulation, seed quality parameters of kabuli chickpea. Seed priming with Vitavax power @ 0.25% (T_2) recorded significantly higher field emergence (89.83 %) i.e. 17.42 % higher over control and the same treatment also recorded higher number of root nodules per plant (32.67). Higher field emergence in primed seeds may be attributed to increased enzyme activity, including of alfa amylase, higher levels of ATP, increased synthesis of RNA and DNA and increased number and efficiency of mitochondria (Bittencourt *et al*., 2005) [5].

Seed quality parameters *viz;* germination, root shoot length and vigour index (I) were significantly influenced due to presowing seed priming. Seed priming with Vitavax power @ 0.25% (T_2) recorded significantly higher germination (91.00%), root shoot length (30.20 cm), seedling dry matter content (2.80 g), vigour index I (2748) and vigour index II (254.47) which were 11.12 %, 32.28 %, 28.44 %,46.95% and 42.34% higher over the control respectively. The variation in seed germination percentage and seedling length may be attributed to plant growth promotional effect of seed priming components especially bio agents that may produce growth regulatory substances (hormones) upon seed imbibition. These findings are in agreement previous studies of Bapurayagouda (2010) [3] and Jin and Tylkowska (2005) [17].

B) Pathological study

The wilt incidence was significantly influenced due to presowing seed priming treatments. Seed priming with Vitavax power @ 0.25% (T_2) recorded significantly lower incidence of wilt (5.11%) which was lower by (50.76 %) than control and (46.54 %) lower than Seed hydration(T_8) as well as (36.11 %) lower than chemical Check – Seed treatment with Bavistin @ 0.3% (T_9). Fungicide application reduces the inoculum as well as eradicates seed borne pathogen and protects the seedling from infection by soil borne pathogens ultimately resulted in low wilt incidence. Significantly decreased damping off disease and increased percentage of surviving plants of chickpea. These findings are in close conformity with the results reported by Zeid *et al*., (2003) [30], Gupta (2006) [12], Khalequzzaman (2008) [19] and Shahid *et al.* (2011) [25] in chickpea.

C) Yield contributing parameters

Yield contributing parameters were significantly influenced due to pre-sowing seed treatment. Seed priming with Vitavax power @ 0.25% (T_2) recorded significantly higher number of pods/ plant (115.42), seed yield (2.19 kg plot^{-1}), seed yield (1825.53 kg ha^{-1}) and biomass yield (2369.98 kg ha^{-1}). The final growth and yield are the product of the commutative action of all the factors contributing to better growth and finally to the crop yield. Higher number of plants due to seed soaking might be attributed to early and higher germination and better establishment of the plants. The seed yield per ha. was 47.02 % higher over the control. It might be due to the fact that primed seed established earlier than without soaking and the plants attained the vegetative and reproductive phase at an early and proper time and taller plants with higher number of branches ultimately resulted in higher number of pods per plant. Primed seeds had faster germination, rapid establishment, and uniform growth after sowing. Such plants expands root system at shorter time as compared to the control. This might happened due to up taking more water and nutrients produces photosynthetic organs rapidly and reaches earlier autotrophic stage (Duman 2006) [7]. In general, increased yield of primed seed was due to activation of cell respiration (Bewley and Black 1994) [4], repairs of macromolecules and movements of acquired materials, activation of cell cycling (Vasquez and Sanchez 2004) [29]. Water absorption is the first stage of germination and the second stage or retardation stage, seeds start the replication of DNA (Bray *et al.,* 1989) [6], increasing of protein and RNA synthesis (Gallardo *et al.,* 2001) [8], availability of more ATP, rapid embryo growth than control seeds. Better growth, higher number of pods and more seeds per pod favourably increased the seed yield per plant. Similar results were reported by Harris *et al.,* 2001 [15]; 2004 [16], Rashid *et al.* (2002) [24] and Ali and Shivkumar (2005) [2] and Kaur *et al.* (2005) [18] in chick pea. Vitavax contains 37.5 % carboxin which has been reported to reduce glucose oxidation to 50%, acetate oxidation to 70-90% as well as reduction in synthesis of DNA, RNA and protein by upto 60-90% in pathogenic fungi. These biochemical alterations may lead to inhibition in fungal growth. The inhibitory effect of vitavax on growth and sporulation was directly proportional to its concentration. In the present study, vitavax primed seeds favour the more plant population and less wilt incidence causing more population of healthy plants which produce more number of branches, number of pods and higher number of seeds per plant resulting increased seed yield (kg/ha). The results are in close conformity with the results reported by Agrwal *et al.* (2002) [1], Gour (2003) [11], Singh and Jha (2003) [27] and Tewari and Mukhopadhyay (2003) [28] in chick pea.

