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Effect of seed priming & foliar spray of bio-agents on quality seed production in chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment entitled "effect of seed priming and foliar spray of bio-agents on quality seed production in chickpea (*Cicer arietinum* L.)" was conducted during *rabi* 2017 at experimental field of STRU (Seed Technology Research Unit), Khanapur Block-B, VNMKV, Parbhani, M.S. The experiment was laid out in randomized block design with three replications and ten treatments. Seed of chickpea var. Akash (BDNG-797) was subjected to seed priming with different bioagents for 12 hrs. before sowing. The different bio-agents were applied as foliar application at different stages (at 15 days interval). Quality seed parameters *viz.*, Germination percentage, root length, shoot length, dry matter content of seedling, vigour index-I and vigour index-II were significantly increased due to spraying of biomix @10ml/lit. and *Metarhizium anisopliae* @ 10ml/lit. in the chickpea genotype Akash (BDNG-797).

Keywords: Chickpea, seed priming, bio-agents, biomix, *Metarhizium anisopliae*, vigour index

Introduction
Among the pulses, the major contribution to the total pulse production comes from chickpea. Gram is important pulse crop occupying third position among the gram legume in world, considered as king of pulses. Chickpea (*Cicer arietinum* L.) is an important *rabi* season self-pollinated legume crop having extensive geographical, distribution. Chickpea is also known as gram, chana, bengal gram or spinach pea etc. Chickpea is a diploid species with a chromosome number 2n=16. It belongs to sub-family papilionaceae of the family *Leguminosae*. India is the largest producer of pulses in the world with 25% share in global production. It is said to be one of the oldest pulse known to be cultivated from ancient time both in Asia and Europe. The major production of chickpea comes from central and northern India (Vishwas *et al*., 2017). Pulse crop have a specific importance for the vegetarian population of our country. However due to explosion and low productivity of pulse crop. Per capita availability of pulse is consistently decreasing. Per capita availability of pulse per day is only 47 gm. as against the minimum requirement of 104 gm. as requirement by the nutritional experts of World Health Organization. Statistically, it occupies about 105.73 Lakh hactor area with production of 111.58 lakh tonnes. The yield productivity is about 1056 kg/ha. in 2017-18 in India. (Source-DES Ministry of Agriculture & FW (DAC & FW) GOI IVth*Adv.Est*.2017-2018).

Strategies of improving the growth and development of crop species have been investigated for many years. Rapid germination and emergence are essential for successful crop establishment for which seed priming is an effective technology to enhance rapid and uniform emergence and to achieve high vigour, leading to better stand establishment and yield. It is simple and low cost hydration technique in which seed are partially hydrated to a point were pre-germination metabolic activities start without actual germination and then re-dried until close to the original dry weight exhibit faster rate of germination, more uniform emergence, greater tolerance to environmental stress (Singh *et al*.,2015) [13]. In view of the above circumstances, the present investigation was undertaken to study the effect of seed priming and foliar spray of bio-agent on quality seed production in chickpea.

Material and Methods
A field experiment entitled "Effect of seed priming and foliar spray of bio-agents on quality seed production in chickpea (*Cicer arietinum* L.)" was conducted during *rabi* 2017 at experimental field of STRU (Seed Technology Research Unit), Khanapur block-B, VNMKV, Parbhani. The experiment was laid out in randomized block design with three replications and ten treatments. The different bio-agents i.e. T_1- Biomix, T_2- *Trichoderma viride* @10ml/lit., T_3- *Azospirillum brasilense* @ 10ml/lit., T_4-*Glucanoacetobacter spp* @10ml/lit., T_5-*Pseudomonas*

fluroscence @ 10ml/lit., T_6- *Pseudomonas striata* @10ml/lit., T_7- *Metarhizium anisopliae* @10ml/lit., T_8- *Beauveria bassiana* @10ml/lit., T_9- *Aspergillus niger* @10ml/lit. and T_{10}- control were applied as foliar application at different stages (at 15 days interval). Seed of chickpea var. Akash (BDNG-797) was subjected to seed priming with different bioagents for 12 hrs. before sowing. After harvesting, the seeds were subjected to germination percentage, vigour index test based on seedling length and dry weight along with control. Standard germination test was conducted by between paper towel method as described in the ISTA rules of seed testing (ISTA 1993) [3]. Seedling length was measured and mean seedling length was expressed in centimetres and the mean dry weight of seedling was recorded and expressed in grams. Primed seeds were compared with unprimed seed for their quality parameters *viz*., germination percentage, root length, shoot length, seedling length, seedling dry weight, seedling vigour index-I and II based on sample size of 100 seed for each test. The formula for calculating SVI-I and SVI-II as described by (Abdul-Baki and Anderson, 1973) [1] were:

