

DETERMINATION OF BEST COMBINATION OF BIOFORTIFICATION AND HYDROPRIMING FOR YIELD AND ITS QUALITY PARAMETERS IN CHICKPEA (*Cicer arietinum* L.)

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Abstract

The present study were carried out in the Department of Genetics and Plant Breeding, Faculty of Agriculture, NDUAT, Faizabad during *rabi* season 2014-15 and 2015-16 entitled “standardization of biofortification and hydropriming for enhance seed yield and its quality parameters in chickpea (*Cicer arietinum* L.)” The objective of the study was assessing the comparative performance of yield and quality. The 27 treatments of bio-fertilizers and seed priming for chickpea variety (Pant G -186) were evaluated following 13 quantitative characters *viz.*, Field emergence (%), Days to 50% flowering, plant height, number of branch/plant, number of pods per plant, number of seeds per pod, harvest index (%), seed index (g), grain yield (kg/ha), biological yield, seed yield per plant (g). The treatment (*Rhizobium* 12g+HP 16 hr) was found best in plant height, number of branch, days to 50% flowering, number of pods plant⁻¹, number of seeds pod⁻¹, biological yield, harvest index, seed yield plant⁻¹, seed yield kg ha⁻¹, seed index and. While, (PSB10 g +HP 16hr) was found in maximum Field emergence and days to maturity. The treatment (*Rhizobium* 12g+HP 16 hr) the best treatment for chickpea variety on the basis of seed yield and seed quality. These finding are based on six months experiment, further experiments are to substantiate for this results.

Keywords: Chickpea, Bio-fertilizers, Priming, Protein.

I. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the most important pulse crop in India with an average yield of 2500-3000 kg/ha. The gram is mentioned in Sanskrit which indicates that it is cultivated in India since a longer period than in any other country in the World. Chickpea (*Cicer arietinum* L.) gram is an important *Rabi* season self pollinated legume crop having extensive geographical distribution. Chickpea is known by different names in various countries such as Gram, Channa, Bengal gram etc. Chickpea is a diploid species with a chromosome number $2n = 16$. It belongs to sub family Papilionaceae of the family Leguminaceae.

Seed priming, several processes including storage, material handling, activation and synthesis of a number of enzymes and nucleic acids, repair and build up, Several biochemical and physiological changes have been observed in seeds during ageing membrane disruption is one of the main reason of seed deterioration the major cause of membrane disruption are increase in free fatty acid level and free radical productivity by lipid peroxydation. Different techniques could be used to enhance crop yield. Priming is also thought to increase free radical scavenging enzymes activity and counteract the effect of lipid peroxidation and reduce leakage of metabolites. The early improvements may increase the rate of uniformity of seed germination and seedling emergence. (Afzal et al., 2002).

The present experiment entitled Determination of best combination of biofortification and hydropriming for yield and its quality parameters in chickpea (*Cicer arietinum* L.) was undertaken with the following objectives. To determine the best combination of biofortification and hydropriming duration

2. MATERIALS AND METHODS

The field experiments under present investigation were conducted during *Rabi* 2014-15 and 2015-16 at Student Instructional Farm and lab experiments were carried out in Seed Testing Laboratory of Seed Technology Section, N. D. University of Agriculture and Technology, Kumarganj, Faizabad (U. P.). Geographically, Narendra Nagar situated between 26.47° N latitude, 82.12° longitude and at an altitude of 113 meters above the mean sea level. The chickpea crop was sown in the field using randomized block design (Factorial) with eight treatments and three replications. The treatment details are presented in Table 1.

Treatment No.	Description
T ₁	Hydro priming with distilled water 13 hrs
T ₂	Hydro priming with distilled water 16 hrs
T ₃	Hydro priming with distilled water 18 hrs
T ₄	<i>Trichoderma</i> 5 gm
T ₅	<i>Trichoderma</i> 7 gm
T ₆	<i>Trichoderma</i> 10 gm
T ₇	PSB 7 gm
T ₈	PSB10 gm
T ₉	PSB 12 gm
T ₁₀	<i>Rhizobium</i> 7 gm
T ₁₁	<i>Rhizobium</i> 10 gm
T ₁₂	<i>Rhizobium</i> 12 gm

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Table 1. Treatments used in this study.

The inoculums of *Rhizobium* and phosphate solubilizing bacterium were obtained from the Biotechnology Park Lucknow, Chickpea (Pant G-186) seeds inoculated by soaking in liquid culture for one hour and then were sown immediately.

