Original Research Article

EFFECT OF SEED TREATMENT WITH BIOINOCULANTS ON SEED YIELD AND QUALITY PARAMETERS IN CHICKPEA (*Cicer arietinum* L.)

ABSTRACT

The field experiment entitled **"EFFECT OF SEED TREATMENT WITH BIOINOCULANTS ON SEED YIELD AND QUALITY PARAMETERS In CHICKPEA (*Cicer arietinum* L.)",** was conducted during *Rabi* 2022 at field experimental center, Department of Genetics and Plant Breeding, SHUATS, Prayagraj, (U.P). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36 %), available N (171.48 kg/ha), available P (15.2 kg/ha) and available K (232.5 kg/ha). The experiment was laid out in Randomized Block Design with thirteen treatments including control whichwere replicated thrice. The treatments are as follows, T0- Control, T1 - Bacillus Subtilis – 20g/kg seeds, T2 – Rhizobium - 20g/kg seeds, T3 – P.S.B – 20g/kg seed, T4 - T. Harzianum – 20g/kg seed, T5 - T.viridae – 20g/kg seed, T6 – B.subtilis + Rhizobium – (10g + 10g/kg seed), T7 - Rhizobium + P.S.B – (10g + 10g/kg seed), T8 - P.S.B + T.Harzianum – (10g + 10g/kg seed), T9 – T.Harzianum + T.viridae – (10g + 10g/kg seed), T10 - T.viridae + B.subtilis – (10g + 10g/kg seed), T11 - B.subtilis + Rhizobium + P.S.B – (10g + 10g+10g/kg seed), T12 - P.S.B + T.Harzianum + T,viridae – (10g + 10g+10g/kg seed) respectively. The experiment results revealed that seeds treated with T7 – Rhizobium + P.S.B – 10 g + 10 g gave better than other treatments *viz*, days for 50% flowering (60.00), Days to 50% pod setting (75.00) and has matured earlier (99.00), Plant height (74.90 cm), number of pods per plant (52.33), number of seeds per pod (3.00), seed yield per plant (26.14 gm), Seed yield per plot (522.80 g), Biological yield per plot (613.58), Seed index (32.24 gm). Were recorded significantly higher compared to other treatments.

Key words: Chickpea, Bacillus Subtilis, Rhizobium, P.S.B, T.Harzianum, T. Viridae.

INTRODUCTION:

Chickpea is also known by the names Chana, Gram and Bengal Gram. Chickpeas come in two forms: whole seed and split seed (dal), Flour may be used to make various types of snacks. Chickpeas are consumed by variety of ways, including as flour, dal, crushed or whole grain cooked or parched, green grain and the leaf as a vegetable. Seeds that have sprouted offer therapeutic properties. (Source: www.chickpea.org).

The chickpea crop is highly self-pollinated. Chickpea having two types which are well recognized viz. Desi type with small and brown seed accounts for nearly 90% area and Kabuli type with bold and cream-colored seed is grown in around 10% area. Almost 90% of the chickpea crop is cultivated rain-fed mostly on receding soil moisture and on marginal lands. The origin of this genus Cicer is from South-eastern Turkey which later spread to the other parts of the world. It is well adapted to relatively cooler climates. The largest area of adaptation is in the Indian sub-continent. (Source: icrisat.org).

The most important pulse crops of India are Chickpea, Red gram, Green gram, Black gram, Cowpea etc. Among them Chickpea (Cicer arietinum L.) is the third most important food legume which is grown on 10.42 m ha with 12.60 million ton production (des.delhigovt.nic.in 2020-21). It is grown nearly over 45 countries of all continents in the world. It is source of high-quality protein to the people in developing countries. People in developed countries consider it as a healthy food. Its green leaves/twigs are used in preparing a nutritious vegetable in south Asian countries. Chickpea is one of the most important pulse crop among all pulses. It is the premier pulse crop of Indian subcontinent. India is the largest chickpea producer and consumer also. India is the largest pulse producing nation in the world. (Source: icrisat.org). Chickpea (*Cicer arietinum* L.) belong to family leguminaceae. It is widely cultivated in India, Australia, Pakistan, Turkey, Myanmar and Ethiopia. It is an important cool season pulse crop and is also called Bengal gram. In terms of pulse production, India contributes about 25% to the total global pulses production and contains 21.1% protein, 61.5 per cent carbohydrate, 4.5% fat. It is also rich in calcium, iron and niacin. It is used for human consumption as well as for feeding to animals.