Table 1: Effect of pre-sowing seed priming treatments on seed yield and quality of kabuli chickpea

Trait	Field emergence (%)				Incidence of wilt (%)				No. of root nodules			
Treatments	**2015-16**	**2016-17**	**2017-18**	**Pooled**	**2015-16**	**2016-17**	**2017-18**	**Pooled**	**2015-16**	**2016-17**	**2017-18**	**Pooled**
T_1: Seed priming with *Trichoderma harzianum* @1.5%	89.17 (71.05)	84.92 (67.67)	81.83 (64.81)	85.31 (67.57)	6.00 (14.07)	6.00 (13.64)	11.33 (19.67)	7.78 (16.17)	22.45	28.00	23.53	24.66
T_2: Seed priming with Vitavax powder @0.25%	91.83 (73.75)	87.75 (69.52)	89.92 (71.49)	89.83 (71.46)	4.00 (11.48)	5.00 (12.75)	6.33 (14.57)	5.11 (13.01)	25.11	32.67	31.73	29.84
T_3: Seed priming with Gibberalic acid @ 500 ppm	83.50 (66.38)	84.58 (67.11)	84.25 (66.70)	84.11 (66.51)	7.67 (16.07)	9.33 (17.75)	9.67 (18.01)	8.89 (17.34)	20.22	24.67	26.07	23.65
T_4: Seed priming with Gibberelic acid @ 50 ppm + seed coating with *Trichoderma harzianum*@15g/kg	80.08 (63.58)	82.83 (65.63)	88.33 (70.04)	83.75 (66.35)	4.67 (12.36)	7.33 (15.66)	8.33 (16.66)	6.78 (15.09)	24.78	30.33	29.40	28.17
T_5: Seed priming with Sodium Molybdate @ 500 ppm	77.17 (61.52)	79.92 (63.46)	85.17 (67.42)	80.75 (64.06)	9.67 (18.11)	8.67 (16.96)	9.33 (17.75)	9.22 (17.67)	21.67	26.00	27.20	24.96
T_6: Seed priming with Sodium Molybdate @ 500 ppm+ seed coating with *Trichoderma harzianum* @15g/kg	83.00 (66.28)	85.67 (67.78)	89.08 (70.71)	85.92 (68.04)	7.33 (15.66)	6.33 (14.43)	7.33 (15.66)	7.00 (15.32)	25.00	31.00	29.27	28.42
T_7: Seed priming with leaf extract of Lantana camara @ 10%	79.83 (63.33)	82.58 (65.36)	83.67 (66.29)	82.03 (64.94)	9.00 (17.44)	7.33 (15.49)	10.00 (18.38)	8.78 (17.21)	18.11	21.00	26.20	21.77
T_8: Seed hydration for 8 hrs and dried upto original M.C. (12%)	73.00 (58.71)	75.75 (60.51)	82.50 (65.36)	77.08 (61.49)	9.67 (18.08)	8.33 (16.66)	10.67 (19.01)	9.56 (18.00)	20.78	21.44	23.20	21.81
T_9: Seed treatment with Bavistin @ 3g/kg seed	77.50 (61.73)	80.25 (63.68)	87.25 (69.13)	81.67 (64.79)	8.00 (16.30)	7.33 (15.57)	8.67 (17.08	8.00 (16.37)	21.22	26.67	27.80	25.23
T_{10}: Control	72.67 (58.50)	75.42 (60.31)	81.42 (64.48)	76.50 (61.07)	11.33 (19.62)	11.67 (19.87)	12.33 (20.56)	11.78 (20.07)	16.56	20.67	21.60	19.61
SE ±	1.843	1.659	1.223	1.326	0.991	1.783	0.934	0.609	1.766	2.333	1.091	0.894
CD @ 5%	5.475	4.928	3.634	3.939	2.944	NS	2.774	1.811	5.247	6.931	3.242	2.657

*Figures in parenthesis are Arc sin transformed values

Table 2: Effect of pre-sowing seed priming treatments on seed yield and quality of kabuli chickpea