For hydro-priming priming treatments seeds of chickpea were washed with water, dipped in 0.1 % mercuric chloride for 5 min and then washed thoroughly with sterilized water. The seeds were soaked in aerated solutions (Kaur *et al.*, 2005). The seeds were then put in the refrigerator at a temperature of 5°C until it was later used.

Plant to plant distance and row to row distance was 10 and 30 cm, respectively. Fertilizer was applied @ 20:40:40 (kg ha⁻¹) N:P:K at the time of sowing. The chickpea crop was cultivated using standard agronomic practices. The observations were recorded at days to 50% flowering, plant height (cm), number of branches per plant, number of pods per plant, number of seeds per pod, biological yield per plant (g), seed index (g), harvest index (%), seed yield per plant (g) and seed yield (q/ha)

3. RESULT & DISCUSSION

3.1 Pre harvest observations

3.1.1 Plant Height (cm) at 30 DAS

The results presented in Table 2 revealed that the maximum plant height (cm) was recorded in *Rhizobium* 12.5gm (12.63). in 2014-15 and 12.198 in 2015-16. was significantly superior than other treatments, indicate that has been decrease in plant height in all the treatments in year 2015-16. The minimum plant height (cm) was recorded in the treatment Trichoderma 10g (11.250). in 2014-15 and 10.95 in the treatment Trichoderma 10g in 2015-16.

3.1.2 Plant Height (cm) at 60 DAS

The results presented in Table 2 revealed that the maximum plant height (cm) was recorded in *Rhizobium* 12gm+16hr (19.81). in 2014-15 and 19.19 in 2015-16. Scored significantly superior values than other treatment indicate that has been decrease in plant height in all the treatments in year 2015-16. The minimum plant height (cm) was recorded in the treatment PSB 7g (18.54). in 2014-15 and 17.13 in the treatment Trichoderma 5g in 2015-16.

3.1.3 Number of branches per plant at 30 DAS

The results presented in Table.2 and revealed that the maximum branches per plant was recorded in *Rhizobium* 12.5gm (6.44). in 2014-15 and 6.17 in 2015-16. scored significantly superior values than other treatment, indicate that has been decrease in number of branches per plant at 30 days in all the treatments in year 2015-16. The minimum branches per plant at 30 DAS was recorded in the treatment Trichoderma 7 g (5.82). in 2014-15 and 5.51 in the treatment PSB 7g in 2015-16.

3.1.4 Number of branches per plant at 60 DAS

The results presented in Table 2 revealed that the maximum branches per plant was recorded in *Rhizobium* 7 gm (7.86). in 2014-15 and 7.62 in 2015-16. was significantly superior than other seed treatments indicate that has been decrease in number of branches per plant at 60 days in all the treatments in year 2015-16. The minimum branches per plant at 60 DAS was recorded in the treatment Trichoderma 5g (7.51). in 2014-15 and 7.17 in the Trichoderma 5g in 2015-16. The increase in number of branches per plant could be due to atmospheric N fixed by *Rhizobium* and growth promoting substances produced by P-solubilizers. These results are in collaboration with the earlier finding in chickpea (Jain *et al.*, 1999).

3.1.5 Days to 50% flowering

The results presented in Table 3 revealed that the early flowering was recorded in *Rhizobium* 10gm (95.5) in 2014-15 and 94.1 in 2015-16. was significantly superior than other seed treatments, indicate that has been decrease in days to 50% flowering

in all the treatments in year 2015-16. The late days to 50% flowering was recorded in the treatment *Rhizobium* 12g (95.00). in 2014-15 and 95.2 in the treatment *Rhizobium* 12gm in 2015-16.

3.1.6 Number of pods per plant

The results presented in Table 3 and revealed that the maximum number of pods per plant were recorded in *Rhizobium* 12g (75.04) in 2014-15 and 71.86 in 2015-16. was significantly superior than other seed treatments indicate that has been decrease in number of pods per plant in all the treatments in year 2015-16. The minimum Number of pod per plant was recorded in the treatment *Trichoderma* 5g (64.1). in 2014-15 and 58.65 in the treatment *Trichoderma* 5 g in 2015-16. The effects of organic and biologic fertilizers on soybean growth and quality of seed, Mekki and Amel (2005) showed that the number of pods per plant was increased by applying biofertilizer.