Rhizobium are a group of Gram-negative aerobic rods, motile, when young have bipolar, subpolar or peritrichous flagella.Symbiotic nitrogen fixation by Rhizobium in legumes contributes substantially to total biological nitrogen fixation. The roots of mung bean bear nodules that can fix atmospheric nitrogen via symbiotic association with bacterium Rhizobium (Gupta and Pratap, 2016). Although native Rhizobium is present in soil but not all of them are capable of forming nodules. Some strains are highly effective in this respect while others are partially or completely effective. It is reported that natural flora gradually loses their efficiency. Hence artificial inoculation with tested effective strains, should be taken up as comparatively means, cheap insurance for obtaining optimum yield.

OBJECTIVES

The present investigation is contemplated with the following objectives:

1.To evaluate the effect of seed treatment with bioinoculants on seed yield and quality parameters in Chickpea.

2.To standardize the suitable seed treatment favorable for Chickpea crop.

MATERIALS AND METHODS:

The present research on **effect of seed treatment with bioinoculants on seed yield and quality parameters in chickpea (*Cicer arietinum* L.)** was made to identify the effect of seed priming of different kinds on seed quality parameters of linseed and to find out suitable seed priming method for linseed. The experiment was laid out in Randomized Block Design with thirteen treatments including control which were replicated thrice in rabi 2022. The treatments are as follows, Bacillus Subtilis, Rhizobium, Phospahte Solubilizing Bacteria, Trichoderma Harzianum, Trichoderma Viridae. The linseed seeds were primed with above different priming agents in above different concentrations and intensities for a given duration. After priming seeds were dried to initial moisture content at room temperature. After that the primed seeds were used to grow under field conditions.

RESULTS:

PRE - HARVEST

1. **Plant height:** minimum plant height at 90 DAS was exhibited by treatment T0 [control] (65.50), while maximum plant height was recorded in treatment T7 – Rhizobium + P.S.B – 10 g + 10 g - (74.90), followed by, T11 – B.subtilis + Rhizobium + P.S.B – 10 g + 10 g +10 g- (72.00) and T12 - P.S.B + T.Harzianum + T,viridae – 10 g + 10 g +10 g- (71.00) were significantly higher than other significant treatments.
2. **Days to 50% pod setting:** minimum Days to 50% pod setting was exhibited by treatment T7 – Rhizobium + P.S.B –10 g + 10 g- (60.00) while maximum Days to 50 % pod setting was recorded in treatment T0 [control] (80.00), followed by T1 – Bacillus Subtilis –20 g/kg seed (78.00) was significantly higher than other significant treatments.
3. **Days to 50% flowering:** The minimum Days to 50% flowering was exhibited by treatment T7 – Rhizobium + P.S.B –10 g + 10 g- (75.00) while maximum Days to 50% flowering was recorded in treatment T0 [control] (95.00), followed by T1 – Bacillus Subtilis –20 g/kg seed (91.00) was significantly higher than other significant treatments.
4. **Days to maturity:** minimum Days to maturity was exhibited by treatment T7 – Rhizobium + P.S.B –10 g + 10 g- (99.00) while maximum Days to maturity was recorded in treatment T0 [control] (118.00), followed by T1 – Bacillus Subtilis –20 g/kg seed (115.00) was significantly higher than other significant treatments.