Trait	No. of pods/plant				Seed yield/plot (kg)				Seed yield/ha (kg)			
Treatments	**2015-16**	**2016-17**	**2017-18**	**Pooled**	**2015-16**	**2016-17**	**2017-18**	**Pooled**	**2015-16**	**2016-17**	**2017-18**	**Pooled**
T_1: Seed priming with *Trichoderma harzianum* @1.5%	99.53	92.67	81.53	91.24	1.62	1.55	1.66	1.61	1353.61	1294.44	1383.53	1343.86
T_2:Seed priming with Vitavax powder @ 0.25%	115.80	132.20	98.27	115.42	2.27	2.31	1.99	2.19	1889.99	1926.10	1660.51	1825.53
T_3: Seed priming with Gibberalic acid @ 500 ppm	86.60	96.67	86.20	89.82	1.49	1.58	1.71	1.59	1245.27	1316.94	1425.20	1329.14
T_4: Seed priming with Gibberelic acid @ 50 ppm + seed coating with *Trichoderma harzianum* @15g/kg	99.60	102.33	93.33	98.42	1.78	1.83	1.77	1.79	1483.05	1524.44	1475.21	1494.23
T_5: Seed priming with Sodium Molybdate @ 500 ppm	95.67	98.33	91.00	95.00	1.52	1.61	1.72	1.62	1270.55	1341.66	1436.31	1349.51
T_6: Seed priming with Sodium Molybdate @ 500 ppm+ seed coating with *Trichoderma harzianum* @15g/kg	113.33	110.67	96.47	106.82	2.07	2.17	1.81	2.02	1728.05	1805.83	1506.88	1680.25
T_7: Seed priming with leaf extract of Lantana camara @ 10%	86.80	96.00	84.73	89.18	1.45	1.57	1.66	1.56	1204.44	1309.72	1384.92	1299.69
T_8: Seed hydration for 8 hrs and dried upto original M.C. (12%)	94.53	78.67	83.27	85.49	1.50	1.45	1.66	1.54	1253.88	1207.50	1383.53	1281.64
T_9: Seed treatment with Bavistin @ 3g/kg seed	93.13	101.33	90.80	95.09	1.52	1.63	1.74	1.63	1266.94	1361.94	1447.98	1358.95
T_{10}: Control	79.33	77.33	81.13	79.26	1.42	1.43	1.62	1.49	1184.72	1190.83	1350.75	1242.10
SE ±	6.467	6.957	1.132	3.783	0.076	0.093	0.068	0.068	63.224	77.093	56.808	56.969
CD @ 5%	19.216	20.672	3.363	11.241	0.226	0.275	0.203	0.203	187.854	229.064	168.792	169.269

Table 3: Effect of pre-sowing seed priming treatment on seed quality of kabuli chickpea

Trait	Germination (%)				Root shoot length (cm)				Vigour index I			
Treatments	**2015-16**	**2016-17**	**2017-18**	**Pooled**	**2015-16**	**2016-17**	**2017-18**	**Pooled**	**2015-16**	**2016-17**	**2017-18**	**Pooled**
T_1: Seed priming with *Trichoderma harzianum* @1.5%	86.00 (68.05)	89.33 (70.94)	86.00 (68.05)	87.11 (69.00)	22.33	25.93	24.55	24.27	1922	2318	2111	2117
T_2:Seed priming with Vitavax powder @ 0.25%	93.00 (74.74)	90.33 (71.92)	89.67 (71.28)	91.00 (72.60)	29.10	31.88	29.62	30.20	2707	2881	2656	2748
T_3: Seed priming with Gibberalic acid @ 500 ppm	88.00 (69.77)	88.67 (70.35)	87.00 (68.94)	87.89 (69.64)	29.00	23.47	25.67	26.05	2553	2086	2235	2292
T_4: Seed priming with Gibberelic acid @ 50 ppm + seed coating with *Trichoderma harzianum* @15g/kg	87.00 (68.94)	89.00 (70.65)	89.00 (70.64)	88.33 (70.04)	27.87	30.54	27.54	28.65	2423	2720	2451	2531
T_5: Seed priming with Sodium Molybdate @ 500 ppm	86.00 (68.05)	86.67 (68.58)	87.67 (69.44)	86.78 (68.69)	28.23	26.96	26.17	27.12	2428	2336	2294	2353
T_6: Seed priming with Sodium Molybdate @ 500 ppm+ seed coating with *Trichoderma harzianum* @15g/kg	89.00 (70.64)	88.67 (70.35)	89.00 (70.67)	88.89 (70.53)	27.87	28.77	28.79	28.48	2481	2552	2562	2532
T_7: Seed priming with leaf extract of Lantana camara @ 10%	88.67 (70.44)	88.67 (70.42)	86.33 (68.32)	87.89 (69.65)	27.97	24.07	25.74	25.93	2481	2125	2223	2276
T_8: Seed hydration for 8 hrs and dried upto original M.C. (12%)	88.33 (70.10)	87.00 (68.87)	86.00 (68.05)	87.11 (68.97)	27.75	22.80	24.90	25.15	2452	1984	2141	2192
T_9: Seed treatment with Bavistin @ 3g/kg seed	87.00 (68.94)	88.33 (70.03)	88.67 (70.34)	88.00 (69.74)	23.60	23.50	26.98	24.69	2054	2076	2393	2174
T_{10}: Control	85.33 (67.48)	75.00 (60.00)	85.33 (67.48)	81.89 (64.99)	21.33	22.63	24.53	22.83	1821	1698	2093	1870
SE ±	1.091	1.222	0.784	1.040	0.933	1.823	0.565	1.109	95.724	163.531	59.096	105.905
CD @5%	3.243	3.630	2.330	3.091	2.773	5.416	1.679	3.295	284.422	485.894	175.590	314.671

* Figures in parenthesis are Arc sin transformed values

Conclusion

It is concluded that, seed priming with Vitavax @ 0.25% (2.5g/kg seed) recorded higher field emergence, better seed yield and quality as well as reduced wilt incidence in kabuli chickpea.

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