3.1.7 Number of seeds per pod

The results presented in Table 3 and revealed that the maximum number of seeds per pod were recorded in *Rhizobium* 10 g (1.6). 2014-15 and 1.51 in 2015-16. was significantly superior than other seed treatments, indicate that has been decrease in number of seed per pods in all the treatments in year 2015-16. The minimum Number of seed per pod was recorded in the treatment *Trichoderma* 5g (1.300). in 2014-15 and 1.31 in the treatment PSB 12g in 2015-16. These results are in confirmation with that of Karadavut and Ozdemir (2001) and Fatima *et al.*, 2008 who reported that inoculation significantly increased grain yield (20% higher than control).

3.2 Post harvest observations:

3.2.1 Harvest index

The results presented in Table 5 and revealed that the maximum harvest index was recorded in *Rhizobium* 12g (44.97) in 2014-15 and 47.39 in the treatment PSB 10g in 2015-16. was significantly superior than other seed treatments indicate that has been increase harvest index in all the treatments in year 2015-16. The minimum harvest index was recorded in the treatment PSB 12g (39.86). in 2014-15 and 42.2 in the treatment PSB 12g in 2015-16.

3.2.2 Biological yield per plant (g)

After being dry, the harvested seed crop in the field the weight of dry seed including the respective dry plant was taken for biological yield. The results presented in table revealed that the maximum biological yield was recorded in PSB 7.5g (27.76). in 2014-15 and 25.41 in the treatment *Rhizobium* 12g 2015-16. was significantly superior than other seed treatments, indicate that has been decrease in biological yield per plant (g) in all the treatments in year 2015-16. The minimum Biological yield per plant (g) was recorded in the treatment *Rhizobium* 7g (23.7). in 2014-15 and 22.8 in the treatment *Rhizobium* 7g in 2015-16.

3.2.3 Seed yield per plant (gm)

The results presented in Table 5 and revealed that the maximum seed yield was recorded in *Trichoderma* 7g (12.033) in 2014-15 and 11.66 in the treatment *Rhizobium* 12g in 2015-16. was significantly superior than other seed treatments indicate that has been decrease seed yield per plant (g) in all the treatments in year 2015-16.

The minimum Seed yield per plant (gm) was recorded in the treatment *Rhizobium* 7g (9.68). in 2014-15 and 9.544 in the treatment *Rhizobium* 7g in 2015-16. Bacteria had beneficial effect on plant growth and seed yield, because they fix atmospheric nitrogen and release auxins to the root zone to enhance growth (Rees *et al.*, 2009). Addition of biofertilizer promotes bacterial response to nitrogen fixation and soil fertility. Higher rates of atmospheric nitrogen fixation promote growth and yield (El-Desuki *et al.*, 2010).

3.2.4 Seed yield/Plot Kg/hectare

The results presented in Table 4 revealed that the maximum seed yield (kg/ha) was recorded in *Rhizobium* 12 gm (1763.87). in 2014-15 and 1696.033 in 2015-16 .was significantly superior than other seed treatments, indicate that has been decrease in seed yield kg per hectare in all the treatments in year 2015-16. The minimum Seed yield/Plot Kg/ hectare was recorded in the treatment Trichoderma 5g (1384.4). in 2014-15 and 1234.95 in the treatment PSB 7g in 2015-16. It might be due to the availability of plant nutrients in the vicinity of rhizosphere and less losses of nutrient due to fertilizer banding. These results are in conformity with those of Din *et al.* (1999) who recorded maximum yield in band placement. Seed inoculation also significantly affected the grain yield of chickpea.

3.2.5 100 Seed weight (g)

The results presented in Table 3 revealed that the maximum Seed Index (g) was recorded in *Rhizobium* 12.g (19.324). in 2014-15 and 19.267 in Treatment *Rhizobium* 12.g in 2015-16. was significantly superior than other seed treatments, indicate that has been decrease in 100 Seed weight (g) in all the treatments in year 2015-16. The minimum 100 Seed weight (g) was recorded in the treatment *Trichoderma* 7g (16.67) in 2014-15 and 17.46 in the treatment *Trichoderma* 7g in 2015-16.

This increase in 100 grains weight may be due to the more availability of nutrients like nitrogen and phosphorus in the rhizosphere and less losses as compared to the broadcast method. These findings are in agreement with those of Timmons *et al.* (1973) who reported less losses of fertilizer in band placement. Similar results were reported by Alam *et al.*, (1999), El-Hadi and Sheikh (1999) Meena *et al.*, (2001) who stated that *Rhizobium* inoculation significantly increased 100 seed weight and yield.