POST - HARVEST

1. **Number of pods per plant:** minimum number of pods per plant was exhibited by treatment T0 [control] (44.33), while maximum number of pods per plant was recorded in treatment T7 – Rhizobium + P.S.B – 10 g + 10 g - (52.33), followed by, T11 – B.subtilis + Rhizobium + P.S.B – 10 g + 10 g+10g (51.33) and T12 - P.S.B + T.Harzianum + T,viridae – 10 g + 10 g+10 g - (50.67) were significantly higher than other significant treatments.
2. **Number of seeds per pod:** minimum number of seeds per pod was exhibited by treatment T0 [control] (1.00), while maximum number of seeds per pod was recorded in treatment T7 – Rhizobium + P.S.B – 10 g + 10 g - (3.00), followed by, T11 – B.subtilis + Rhizobium + P.S.B – 10 g + 10 g +10 g(2.00) and T12 - P.S.B +

T.Harzianum + T,viridae – 10 g + 10 g+ 10 g - (2.00) were significantly higher than other significant treatments

3. **Seed yield per plant:** minimum seeds yield per plant was exhibited by treatment T0 [control] (19.69 gm), while maximum seeds yield per plant was recorded in treatment T7 – Rhizobium + P.S.B – 10 g + 10 g - (26.14 gm), followed by, T11 – B.subtilis + Rhizobium + P.S.B – 10 g + 10 g +10 g(25.22 gm) and T12 - P.S.B + T.Harzianum + T,viridae – 10 g + 10 g+ 10 g - (24.78 gm) were significantly higher than other significant treatments.
4. **Seed yield per plot:** minimum seed yield per plot was exhibited by treatment T0 [control] (393.80 gm), while maximum seed yield per plot was recorded in treatment T7 – Rhizobium + P.S.B – 10 g + 10 g - (522.80 gm), followed by, T11 – B.subtilis + Rhizobium + P.S.B – 10 g + 10 g+10 g (504.40 gm) and T12 - P.S.B + T.Harzianum + T,viridae – 10 g + 10 g + 10 g- (495.60 gm) were significantly higher than other significant treatments.
5. **Biological yield:** minimum biological yield per plot was exhibited by treatment T0 [control] (484.58 gm), while maximum biological yield per plot was recorded in treatment T7 – Rhizobium + P.S.B – 10 g + 10 g - (613.58 gm), followed by, T11 – B.subtilis + Rhizobium + P.S.B – 10 g + 10 g + 10 g(595.18 gm) and T12 - P.S.B + T.Harzianum + T,viridae – 10 g + 10 g+ 10 g - (586.38 gm) were significantly higher than other significant treatments.
6. **Seed index:** minimum seed index was exhibited by treatment T0 [control] (25.47 gm), while maximum seed index was recorded in treatment T7 – Rhizobium + P.S.B – 10 g + 10 g - (32.24 gm), followed by, T11 – B.subtilis + Rhizobium + P.S.B – 10 g + 10 g+ 10g (31.00gm) and T12 - P.S.B + T.Harzianum + T,viridae – 10 g + 10 g+ 10 g - (30.56 gm) were significantly higher than other significant treatments.

Discussion:

Application of Bradyrhizobium japonicum increased soybean seed and nitrogen uptake. Increase in nitrogen uptake due to Rhizobium inoculation was mainly due to significant increase in nodulation, resulted in higher accumulation of N due to atmospheric N2 fixation.

The higher assimilation of nitrogen might have resulted in higher biomass

production thus resulting in higher uptake of N. Higher uptake of N, P and K by soybean crop correspondence to higher biomass production by the crop Gajbhiye *et al*. (2011). Whereas, seed inoculation with Rhizobium spp., Bacillus subtilis and Bacillus megaterium, especially dual and triple combinations, may substitute costly N, P fertilizers in chickpea production as reported by Elkoca *et al*. (2008) reported inoculation of Bradyrhizobium japonicum + Bacillus subtilis was significantly increased seed yield of Chickpea. Similarly, previous studies also showed that dual inoculations significantly increased grain yield as compared with single inoculation of individual organisms in soybean (Dashti *et al*., 1998): Patra *et al*. (2012) reported inoculation of Bacillus spp. and of rhizobial strain maximum increase grain yield. In fact, PGPR (Bacillus) have been shown to greatly improve the productivity and quality of many legumes, when co-inoculated with rhizobia.

Bullied *et al*. (2001) reported that Bacillus spp. enhance the phosphorus and potassium contents of many plants. Among the plant growth promoting traits, IAA production by the bacterium has a cascading effect on the plant development due to its ability to influence root growth and biomass, which in turn affects the nutrient uptake (Mishra *et al*,. 2008). Indole-3-acetic acid is implicated in signaling between microorganisms and plants (Spaepen *et al*.