Seedling Vigour Index-I = Germination % x Seedling length

Seedling Vigour Index-II = Germination % x Seedling dry weight

Result and Discussion

Germination percentage

The data on the germination percentage as influenced by different bio-agent recorded at 60, 90, 120, 150 DAH are presented in Table 1. Data revealed that germination percentage decreased rapidly up to 150 days after harvesting. All treatments have higher germination percentage than control at all stages. The treatment T_1-Biomix @ 10ml/lit. (88.90%) followed by T_7-*Metarhizium anisophilae* @ 10ml/lit (86.33%) was recorded significantly higher germination percentage and minimum in T_{10}-control (77.90%). Whereas, at 120 days after harvesting, the data shows that the treatment T_1-Biomix @ 10ml/lit. (87.37%) was recorded higher germination percentage over other treatments and T_{10}-control (74.30%). At 150 days after harvesting, the data regarding germination percentage showed that the treatment T_1-Biomix @10ml/lit. (85.3%) was recorded significantly higher germination percentage as compared to other treatments and T_{10}-control (70.30%).

Root length (cm)

The data measured for root length (cm) as influenced by different bio-agents at 60, 90, 120 and 150 days after harvesting are presented in the Table 1. shows that the root length decreased rapidly up to 150 days after harvesting. At 60 days after harvesting, the data shows that the treatment T_1-Biomix @10ml/lit. (12.5cm) followed by T_7-*Metarhizium anisophilae* @ 10ml/lit. (12.4cm) was found significantly higher root length over other treatments and control (9.0 cm). However, at 90 days after harvesting, the treatment T1-Biomix (12.2cm) followed by T_7-*Metarhizium anisophilae* @10ml/lit. (12.4cm) was recorded significantly higher root length over other treatments and T_{10}-Control (8.5 cm).Whereas, at 120 days after harvesting, the data indicated that the treatment T_1-Biomix (11.4 cm) @10ml/lit. followed by T_7-*Metarhizium anisophilae* @10ml/lit. (11.3 cm) was recorded significantly higher root length over other treatments and T_{10}-control (7.0 cm). At 150 days after harvesting, the data on the root length indicated that the treatment T_1-Biomix @10ml/lit. (8.9 cm) was recorded significantly higher root length over other treatments and T_{10}-control (5.3 cm).

Shoot lenth (cm)

Data on the shoot length as influenced by different bio-agents are recorded in the Table 1. The data indicated that shoot length after harvesting are constant upto the 90 days after harvesting and then rapidly get decreased upto 150 days after harvesting. All treatments have higher shoot length (cm) than control at all stages. At 60 days after harvesting, T_1-Biomix @10ml/lit. (26.6 cm) followed by T_7-*Metarhizium anisophilae* @10ml/lit. (26.2cm) was recorded significantly higher shoot length over other treatments and T_{10}-control (20.5cm). Similarly at 90 days after harvesting, the data recorded on the shoot length indicated that the treatment T_1-Biomix@10ml/lit. (25.5cm) followed by T_7-*Metarhizium anisophilae*@10ml/lit. (25.7cm) was recorded significantly higher shoot length over other treatments and T_{10}-control (20.4cm). However at 120 days after harvesting, the data on the shoot length shows that the treatment T_1-Biomix @10ml/lit. (24.5cm) followed by treatments T_7-*Metarhizium anisophilae* @10ml/lit. (24.9cm) was recorded significantly higher shoot length over T_{10}-control (17.8cm).Whereas, at 150 days after harvesting, the treatment T_1-Biomix @10ml/lit. (20.7cm) followed by T_7-*Metarhizium anisophilae* @10ml/lit. (20.3cm) was recorded significantly higher shoot length as compared to other treatments and T_{10}-control (15.3cm).

Dry matter content of seedlings (g/seedling)

Data on the dry matter content of seedlings as influenced by different bio-agents recorded at 60, 90, 120 and 150 days after harvesting are presented in the Table 2. At 60 days after harvesting, The treatment T_1-Biomix @10ml/lit. (1.67g.) was recorded significantly higher dry matter content of seedlings as compared to other treatments and T_{10}-control (1.26g.).Similarly at 90 days after harvesting, the data recorded on the dry matter content of seedlings indicated that the treatment T_1-Biomix @10ml/lit. (1.45g.) followed by T_7-*Metarhizium anisophilae* @10ml/lit. (1.44g.) was recorded significantly higher dry matter content of seedlings as compared to other treatments and T_{10}-control (20.4g.).However at 120 days after harvesting, the data shows that dry matter content of seedlings at the treatment T_1-Biomix @10ml/lit. (1.39g.) followed by T_7-*Metarhizium anisophilae* @10ml/lit. (1.38g.) was recorded significantly higher dry matter content of seedlings as compared to other treatment and T_{10}-control (0.94g.). Whereas at 150 days after harvesting, the data on the dry matter content of seedlings shows that the treatment T_1-Biomix @10ml/lit. (0.84g.) followed by T_7-*Metarhizium anisophilae*@10ml/lit. (0.81g.) was recorded significantly higher dry matter content of seedlings as compared to other treatments and T_{10}-control (0.50g.).

