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COMPARATIVE STUDIES ON EFFECT OF SEED ENHANCEMENT TREATMENTS ON VIGOUR AND FIELD EMERGENCE OF DESI AND KABULI CHICKPEA (*CICER ARIETINUM* L.)

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ABSTRACT
A study was conducted to assess the comparative effect of seed enhancement treatment on seed vigour, abnormal seedling, and field emergence of desi and kabuli type of chickpea (*Cicer arietinum* L.). Desi cultivar Pusa 256, and Kabuli cultivar Pusa1053, each of fresh, 2yrs old and 4 yrs old lots were taken for seed enhancement treatments viz; osmopriming, halopriming, fungicidal, botanical and polymer coating alone and in combination with thiram and neemoil. It was observed that seed treatment with thiram alone or in combination with polymer (PVP or PEM) significantly enhances germination and field performance. The indirect test for seed vigour i.e. Electrical Conductivity (EC) test was also conducted and observed that it was very significantly correlated with first count, vigour index I and II and field emergence. The storage studies under ambient conditions indicated that desi variety maintained satisfactory germination and field performance upto 2 years while kabuli variety suitable for sowing in maximum upto subsequent year stored under ambient condition.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the largest produced food legume in South Asia and the 3rd largest produced food legume globally after common bean and field pea. It is small herbaceous plant with deep rooted system. There are two type of chickpea; *viz*. desi and kabuli, grown in the world recognized visually by seed coat colour and seed size. The desi types is characterized by small seed size and thick seed coat with pale to dark brown in colour, where as kabuli type is large seed size cream in colour with thick seed coat. Chickpea is grown in more than 50countries with 89.7% production area in Asia alone. India is the largest chickpea producing country accounting for 64% of the global chickpea production (Gaur *et al.,* 2010). It is an important pulse crop in India sharing 29.7 and 38% of the total area and production of total pulses, respectively (Chand *et al*., 2010). Chickpea is good source of dietery protein, carbohydrate, unsaturated fatty acid, ditery fibre, mineral and B-carotene (Jukanti *et al*., 2012). The kabuli type commands a higher price owing to its larger seed size, and the desi type is smaller in size and is relatively cheaper. It is mainly grown in dry or rainfed area, where patchy plant stand often result from failure of crop to emerge quickly and uniformly. The planting value of seed is one of the key factors for proper plant establishment and performance, particularly under moisture stress conditions. Use of quality seed alone has been reported to improve productivity in chickpea from 15-20 percent. Pre-sowing seed treatment including chemical, polymer coating, botanical and priming treatments are known to improve seed performance. Quick and synchronized germination is desirable to set crop successfully in order to compete with weed species and better seed performance. Harris *et al*. (1999) have reported seed priming as one of the important practices which ensures rapid and uniform germination under adverse environmental conditions. Treating the seed before sowing with fungicide prevent fungal invasion particularly in young seedlings. The beneficial effect of thiram treatment is attributed to its role in reducing the fungal infection, control of pre and post mortality (Solenke *et al.,* 1997) on the germinating seeds. The improvement in field emergence and final plant stand due to royalflo is attributed to its thiram base (Shinde, 2009). Seed priming with 2 per cent $CaCl_2$ solution enhanced daily germination index, coefficient of velocity of germination, seed germination, seedling root length, shoot length, Seedling Vigour Index-I, seedling dry weight and Seedling Vigour Index -II of hybrid caster(Jamadar and Chandrashekhar,2015). The seed priming treatments GA_3 (100 ppm) and hydration with water with Bavistin (3.0 g/kg) found effective for improvement in dry matter content of seedling in soybean variety JS-9305 (Agawane and Parhe,

2015). The effects of seed coating with different polymeric formulations in general deteriorate at slower pace as manifest in high germination percentage (Kumar *et al*., 2004). The effect of seed treatment with powdered neem and neem oil formulations suppressed nematode population growth and increased grain yield significantly in chickpea. The study was undertaken to find most appropriate seed enhancement treatment for better field performance and performance of stored seed of desi and kabuli type chickpea under ambient condition.

MATERIALS AND METHODS

Seeds and treatment materials

The seed material for study constituted of four seed lots of two years and four years old of Desi cultivar Pusa 256 and Kabuli cultivar Pusa 1053 each. The two years old seed lots were available from Division of Seed Science and Technology, Indian Agricultural Research Institute, New Delhi and four years old lots were collected from Pulse Laboratories, Indian Agricultural Research Institute, New Delhi. Seeds selected for experiment were bold and free from any damage. The polymer polyvinyl pyrrolidane (PVP) and polyethyl methyl acrylate (PEM) were obtained from Division of Agriculture Chemical, Indian Agricultural Research Institute, New Delhi

Seed treatments

The treatment T_2 *i.e.* Osmo-priming was done by polyethylene glycol (PEG8000) solution containing 25g PEG dissolved in 100ml water. The eight replicate of 50 seeds placed in PEG saturated two layers of filter paper in petri plate for 48 hrs at 20°C. Similarly, treatment T_3 *i.e.* halo-priming was done by taking 2 percent solution of KNO_3 instead of PEG. Primed seeds were rehydrated for next 24 hrs at room temperature before sowing. Fungicidal treatment T_4 and botanical seed treatment T_5 were done with thiram @ 2g per kg of seed and neem oil @ 4ml per kg of seed respectively. The details of seed treatments are given in table 1. For preparation of seed coating formulation 4.0g of each polyvinyl pyrrolidone (PVP) and polyethyl methyl acrylate (PEM) and mixture of 0.10g sodium lauryl sulphate (act as binder) and 0.15g Sodium lingosulfonate (act as surfactant) were added to water and a wet grind was prepared individually for both the polymers. These polymer alone @ 4.0ml per kg and in combination with thiram and neem oil were applied to seed by seed coating machine.

