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Standardization of Hydropriming Duration for Enhance Seed Yield and its Quality Parameters in Chickpea (*Cicer arietinum* L.)

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A B S T R A C T

The present study were carried out in the Department of Genetics and Plant Breeding, N. D. University of Agriculture and Technology, Kumarganj Faizabad during *Rabi* season 2014-15 and 2015-16 entitled "Standardization of hydropriming duration for enhance seed yield and its quality parameters in chickpea (*Cicer arietinum* L.)" The objective of the study was to standardize the hydro priming duration Seed priming is a simple and cheap method but is acceptable in different areas. In order to the effect of hydropriming treatment on germination percentage in caraway (Carum carviL.), this experiment was conducted by randomized block design (Factorial) design with three replications. The factor was including hydro priming 13(P_1), 16(P_2), and 18(P_3) hours. The results showed that the effect of hydropriming was significant on germination percentage, seedling length, and seedling vigour index. Mean comparison showed that the highest germination percentage, seedling length were achieved by P_2 and also the highest seedling dry weight and seedling vigour were achieved by P_2 and lowest germination percentage, seedling length, seedling dry weight and seedling vigour were achieved by P_1. The results of this experiment showed that hydro priming method can improve the germination percentage in field condition and lab condition.

Introduction

Chickpea (*Cicer arietinum* L.) is the most important pulse crop in India with an average yield of 1500-2000 kg/ha. Chickpea is a diploid species with a chromosome number 2n = 16. It belongs to subfamily Papilionaceae of the family Leguminaceae. It's seeds contain 16.4-31.2% protein, 3.0% fibre, 38.1-73.3% carbohydrates, 1.6-9.0% cellulose, 0.2% Ca, 0.3% P, 3.0% ash, vitamins (C and B) and minerals (Mg, Zn, K, Fe) (Huda *et al.*, 2003 and Ozer *et al.*, 2010). Combined inoculation of *Rhizobium* with *Pseudomonas striata* or *Bacillus polymyxa* and with *Bacillus megaterium* have shown increased dry matter, grain yield and phosphorus uptake significantly over the uninoculated control in legumes (Elkoca *et al.*, 2008). Phosphate solubilising bacteria (PSB) plays an important role in making phosphorus available to crop plants.

The present study was undertaken comparative study of biofertilizers and seed priming on seed yield and quality of chickpea (*Cicer arietinum* L.). 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)

Hydropriming (using distilled water with temperature of 30°C for 18 days) on chickpea germination under 3 different temperatures of 15, 25, and 38°C, coming to conclusion that no significant impact of osmopriming and hydro-priming would be found between 25 and 38°C on seed germination. The beneficial effects of osmo- and hydropriming are associated with increase in radicle and plumule lengths. Chickpea is a short-season edible grain legume grown crop, which cultivated mostly in arid and semi-arid region of the world where salinity, high temperature, rapid soil drying, and crust formation are barriers to good chickpea crop establishment. However, no study has been previously reported in the context of Iran on the effects of different osmopriming on chickpea seed germination and early seedling growth. Consequently, the aim of this study was to elucidate the effects of osmo-priming on seed emergence and early seedling growth of chickpea under the pot condition (Nascimento, 2003).

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 26.47^0 N latitude, 82.12^0 longitude and at an altitude of 113 meters above the mean sea level.

The climate of district Faizabad is semi-arid with hot summer and cold winter. Nearly 80 per cent of total rain fall is received during the monsoon the treatment details are presented in table 1.

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 plant height (cm), number of branches per plant, 50% flowering, 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), seed yield (q/ha)

Result and Discussion

Mean performance

The data presented in table 2, show mean performance of 27 treatments for 16 characters. The grand mean and range for all the traits are also depicted in table 2.

Days to 50% flowering

Scanning of data presented in table 1 indicates that hydro-priming of seed influenced the flowering period of chickpea and minimum flowering period of 96.70 and 97.61 days was associated with 13 hrs and 16 hrs hydro-priming during 2014-15 and 2015-16 respectively. During 2014-15 flowering

periods were statistically similar in 16 hrs and 18 hrs priming. While during 2015-16 similar flowering period was noted in 13, 16 and 18 hrs priming of seeds.