Vigour index-I

The data recorded at 60, 90, 120 and 150 days after harvesting for vigour index-I as influenced by different bio-agents are presented in the Table 2. At 60 days after harvesting, the data shows that treatment T_1-Biomix @10ml/lit. (3581.5) followed by T_7-*Metarhizium anisophilae* @10ml/lit. (3485.5) was recorded significantly higher vigour index-I as compared to T_{10}-control (2391.6). Similarly, at 90 days after harvesting, The treatment T_1-Biomix (3357.7) followed by T_7-*Metarhizium anisophilae* (3288.0) was recorded significantly higher vigour index-I and as compared

to T_{10}-control (2181.2). Whereas, at 120 days after harvesting, the data indicated that the treatment T_1-Biomix @10ml/lit. (3151.5) followed by T_7-*Metarhizium anisophilae* @10ml/lit. (3080.6) was recorded significantly higher vigour index-I as compared to other treatments and T_{10}-Control (1812.9).

Vigour index-II

The data recorded at 60, 90, 120 and 150 days after harvesting for vigour index-II as influenced by different bio-agents are presented in the Table 2. The vigour index-II was found decreased rapidly up to 150 days after harvesting. At 60 days after harvesting, the data shows that treatment T_1-Biomix @10ml/lit. (153.5) was recorded significantly higher vigour index-II and as compared to other treatments and T_{10}-Control (97.1). Similarly at 90 days after harvesting, The treatment T_1-Biomix @10ml/lit. (128.9) followed by T_7-*Metarhizium anisophilae* @10ml/lit. (124.2) was recorded significantly higher vigour index-II as compared to other treatments and T_{10}-control (88.0). However at 120 days after harvesting, the data indicated that the treatment T_1-Biomix @10ml/lit. (117.7) followed by T_7-*Metarhizium anisophilae*@10ml/lit. (116.3) was recorded significantly higher vigour index-II as compared to T_{10}-Control (1812.9).

The findings are conformity with Rajput *et al*., (2010) [9], Raj *et al*., (2013) [8], Singh *et al*., (2013) [12], Savita and Jakhar (2015) [11], Sarathakumar*et al*., (2016) [10], Quesemi*et al*., (2016) [7], Madhukeshwara *et al*., (2017) [5] and Monalisa *et al*. (2017) [6] who reported that bioagents significantly increase the germination percentage, shoot length, root length, dry matter content of seedlings, vigour index-I and II.

After physiological maturity, seed begin to deteriorate at varying rate depends upon the condition of storage environment who have highlighted the deteriorative changes in seed which include membrane degradation, accumulation of toxic metabolites, decrease enzyme activity, liquid auto-oxidation, failure to repair mechanism and genetic degradation. Consequence of these factors led to reduced viability and vigour in stored seeds. The decline in germination during ageing is related to degree of deterioration of seeds. The decline in seed germination and vigour during storage were influenced by chronological age of seed rather than initial germination percentage. This result is in conformity with (Jitender *et al*.2018) [4].

Table 1: Effect of seed priming and foliar spray of bio-agents on germination percentage, root length and shoot length