2007) leading too stimulation of cell division, initiation of lateral and adventitious roots (Malamy and Benfry 1997), cell enlargement (Salisbury, 1994) and results into elongation of stems and roots. Results of the present investigation pertaining to enhanced nutrient uptake by soybean due to Bacillus spp. inoculation with B. japonicum are in conformity with those of Bullied *et al*. (2001). Higher uptake of N, P and K by soybean crop correspondence to higher biomass production by the crop Gajbhiye *et al*. (2011). Whereas, seed inoculation with Rhizobium spp., Bacillus subtilis and Bacillus megaterium, especially dual and triple combinations, may substitute costly N, P fertilizers in chickpea production as reported by Elkoca *et al*. (2008) Increase phosphorus uptake in the present investigation can be explained on the bases of results of these workers.

Table 1 Analysis of variance for effect of seed treatments on Chickpea (*Cicer arietinum* L.)

Characters	Mean sum of squares		
	Replications (d. f = 2)	Treatments (d. f = 12)	Error (d. f = 24)
Field emergence at 4 DAS	0.006	9.342*	0.09
Field emergence at 7 DAS	1.663	18.35*	1.424
Field emergence at 10 DAS	1.395	22.072*	4.365
Plant height at 30 DAS	0.037	13.647*	0.467
Plant height at 60 DAS	2.785	15.58*	1.158
Plant height at 90 DAS	3.081	21.321*	4.686
Days to 50% flowering	2.000	115.423*	1.600
Days to 50% Pod setting	3.962	107.5*	4.641
Days to maturity	1.275	102.23*	4.729
Number of pods per plant	3.564	18.786*	1.119
Number of seeds per pod	0.025	1.807*	0.025
Seed yield per plant	0.158	10.966*	0.388
Seed yield per plot	63.322	4386.3*	155.32
Biological yield per plot	249.33	4386.3*	186.98
Harvest index	0.5805	0.3862*	0.9575
Seed index	0.2905	11.471*	0.6067

Table 2: Influence of Bacillus Subtilis, Rhizobium, P.S.B, T.Harzianum, T. Viridae on Plant height, Days to 50% pod setting, Days to 50% flowering, Days to maturity.

TREATMENT	PLANT HEIGHT	Days to 50% pod setting	Days to 50% Flowering	Days to maturity
T0 – Control	65.50	95.00	80.00	118.00
T1	65.70	91.00	78.00	115.00
T2	69.70	83.00	68.00	107.00
T3	68.80	84.00	69.00	108.00
T4	67.10	88.00	73.00	112.00
T5	66.90	89.00	74.00	113.00
T6	69.80	82.00	67.00	106.00
T7	74.90	75.00	60.00	99.00
T8	70.70	79.00	64.00	103.00
T9	68.20	86.00	71.00	110.00
T10	67.70	86.00	71.00	110.00
T11	72.00	76.00	61.00	100.00
T12	71.00	78.00	63.00	102.00
SE m (±)	1.24	1.24	0.73	1.25
CV	3.13	2.56	1.82	2.01

Table 3: Influence of Bacillus Subtilis, Rhizobium, P.S.B, T.Harzianum, T. Viridae on number of pods per plant, number of seeds per pod, seed yield per plant, seed yield per plot.

TREATMENT	Numbers of pods per plant	Numbers of seeds per pod	Seed yield per plant	Seed yield per plot
T0 – Control	44.33	1.00	19.69	393.80
T1	44.33	1.33	20.73	414.60
T2	48.33	2.00	23.85	477.00
T3	47.67	2.00	23.33	466.60
T4	46.67	1.00	21.71	434.20
T5	46.33	1.00	21.26	425.20
T6	48.00	2.00	24.22	484.40
T7	52.33	3.00	26.14	522.80
T8	49.67	2.00	24.60	492.00
T9	47.00	2.00	22.69	453.80
T10	46.33	1.00	22.42	448.40
T11	51.33	3.00	25.22	504.40
T12	50.67	3.00	24.78	495.60
SE (m)	0.61	0.09	0.35	7.19
CV	2.22	8.55	2.69	2.69

Table 4: Influence of Bacillus Subtilis, Rhizobium, P.S.B, T.Harzianum, T. Viridae on Biological yield, Seed index.