Days to maturity

Scanning of data presented in table 1 indicates that hydroprimied seed influenced the flowering period of chickpea. Minimum flowering period 146.5 and 145.7 days were associated with 16 hours and 18 hours hydro priming during 2014-15 and 2015-16 respectively. During 2014-15 maturity periods were statistically similar in 13, 16 and 18 hrs priming while during 2015-16 similar maturity period was noted in 13, 16, and 18 hrs priming of seeds.

Plant height (cm) at 30 DAS

Scanning of data presented in table 2 showed due to that hydropriming of seed influenced the plant height of chickpea the maximum plant height of 10.16 and 11.14 cm was associated with 16 hours priming during season first and season second respectively. During season first plant height was statistically similar in 18 hrs priming. 16 hours hydroprimed, priming seed was significantly superior to 13 and 18 hrs were recorded in season second.

Plant height (cm) at 60 DAS

Scanning of data presented in table 2 indicates that plant height of chickpea affected by hydro priming technique. Maximum plant height 18.50 and 18.13 cm was associated with 16 hrs hydro priming during 2014-15 and 2015-16 respectively. During 2014-15 plant height was statistically at par with 18 hrs priming. While during 2015-16, plant height in 16 hrs was statistically at par with 13 and 18 hrs priming of seeds.

Number of branches per plant at 30 DAS

Table 3 indicates that hydro priming of seed influenced the number of branches per plant in chickpea and maximum branches 5.97 and 6.52 was associated with 16 hrs hydro priming during 2014-15 and 2015-16 respectively. During 2014-15 numbers of branches in 16 hrs were significantly superior to 13 and 18 hrs priming. While during 2015-16 numbers of branches were significantly superior with 13 and 18 hrs primed of seeds of chickpea variety (Pant G-186).

Number of branches per plant at 60 DAS

Scanning of data presented in table 3 indicates that hydro priming of seed influenced the number of branches per plant of chickpea and maximum branches 10.20 and 10.71 were associated with 16 hrs hydro priming during 2014-15 and 2015-16 on 60 days, respectively. During 2014-15 number of branches per plant in 16 hrs was hydro priming significantly superior than 13 and 18 hrs. While during 2015-16 number of branches in 16 hrs were significantly superior with 13 hrs priming of seeds.

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).

Number of pods per plant

Scanning of data in table 4 indicates that hydro priming influenced the number of pods per plant of chickpea and maximum pod 76.69 and 72.19 were associated with 16 hour hydro priming during 2014-15 and 2015-16 respectively. During 2014-15 numbers of pods per pod in 16 hrs were significantly superior to 13 and 18 hrs priming.

Table.1

S.N.	Characters / Treatments	Days to 50 (%) flowering						Days to maturity					
		Rabi 2014-15			*Rabi* 2015-16			*Rabi* 2014-15		*Rabi* 2015-16			
		HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.
T_1	*Trichoderma* 5g	94.00	102.33	96.67	92.67	101.33	96.33	150.33	148.00	147.33	150.00	145.67	147.00
T_2	*Trichoderma* 7.5g	91.00	105.67	97.00	94.00	98.13	99.67	151.67	149.67	145.33	150.67	149.33	142.00
T_3	*Trichoderma* 10g	95.67	97.00	94.33	106.33	99.00	104.00	146.33	147.33	144.67	144.33	147.67	143.67
T_4	PSB 7.5g	101.67	94.33	98.67	101.67	100.33	97.67	144.67	146.00	146.67	144.33	144.67	144.67
T_5	PSB 10g	97.67	97.33	102.00	102.00	96.33	99.00	145.00	143.67	144.67	144.67	144.67	146.00
T_6	PSB 12.5g	104.67	96.00	106.00	99.67	93.67	104.33	153.67	149.67	153.00	151.33	147.67	148.67
T_7	*Rhizobium* 7.5g	96.67	99.33	94.67	96.67	94.00	105.33	145.33	143.33	149.00	146.67	144.00	148.67
T_8	*Rhizobium* 10g	93.33	98.00	95.33	94.00	97.67	105.00	141.67	143.67	149.33	142.33	145.00	146.00
T_9	*Rhizobium* 12.5g	95.67	93.33	100.33	96.33	98.00	100.67	143.33	148.00	146.67	141.00	144.00	144.67
Grand Mean		**96.70**	**98.15**	**98.33**	98.15	**97.61**	**101.33**	**146.89**	**146.59**	**147.41**	**146.15**	145.85	**145.70**
SEM			**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**
Due to Treatment		0.972	2.759	3.677	1.397	3.964	5.284	0.548	1.554	2.072	0.721	2.046	2.727
Due to Priming		0.561	1.593	2.123	0.807	2.288	3.050	0.316	0.897	1.196	0.416	1.181	1.574
Due to Interaction PxT		1.684	4.778	4.778	2.420	6.865	9.151	0.949	2.692	3.588	1.249	3.543	4.723