Treatments	Germination percentage				Root length (cm)				Shoot length (cm)			
	At 60 DAH	At 90 DAH	At 120 DAH	At 150 DAH	At 60 DAH	At 90 DAH	At 120 DAH	At 150 DAH	At 60 DAH	At 90 DAH	At 120 DAH	At 150 DAH
T_1-Biomix @ 10ml/lit.	91.60	88.90	87.37	85.30	12.5	12.5	12.5	12.5	26.6	25.5	24.5	20.7
T_2- *Trichoderma viride* @ 10ml/lit.	87.37	82.23	79.47	79.00	12.5	12.5	12.5	12.5	24.8	24.1	23.3	19.2
T_3-*Azospirillum brasilense* @ 10ml/lit.	88.20	83.13	83.57	81.37	12.5	12.5	12.5	12.5	25.5	25.1	23.1	19.3
T_4-*Glucanoacetobacter* spp.@ 10ml/lit.	89.47	84.80	83.67	82.37	12.5	12.5	12.5	12.5	25.7	25.3	23.8	19.7
T_5- *Pseudomonas fluroscence* @ 10ml/lit.	85.40	81.50	82.10	78.37	12.5	12.5	12.5	12.5	24.4	23.7	22.7	18.8
T_6- *Pseudomonas striata* @ 10ml/lit.	86.17	79.87	79.07	76.50	12.5	12.5	12.5	12.5	24.8	23.3	21.3	18.3
T_7-*Metarhiziumanisophilae* @ 10ml/lit.	90.30	86.33	85.10	83.93	12.5	12.5	12.5	12.5	26.2	25.7	24.9	20.3
T_8-*Beauveriabassiana*@ 10ml/lit.	86.23	79.50	76.17	75.46	12.5	12.5	12.5	12.5	24.4	23.8	21.6	18.6
T_9-*Aspergillusniger* @ 10ml/lit.	84.80	79.77	77.93	73.40	12.5	12.5	12.5	12.5	23.3	22.4	20.4	18.3
T_{10}-Control	83.80	77.90	74.30	70.30	12.5	12.5	12.5	12.5	20.5	20.4	17.8	15.3
SE±	3.11	2.96	3.01	3.30	12.5	12.5	12.5	12.5	1.64	1.68	1.84	1.45
CD @ 5%	NS	8.79	8.94	9.80	12.5	12.5	12.5	12.5	4.89	5.01	5.49	4.33-
CV%	6.88	6.22	6.44	7.27	12.5	12.5	12.5	12.5	11.56	12.19	14.31	13.44

Table 2: Effect of seed priming and foliar spray of bio-agents on dry matter content of seedlings, vigour index-I and II

Treatments	Dry matter content of seedlings (g)				Vigour index-I				Vigour index-II			
	At 60 DAH	At 90 DAH	At 120 DAH	At 150 DAH	At 60 DAH	At 90 DAH	At 120 DAH	At 150 DAH	At 60 DAH	At 90 DAH	At 120 DAH	At 150 DAH
T_1-Biomix @ 10ml/lit.	1.67	1.45	1.39	0.84	3581.5	3357.7	3151.5	2524.8	153.5	128.9	117.7	71.6
T_2- *Trichoderma viride* @ 10ml/lit.	1.48	1.29	1.14	0.67	3160.2	2901.2	2588.4	2227.8	131.2	106.0	92.7	52.9
T_3-*Azospirillum brasilense* @ 10ml/lit.	1.54	1.34	1.23	0.73	3298.6	3008.2	2745.3	2222.2	138.2	111.3	102.7	59.7
T_4-*Glucanoacetobacter* spp.@ 10ml/lit.	1.57	1.38	1.27	0.77	3379.3	3112.1	2854.1	2307.2	142	117.0	109.7	63.3
T_5- *Pseudomonas fluroscence* @ 10ml/lit.	1.44	1.35	0.80	0.60	3065.8	2836.2	2621.9	1975.6	124.8	110	90.0	46.9
T_6- *Pseudomonas striata* @ 10ml/lit.	1.42	1.23	1.09	0.70	3099.6	2681.2	2354.2	1843.6	122.3	98.1	88.4	53.5
T_7-*Metarhiziumanisophilae* @ 10ml/lit.	1.55	1.44	1.38	0.81	3485.5	3288.0	3080.6	2397.0	139.8	124.2	116.3	67.9
T_8-*Beauveriabassiana*@ 10ml/lit.	1.38	1.28	1.23	0.60	2991.1	2671.2	2199.2	1824.6	120	101.7	88.8	47.9
T_9-*Aspergillusniger* @ 10ml/lit.	1.37	1.20	1.0	0.63	2741.5	2478.6	2135.6	1663.2	116.4	95.6	79.6	46.2
T_{10}-Control	1.26	1.13	0.94	0.50	2391.6	2181.2	1812.9	1279.4	97.1	88.0	72.0	39.5
SE±	0.08	0.06	0.14	0.08	139.8	175.01	131.06	119.8	8.19	4.97	7.55	4.60
CD @ 5%	0.24	0.20	0.43	0.25	415.5	520.11	389.4	355.9	24.34	14.78	22.43	13.07

Conclusion

From above results of experiment it is concluded that, Quality seed parameters *viz.*, Germination percentage, root length, shoot length, dry matter content of seedling, vigour index-I and vigour index-II were significantly increased due to spraying of biomix @10ml/lit. and *Metarhizium anisopliae* @ 10ml/lit. in the chickpea genotype Akash (BDNG-797).

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