TREATMENT	Biological yield perplot (gm)	Seed index (gm)
T0 – Control	484.58	25.47
T1	505.38	26.51
T2	567.78	29.63
T3	557.38	29.11
T4	524.98	27.49
T5	515.98	27.04
T6	575.18	30.00
T7	613.58	32.24
T8	582.78	30.38

T9	544.58	28.47
T10	539.18	28.20
T11	595.18	31.00
T12	586.38	30.56
S Em (±)	7.89	0.44
CD (p=0.05)	2.47	2.69

CONCLUSION:

It is concluded from the present study that the seeds of Chickpea *(Cicer arietinum L.*) were treated with (T7) Rhizobium + P.S.B –10 g + 10 g showed significant increase in seed yield per plant (26.14 g) followed by T11 – B. subtilis + Rhizobium + P.S.B – 10 g + 10 g+ 10 g (25.22 gm), application of both rhizobium and Phosphate and solubilizing bacteria helps in keeping agricultural production at a sustainable level. It reduces the cost of agricultural production and also improves the soil health. Findings are based on research done in one season in Prayagraj (Allahabad) U.P. further trails may be required for considering it for the recommendation.

REFERENCE:

Bullied, W. J., Buss, T. J. and Vessey, J. K. 2001. Bacillus cereus UW85 inoculation effect on growth nodulation, and N accumulation in grain legumes: field studies. Can. J. Plant Sci. 4: 77-84.

Dashti, N., Zhang, F., Hynes, R. and Smith, D. L. 1998. Plant growth promoting rhizobacteria accelerate nodulation and increase nitrogen fixation activity by field grown soybean [Glycine max (L.) Merr.] under short season conditions. Plant Soil. 200: 205–213.

Elkoca, E., Kantar, F. and Sahin, F. 2008. Influence of nitrogen fixing and phosphate solubilizing bacteria on nodulation, plant growth and yield of chickpea. J. Plant Nutr. 31: 157- 171.

Fatima, Z., Zia, M. and Chaudhary, M. F. 2007. Interactive effect of Rhizobium strains and

P on soybean yield, nitrogen fixation and soil fertility. Pak. J. Bot. 39: 255-264.

Gupta, S., Pratap, A. 2016. Mung bean-Summer cultivation in India (Pocket Guide). AICRP on MULLaRP. Indian Institute of Pulses Research, Kanpur-208024. Extension Bulletin. pp 1-20.

Gajbhiye, P. N., Bulbule, A. V., Pawar, R. B. and Ingavale, M. T. 2011. Integrated nutrient management in soybean (Glycine max L.)-wheat (Triticum aestivum L.) cropping sequence in lithic Ustorthents of western Maharastra. Crop Res. 42 (1, 2 & 3): 98-103.

Malamy, J. E. and Benfry, P. N. 1997. Organization and cell differentiation in lateral roots of Arabidopsis thaliana. Development. 124: 33-44.

Mishra. P. K., Mishra, S., Selvakumar, G., Kundu, S. and Gupta, H.S. 2009. Enhanced soybean (Glycine max L.) plant growth and nodulation by Bradyrhizobium japonicum-SB1 in presence of Bacillus thuringiensis-KR1 Acta agriculturae scandinavica section B. Soil Plant Sci., 59: 189-196.

Patra, R. K., Pant, L. M., and Pradhan, K. 2012 Response of Soybean to Inoculation with Rhizobial Strains: Effect on growth, yield, N uptake and soil N status. World J. Agric. Sci. 8 (1): 51-54.

Spaepen, S., Vanderleyden, J. and Remans, R. 2007. Indole-3- acetic acid in microbial and microorganism-plant signaling. Microbiol. 4: 286-300.

Salisbury, F. B. 1994. The role of plant hormones in plant environment interactions. Marcel Dekker, New York.