Table.2

S.N.	Characters / Treatments	Plant height (cm) on 30 days						Plant height (cm) on 60 days					
		Rabi 2014-15			*Rabi* 2015-16			*Rabi* 2014-15			*Rabi* 2015-16		
		HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.
T_1	*Trichoderma* 5g	7.68	7.07	9.21	7.68	7.03	7.23	15.99	17.16	18.57	15.28	17.06	17.97
T_2	*Trichoderma* 7.5g	6.40	7.77	9.82	6.87	10.17	10.01	18.81	19.30	18.70	18.00	18.73	18.30
T_3	*Trichoderma* 10g	7.93	8.92	10.61	9.77	11.36	8.88	17.78	15.55	15.79	18.11	14.98	15.49
T_4	PSB 7.5g	7.21	10.00	8.67	8.12	9.91	9.23	17.69	16.03	16.30	16.87	15.40	16.03
T_5	PSB 10g	8.50	9.70	9.84	10.43	12.20	9.63	16.63	18.51	17.73	16.13	17.84	15.57
T_6	PSB 12.5g	9.49	8.78	8.80	9.39	9.80	9.00	20.42	17.80	16.24	19.90	17.07	17.64
T_7	*Rhizobium* 7.5g	7.57	10.88	10.58	11.97	11.29	12.46	18.41	18.99	17.20	17.83	16.95	17.50
T_8	*Rhizobium* 10g	8.03	13.14	7.17	7.97	13.49	7.53	16.74	19.90	18.67	15.52	20.67	16.90
T_9	*Rhizobium* 12.5g	9.02	15.17	6.83	9.25	15.02	8.17	17.10	23.29	18.47	16.77	24.45	19.04
Grand Mean		**7.98**	**10.16**	**9.06**	9.05	**11.14**	**9.13**	**17.73**	**18.50**	**17.52**	**17.16**	18.13	**17.16**
SEM			**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**
Due to Treatment		0.372	1.055	1.407	0.487	1.382	1.842	0.576	1.633	2.176	0.563	1.598	2.131
Due to Priming		0.215	0.609	0.812	0.281	0.798	1.064	0.332	0.943	1.257	0.325	0.923	1.230
Due to Interaction PxT		0.644	1.828	2.437	0.844	2.394	3.191	0.997	2.828	3.770	0.976	2.768	3.690

Table.3

S.No.	Characters / Treatments	Number of branches/plant on 30 days						Number of branches/plant on 60 days					
		Rabi 2014-15			*Rabi* 2015-16			*Rabi* 2014-15			*Rabi* 2015-16		
		HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.
T_1	*Trichoderma* 5g	4.87	5.77	4.53	4.87	6.80	4.40	8.47	8.60	8.07	8.60	10.27	8.67
T_2	*Trichoderma* 7.5g	4.60	5.67	4.27	4.13	5.53	5.13	8.07	9.60	8.93	9.27	8.63	9.70
T_3	*Trichoderma* 10g	5.27	4.60	5.00	3.53	6.80	4.27	7.93	7.87	11.20	8.00	7.87	10.80
T_4	PSB 7.5g	4.73	5.67	5.40	4.07	5.47	5.40	8.93	9.37	8.40	9.67	10.27	8.67
T_5	PSB 10g	4.77	6.00	6.13	5.17	7.07	6.13	10.20	11.47	9.53	8.80	11.93	8.20
T_6	PSB 12.5g	4.67	5.40	5.53	4.00	5.73	4.40	8.80	9.13	10.40	7.73	10.60	11.33
T_7	*Rhizobium* 7.5g	5.60	5.40	5.03	4.80	5.80	6.40	10.07	8.53	9.27	11.00	9.47	10.07
T_8	*Rhizobium* 10g	4.63	7.07	4.53	4.60	7.13	4.80	9.53	12.67	10.47	8.40	12.43	9.00
T_9	*Rhizobium* 12.5g	6.53	8.13	5.00	5.93	8.33	4.87	8.87	14.53	8.40	9.47	14.97	13.60
Grand Mean		**5.07**	**5.97**	**5.05**	**4.57**	6.52	**5.09**	**8.99**	**10.20**	**9.41**	**8.99**	10.71	**10.00**
SEM			**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**
Due to Treatment		0.264	0.748	0.997	0.223	0.634	0.845	0.395	1.121	1.495	0.434	1.231	1.640
Due to Priming		0.152	0.432	0.576	0.129	0.366	0.488	0.228	0.647	0.863	0.250	0.710	0.947
Due to Interaction PxT		0.457	1.295	1.727	0.387	1.097	1.463	0.685	1.942	2.589	0.751	2.131	2.841