3.2.6 Germination %

The results presented in Table 4 and revealed that the maximum germination % was recorded in *Rhizobium* 12g (88.88) in 2014-15 and 89.45 in the treatment *Rhizobium* 12g in 2015-16. was significantly superior than other seed treatments indicate that has been increase germination % in *Rhizobium* 12.5gm in year 2015-16. The minimum Germination % was recorded in the treatment PSB 7g (87.00) in 2014-15 and 86.511 in the treatment *Rhizobium* 7g in 2015-16.

3.2.7 Seedling length

The results presented in Table 4 revealed that the maximum harvest index was recorded in *Rhizobium* 12g (17.33) in 2014-15 and 17.66 in the treatment *Rhizobium* 12g in 2015-16. was significantly superior than other seed treatments, indicate that has been increase in seedling length in *Rhizobium* 12.5gm+16hr in year 2015-16. The minimum Seedling length was recorded in the treatment Trichoderma 5g (13.733) in 2014-15 and 13.86 in the treatment PSB 5g in 2015-16.

3.2.8 Vigour index

The results presented in Table 4 revealed that the maximum harvest index was recorded in *Rhizobium* 12g (1537.55) in 2014-15 and 1582.36 in the treatment *Rhizobium* 12g 2015-16. was significantly superior than other seed treatments indicate that has been increase vigour index in *Rhizobium* 12. in year 2015-16. The minimum Vigour index was recorded in the treatment Trichoderma 5g (1194.8) in 2014-15 and 1203.76 in the treatment Trichoderma 5g in 2015-16 .

S.No	Characters	Plant height				Number of branch			
		30 DAS		60DAS		30 DAS		60DAS	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
		pooled	pooled	pooled	pooled	pooled	pooled	pooled	pooled
1	Tricho 5g	11.780	11.351	18.658	17.193	5.933	5.644	7.511	7.178
2	Tricho7.5g	11.417	11.211	19.104	18.161	5.822	5.667	7.622	7.378
3	Tricho 10g	11.250	10.951	19.040	18.187	5.978	5.956	7.600	7.311
4	PSB 7.5g	11.617	11.320	18.542	17.876	5.911	5.511	7.844	7.533
5	PSB 10g	12.083	11.598	19.180	18.233	5.911	5.822	7.778	7.622
6	PSB 12.5g	11.633	11.242	19.087	18.120	6.067	5.822	7.600	7.356
7	Rhizo 7.5g	11.723	11.182	18.653	17.849	6.067	5.778	7.867	7.489
8	Rhizo 10g	12.200	11.878	19.009	18.284	6.178	6.000	7.778	7.511
9	Rhizo12.5g	12.630	12.198	19.816	19.191	6.444	6.178	7.733	7.467
10	Mean	11.815	11.437	19.010	18.122	6.035	5.820	7.704	7.427
11	CV	1.590	4.344	5.000	5.589	7.954	7.303	6.426	6.712
12	F.Prob	0.000	0.000	0.199	0.028	0.234	0.057	0.800	0.727
13	S.E.M.	0.063	0.166	0.317	0.338	0.160	0.142	0.165	0.166
14	C.D. 5%	0.178	0.470	–	0.958	–	–	–	–
15	C.D. 1%	0.237	0.626	–	1.277	–	–	–	–

Table 2

Mean performance The data presented in table 2, show mean performance of 8 treatments for 13 characters. The grand mean and range for all the traits are also depicted in table 2.