Table.4

S. N.	Characters / Treatments	Number of pods/plant						Number of seeds/pod					
		Rabi 2014-15			*Rabi* 2015-16			*Rabi* 2014-15			*Rabi* 2015-16		
		HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.
T1	*Trichoderma* 5g	58.73	73.07	60.27	66.67	77.53	50.40	1.53	1.33	1.33	1.40	1.40	1.20
T2	*Trichoderma* 7.5g	59.73	69.93	71.67	47.80	64.00	57.13	1.60	1.73	1.40	1.00	1.40	1.53
T3	*Trichoderma* 10g	64.07	77.93	59.40	73.97	70.73	62.53	1.40	1.60	1.40	1.40	1.40	1.00
T4	PSB 7.5g	57.53	72.67	73.73	53.00	68.97	72.90	1.27	1.47	1.80	1.28	1.60	1.60
T5	PSB 10g	71.53	75.67	66.33	58.30	74.57	69.37	1.40	1.60	1.47	1.60	1.60	1.20
T6	PSB 12.5g	59.47	66.93	68.20	66.67	59.27	70.33	1.40	1.47	1.47	1.40	1.40	1.40
T7	*Rhizobium* 7.5g	54.00	74.87	62.33	57.43	68.30	57.97	1.27	1.27	1.73	1.20	1.20	1.60
T8	*Rhizobium* 10g	61.27	83.53	74.40	76.67	79.27	68.43	1.73	1.60	1.33	1.40	1.40	1.00
T9	*Rhizobium* 12.5g	71.93	95.57	71.27	65.23	87.10	73.80	1.40	1.87	1.47	1.40	1.67	1.40
Grand Mean		**62.03**	**76.69**	**67.51**	**62.86**	72.19	**64.76**	**1.44**	**1.55**	**1.49**	**1.34**	1.45	**1.33**
SEM			**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**
Due to Treatment		1.535	4.355	5.805	2.770	7.859	10.476	0.047	0.134	0.179	0.052	0.147	0.195
Due to Priming		0.886	2.514	3.352	1.599	4.538	6.049	0.027	0.077	0.103	0.030	0.085	0.113
Due to Interaction PxT		2.659	2.659	10.055	4.798	13.613	18.146	0.082	0.232	0.309	0.089	0.054	0.338

Table.5

S. N.	Characters / Treatments	Biological yield (g)						Harvest index					
		Rabi 2014-15			*Rabi* 2015-16			*Rabi* 2014-15			*Rabi* 2015-16		
		HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.
T1	*Trichoderma* 5g	48.67	58.60	50.33	46.57	53.50	45.53	31.52	39.65	31.19	31.19	30.08	25.30
T2	*Trichoderma* 7.5g	52.53	56.53	51.44	45.60	50.90	52.97	38.39	38.37	26.07	30.49	27.39	32.59
T3	*Trichoderma* 10g	56.40	53.44	46.93	47.93	51.57	51.77	27.66	30.77	31.77	34.70	30.99	34.24
T4	PSB 7.5g	44.53	63.47	50.00	49.03	56.13	60.30	41.24	27.00	33.66	37.37	36.45	31.19
T5	PSB 10g	44.63	59.87	52.10	47.00	49.37	47.73	30.65	35.85	41.94	42.71	33.06	30.14
T6	PSB 12.5g	53.33	50.57	55.80	57.47	50.00	49.13	27.38	26.94	36.29	30.24	35.41	27.81
T7	*Rhizobium* 7.5g	61.73	48.03	52.87	48.70	59.47	52.10	32.81	28.06	31.45	33.34	30.03	38.22
T8	*Rhizobium* 10g	44.13	53.63	42.70	54.80	61.37	55.50	45.93	46.15	37.63	29.04	38.80	30.40
T9	*Rhizobium* 12.5g	49.20	75.73	55.40	58.23	64.00	54.00	41.41	42.78	33.41	33.56	44.56	38.56
Grand Mean		**50.57**	**57.76**	**50.84**	50.59	**55.14**	**52.11**	**35.22**	**35.06**	**33.71**	33.63	**34.08**	**32.05**
SEM			**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**
Due to Treatment		1.743	4.944	6.590	1.762	4.997	6.662	1.461	4.145	5.526	1.921	5.450	7.265
Due to Priming		1.006	2.854	3.805	1.017	2.885	3.846	0.844	2.393	3.190	1.109	3.147	4.195
Due to Interaction PxT		3.018	8.563	11.414	3.051	8.656	11.538	2.531	7.180	9.571	3.328	9.440	12.584

Table.6

S. N.	Characters / Treatments	Seed yield/Plant (g)						Seed yield (Kg/ha)					
		Rabi 2014-15			*Rabi* 2015-16			*Rabi* 2014-15		*Rabi* 2015-16			
		HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.
T1	*Trichoderma* 5g	15.21	23.20	15.67	14.40	16.03	11.50	1741.27	1607.53	1545.07	1772.00	1450.63	1455.03
T2	*Trichoderma* 7.5g	20.13	21.67	13.31	13.87	13.97	16.83	1544.63	1549.03	1720.33	1581.53	1860.83	1746.90
T3	*Trichoderma* 10g	15.68	16.41	14.90	16.63	15.97	17.63	1747.67	1845.90	1756.93	1825.10	2005.50	1596.67
T4	PSB 7.5g	18.20	16.90	16.80	18.23	20.03	18.83	1682.07	1779.23	2142.40	1433.50	1740.73	1627.00
T5	PSB 10g	13.63	21.30	21.73	20.07	16.30	14.30	1834.97	2138.57	1728.83	1625.97	2165.47	1761.73
T6	PSB 12.5g	14.57	13.63	19.90	17.33	17.77	13.63	1655.10	1987.47	1813.43	2149.83	1692.70	1651.33
T7	*Rhizobium* 7.5g	20.17	13.40	16.70	16.40	17.70	19.93	2137.23	2017.27	2355.73	1474.77	1757.37	1849.07
T8	*Rhizobium* 10g	20.13	24.73	16.00	15.90	23.57	16.97	2453.03	2284.63	1650.37	1610.67	2247.07	1463.70
T9	*Rhizobium* 12.5g	20.05	32.40	18.37	18.97	28.53	20.30	1752.87	2579.97	2046.47	1755.77	2477.03	2016.70
Grand Mean		**17.53**	**20.40**	**17.04**	16.87	**18.87**	**16.66**	**1838.76**	**1976.62**	**1862.17**	1692.13	**1933.04**	**1685.35**
SEM			**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**
Due to Treatment		0.648	1.839	2.451	0.875	2.482	3.309	50.371	142.897	190.482	41.339	117.274	156.326
Due to Priming		0.374	1.062	1.415	0.505	1.433	1.910	29.081	82.502	109.975	23.867	67.708	90.255
Due to Interaction PxT		1.123	3.185	4.245	1.515	4.299	5.731	87.244	247.505	329.924	71.600	203.124	270.765