Table 3

S.No	Characters	Day 50% Flowering		Number of pod/plant		Number of Seed/Pod		100 Seed Weight	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
	Treatments	pooled	pooled	pooled	pooled	pooled	pooled	pooled	pooled
1	Tricho 5g	96.667	95.222	64.111	58.65	1.367	1.444	17.096	18.078
2	Tricho7.5g	96.222	94.889	70.267	66.50	1.567	1.422	16.670	17.467
3	Tricho 10g	96.111	94.667	65.133	60.53	1.467	1.444	17.641	18.000
4	PSB 7.5g	96.333	95.000	68.133	66.31	1.533	1.511	16.946	17.667
5	PSB 10g	96.667	95.333	68.089	64.32	1.433	1.400	17.600	18.744
6	PSB 12.5g	97.000	95.222	65.289	62.27	1.400	1.311	17.874	17.744
7	Rhizo 7.5g	96.333	94.556	65.000	61.91	1.433	1.444	18.079	18.056
8	Rhizo 10g	95.556	94.111	69.578	65.60	1.600	1.511	18.784	18.722
9	Rhizo12.5g	97.778	96.000	75.044	71.86	1.567	1.444	19.324	19.267
10	Mean	96.519	95.000	67.849	64.21	1.485	1.437	17.779	18.194
11	CV	1.151	0.899	5.834	6.73	8.451	6.920	6.737	7.611
12	F.Prob	0.011	0.002	0.000	0.02	0.001	0.004	0.000	0.134
13	S.E.M.	0.370	0.285	1.320	2.39	0.042	0.033	0.399	0.462
14	C.D. 5%	1.050	0.808	3.745	3.948	0.119	0.094	1.133	-
15	C.D. 1%	1.400	1.076	4.989	10.10	0.158	0.125	1.510	-

Table 4

S.N.	Characters	BIOLOGICAL YIELD		HARVEST INDEX		Seed Yield/ Plant gm	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
	Treatments	pooled	pooled	pooled	pooled	pooled	pooled
1	Tricho 5g	25.649	24.240	42.297	43.209	10.833	10.422
2	Tricho7.5g	27.591	25.144	43.804	45.641	12.033	11.411
3	Tricho 10g	25.862	23.484	42.031	44.653	10.744	10.389
4	PSB 7.5g	27.760	25.078	42.192	44.578	11.622	11.067
5	PSB 10g	25.027	23.893	46.712	47.397	11.744	11.344
6	PSB 12.5g	26.549	24.156	39.864	42.264	10.533	10.089
7	Rhizo 7.5g	23.709	22.888	41.869	42.471	9.689	9.544
8	Rhizo 10g	25.073	23.916	44.639	45.018	11.078	10.667
9	Rhizo12.5g	26.787	25.411	44.971	45.959	12.022	11.667
10	Mean	26.001	24.246	43.153	44.577	11.144	10.733
11	CV	10.364	9.184	17.658	12.084	14.574	15.472
12	F.Prob	0.049	0.288	0.725	0.535	0.053	0.155
13	S.E.M.	0.898	0.742	2.540	1.796	0.541	0.554
14	C.D. 5%	2.549	-	-	-	-	-
15	C.D. 1%	3.396	-	-	-	-	-

Table 5

S.No	Characters	Germination %		Seedling Length		Vigour Index		Yield/ Plot kg / hectares	
		2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
	Treatments	pooled	pooled	pooled	pooled	pooled	pooled	pooled	pooled
1	Tricho 5g	87.056	86.811	13.733	13.867	1194.844	1203.761	1384.467	1415.567
2	Tricho7.5g	87.667	87.211	13.967	14.567	1225.100	1270.176	1695.000	1639.733
3	Tricho 10g	87.333	87.156	14.800	15.900	1292.833	1384.763	1644.967	1583.811
4	PSB 7.5g	87.000	86.544	14.956	14.011	1300.878	1215.329	1485.556	1234.956
5	PSB 10g	87.556	87.189	14.856	15.367	1305.956	1339.848	1593.056	1532.600
6	PSB 12.5g	88.556	87.911	14.878	14.911	1320.667	1309.636	1500.300	1424.400
7	Rhizo 7.5g	87.022	86.511	14.156	15.100	1228.455	1306.156	1536.078	1479.167
8	Rhizo 10g	88.778	87.689	15.967	16.278	1422.089	1429.715	1661.645	1596.622
9	Rhizo12.5g	88.889	89.456	17.333	17.667	1537.556	1582.364	1763.878	1696.033
10	Mean	87.762	87.386	14.960	15.296	1314.264	1337.972	1584.994	1478.099
11	CV	1.352	1.330	12.118	15.238	12.428	15.014	14.105	14.847
12	F.Prob	0.001	0.000	0.004	0.031	0.001	0.007	0.020	0.000
13	S.E.M.	0.396	0.387	0.604	0.777	54.447	66.962	74.523	73.151
14	C.D. 5%	1.123	1.099	1.715	2.205	154.509	190.025	211.483	207.590
15	C.D. 1%	1.496	1.465	2.285	2.938	205.875	253.197	281.788	276.601

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