Table.7

S. N.	Characters / Treatments	100-Seed weight (g)						Germination (%)					
		Rabi 2014-15			*Rabi* 2015-16			*Rabi* 2014-15		*Rabi* 2015-16			
		HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.
T1	*Trichoderma* 5g	17.88	18.91	18.60	17.80	20.90	19.05	86.33	91.42	87.25	85.19	88.37	85.20
T2	*Trichoderma* 7.5g	21.10	18.75	18.53	20.60	18.93	18.61	89.50	86.08	85.50	88.07	84.83	87.57
T3	*Trichoderma* 10g	18.47	20.49	19.02	18.23	18.37	20.70	87.75	87.58	86.75	85.97	85.87	89.03
T4	PSB 7.5g	21.10	18.91	18.81	21.03	20.90	19.10	87.92	87.42	86.75	84.93	90.23	85.31
T5	PSB 10g	17.30	19.93	20.40	20.90	19.17	21.20	89.50	89.33	87.00	86.37	87.90	90.01
T6	PSB 12.5g	19.16	19.89	19.37	20.73	20.07	21.53	88.75	87.25	86.18	89.90	88.75	91.20
T7	*Rhizobium* 7.5g	21.50	17.73	19.75	19.50	20.10	20.90	86.00	85.83	88.42	91.70	85.55	88.03
T8	*Rhizobium* 10g	19.52	20.28	17.89	19.70	19.20	16.88	89.75	88.92	85.83	89.20	87.38	86.09
T9	*Rhizobium* 12.5g	16.93	20.10	17.50	20.20	20.47	19.00	87.75	88.25	87.40	85.53	88.60	85.67
Grand Mean		**19.22**	**19.45**	**18.87**	19.86	**19.79**	**19.66**	**88.14**	**88.01**	**86.79**	**87.43**	**87.50**	**87.57**
SEM			**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**
Due to Treatment		0.360	1.020	1.360	0.439	1.245	1.659	0.646	1.833	2.443	0.701	1.989	2.651
Due to Priming		0.208	0.589	0.785	0.253	0.719	0.958	0.373	1.058	1.410	0.405	1.148	1.531
Due to Interaction PxT		0.623	1.767	2.355	0.760	2.156	2.873	1.119	3.174	4.231	1.014	3.445	4.52

Table.8

S. N.	Characters / Treatments	Seedling length (cm)						Seedling vigour index					
		Rabi 2014-15			*Rabi* 2015-16			*Rabi* 2014-15		*Rabi* 2015-16			
		HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.	HP13 Hrs.	HP16 Hrs.	HP18 Hrs.
T1	*Trichoderma* 5g	14.58	19.73	16.79	13.47	16.80	15.27	1260.14	1804.11	1464.62	1147.60	1485.34	1300.43
T2	*Trichoderma* 7.5g	16.39	15.73	13.82	15.10	19.83	13.97	1467.06	1355.56	1182.33	1329.10	1681.69	1223.81
T3	*Trichoderma* 10g	12.63	16.85	15.10	17.27	16.17	16.17	1107.89	1476.55	1310.49	1484.45	1388.06	1439.96
T4	PSB 7.5g	17.98	17.23	16.64	18.53	18.03	19.10	1580.63	1506.26	1443.65	1575.09	1627.05	1629.43
T5	PSB 10g	18.06	16.73	11.93	16.07	16.63	16.33	1617.28	1495.69	1037.27	1387.71	1461.33	1471.30
T6	PSB 12.5g	13.17	19.79	13.47	14.59	15.37	14.87	1168.47	1728.09	1160.20	1312.06	1364.39	1355.97
T7	*Rhizobium* 7.5g	17.62	15.59	16.81	15.90	19.60	20.17	1513.28	1337.05	1485.49	1456.95	1677.37	1775.68
T8	*Rhizobium* 10g	16.13	17.33	18.40	16.63	19.50	18.00	1446.51	1541.45	1579.08	1482.71	1705.81	1549.23
T9	*Rhizobium* 12.5g	17.21	18.21	21.97	15.50	20.67	19.93	1508.11	1608.00	1920.92	1325.86	1832.85	1707.87
Grand Mean		**15.97**	**17.47**	**16.10**	**15.90**	**18.07**	**17.09**	**1407.71**	**1539.20**	**1398.23**	**1389.06**	**1580.43**	**1494.85**
SEM			**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**		**CD 5%**	**CD 1%**
Due to Treatment		0.424	1.203	1.603	0.364	1.032	1.375	39.189	111.175	148.197	35.869	101.756	135.641
Due to Priming		0.245	0.694	0.926	0.210	0.596	0.794	22.626	64.187	85.561	20.709	58.749	78.313
Due to Interaction PxT		0.734	2.083	2.777	0.630	1.787	2.382	67.877	192.561	256.684	62.126	176.247	234.938

Treatments used in this study

Treatment No.	Description
P_1	Hydro priming with distilled water 13 hrs
P_2	Hydro priming with distilled water 16 hrs
P_3	Hydro priming with distilled water 18 hrs
T_1	*Trichoderma* 5 gm
T_2	*Trichoderma* 7.5 gm
T_3	*Trichoderma* 10 gm
T_4	PSB 7.5 gm
T_5	PSB10 gm
T_6	PSB 12.5 gm
T_7	*Rhizobium* 7.5 gm
T_8	*Rhizobium*10 gm
T_9	*Rhizobium*12.5 gm

While during 2015-16 number of pods per plant in 16 hrs was significantly superior to 13 and18 hrs priming of seeds.

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.

Number of seeds per pod

Revealed table 4 hydro priming of seed influenced the number of seeds per pod in chickpea and maximum seeds per pod 1.55 and 1.45 were associated with 16 hours hydro priming during 2014-15 and 2015-16 both seasons, respectively.

During 2014-15 numbers of seeds per pod in 16 hrs were statistically similar with 13 and 18 hrs priming. Besides during 2015-16 numbers of seeds per pod in 16 hrs were statistically similar with 13 and18 hrs priming of seeds. 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).

Biological yield per plant (g)

Scanning of data presented in table 5 indicates that hydro priming of seed influenced the biological yield per plant of chickpea and maximum biological yield per plant 57.76 g and 55.14 g were associated with 16 hours hydro priming during *Rabi* 2014-15 and 2015-16, respectively. During first season and second season biological yield per plant for 16 hrs was significantly superior to 13 and 18 hrs priming period.

Harvest index

Scanning of data presented in table 5 indicates that hydro priming of seed influenced the harvest index of chickpea and maximum harvest index 35.2 and 34.08 were associated with 13 hours and 16 hours hydro priming during 2014-15 and 2015-16, respectively.

Seed yield per plant (gm)

Scanning of data presented in table 6 indicates that hydro priming of seed influenced the seed yield per plant of chickpea and the maximum seed yield per plant 20.40 and 18.87 were associated with 16 hours hydro priming duration in both years. During first year seed

yield per plant for 16 hrs was significantly superior to 13 and 18 hrs priming time. While during second year seed yield per plant for 13 hrs priming time was significantly superior to 16 and18 hrs priming duration.

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).

Seed yield (Kg/ha)

The maximum seed yield 1976.62 and 1933.04 (Kg/ha) were associated with 16 hours hydropriming during both period respectively. During 2014-15 seed yield (Kg/ha) for 16 hrs was significantly superior to 13 and 18 hrs priming time. While during 2015-16 Seed yield (Kg/ha) in16 hrs was significantly superior than 13 and18 hrs priming period for chickpea seed crop production

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.

100-seed weight (g)

Revealed of data presented in table 7 indicates that hydro priming of seed influenced the 100-seed weight of chickpea. The maximum 100-seed weight 19.45 and 19.86 g were associated with 16 and 13 hours hydro priming during 2014-15. During 2014-15, 100-seed weight in16 hrs was statistically similar with 13 hrs and 18 hrs priming. However during 2015-16 similar 100 -seed weight was statistically similar in 13, 16 and 18 hrs priming. Period for above mentioned chapter

Germination %

During 2014-15 germination in 13 hrs was statistically similar in 16 and 18 hrs priming. While during 2015-16 germination were statistically similar in 13 and16 hrs priming of seeds

Seedling length

Table 8 data indicates that hydro priming of seeds influenced the seedling length of chickpea and maximum seedling length 17.47 cm and 18.07 cm were associated with 16 hours hydro priming during 2014-15 and 2015-16, respectively. During 2014-15 seedling length for 16 hrs significantly superior than 13 and 18 hrs priming. While during 2015-16 seedling length cm in 18 hrs was significantly superior in 13 and16 hrs priming of seeds.

Vigour index

Scanning of data presented in table 8 showed that hydro priming technique seed influenced the vigour index of chickpea crop seed and maximum vigour index 1539.2 and 1580.4 were associated with 16 hrs hydropriming during both season. Vigour index seed quality parameters for 16 hrs were significantly superior to 13 and 18 hrs priming period for first and second year.

From the present study it was concluded that Seed priming has been used to improve germination, reduce seedling emergence time, and improve stand establishment and yield. The beneficial effects of priming have been

demonstrated for many field crops. It is the best solution of germination related problems especially when crops are grown under unfavorable conditions. Many priming techniques have been evolved which are being utilized in many crops now days. It can enhance rates and percentage of germination and seedling emergence which ensure proper stand establishment under a wide range of environmental conditions.

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