Germination (%)

Eight replicate of 50 seed each variety and each treatments were tested for germination studies as per ISTA method (Ann; 2004). In this method, seed were placed between two layer of wet germination paper which was then rolled and wrapped in wax sheet and placed in germinator in an upright position under 20 ± 1 C and 95 % RH for 8 days. On the day of final count i.e. 8th day, it were evaluated for Normal seedling, Abnormal seedling, Dead and Hard seed.

Abnormal seedling (%)

The entire damaged, decayed and deformed seedlings which were not able to produce normal seedling were counted and considered as abnormal seedling.

Total seedling length (cm)

Ten normal seedlings were taken at random from each replication and shoot and root lengths of each seedling were measured. The mean value was taken for analysis.

Seedling dry weight (mg)

Ten normal seedlings were taken at random from each replication for observing seedling length were dried in hot air oven maintained at 70 ± 1C for 48 hr and cooled in dessicators. The mean value of seedling dry weight was taken for analysis.

Vigour index I and II

The vigour indices were computed by adopting the method of Abdul Baki and Anderson (1973) by using following formula:

Vigour Index I = Germination (%) * Total Seedling Length (cm)

Vigour Index II = Germnation (%) * Seedling Dry Weight (mg)

Field emergence (FE)

Field emergence was estimated by sowing 100 seeds in 4 replications in the field. Observations were recorded on alternate day till 30th day of sowing. The emergence was expressed as percentage of seedling emergence.

Electrical conductively (EC)

Four replicate of 50 seeds were soaked in 250mL of deionized water for 24 hr. Seed leachate was collected and conductivity was measured using Elico Conductivity Bridge. EC of distilled water is taken as control. The above operation was conducted at 200°C temperature.

The conductivity per gram of seed weight for each replicate was calculated after accounting for the background conductivity of original water and average of the four replicates using the following formula;

$$\text{Conductivity } (\mu\text{mhos/cm/g}) = \frac{\text{Conductivity reading - Background reading}}{\text{Weight of replicate (g)}}$$

Statistical analysis

The data from laboratory experiment were collected by adopting complete randomized design (CRD), while data collected from field experiment were through Random block design (RBD) as prescribed by Panse and Sukhatme (1985). The data was analysed using the softwere SPSS10.0.

RESULTS AND DISCUSSION

The experiment was undertaken keeping in view multiple objectives in mind as the main aim was to see the differential pattern of loss in vigour of desi and kabuli chickpea stored under ambient condition and effect of seed enhancement treatment on field performance.

As perusal of germination test data of fresh seed lots presented in Table 2 revealed that both desi and kabuli variety *i.e.* Pusa 256 and Pusa 1053 had more than 90 percent germination. However, it was higher in desi type chickpea. This is largely because desi is basically a semi tropic crop therefore, suiting

Table 1: Details of seed enhancement treatments on chickpea

S.N.	Treatments	Dosage
1	Control	-
2	Osmo-priming	25 % Solution (w/v)
3	Halo-priming	2 % Solution (w/v)
4	Thiram	2.5 g/Kg
5	Neem oil	4 ml/Kg
6	Polymer(PVP)	4ml/Kg
7	Polymer(PVP) + Thiram	4ml/Kg + 2.5 g/Kg
8	Polymer(PVP) + Neem oil	4ml/Kg + 4 ml/Kg
9	Polymer(PEM)	4 ml/Kg
10	Polymer(PEM) + Thiram	4ml/Kg + 2.5 g/Kg
11	Polymer(PEM) + Neem oil	4ml/Kg + 4 ml/Kg

Table 2: Mean table of initial vigour parameters of freshly harvested seed

Type	Variety	Germination (%)	abnormal seedling	Seedling length (cm)
Desi	Pusa 256	95	3	20.4
Kabuli	Pusa1053	92	5	16.9

Table 2: Cont.....

Type	Seedling dry weight(mg)	Vigour indexI	Vigour II index	Field emergence (%)
Desi	528	1937	50203	91
Kabuli	645	1554	59340	87

more to Indian conditions where as kabuli type being a temperate crop. In the two year old seed lot, loss of germination was more in kabuli type. The mean germination of Pusa 256 and Pusa 1053 were 88.3 and 74.5 respectively (Table 3). The same trends of loss in germination were followed in four year old seed lots as presented in Table 4. In the fresh seed lots, because of higher value of most of vigour parameters, the effect of seed enhancement treatment was not significant. But in the two year and four year old seed lots, thiram alone or in combination with polymers improved the germination significantly. The comparative effectiveness of treatment was more pronounced in Kabuli type.

The proportion of abnormal seedling in the fresh seed lot of Kabuli type *Viz*. Pusa 1053 was more than Desi types *Viz*. Pusa 256. On ageing, the rate of increased in number of abnormal seedling was much faster in kabuli lot. It was observed that in the fresh, two year old and four year old lot the number of abnormal seedling were 5, 12 and 14 respectively, where as in desi type it were 3, 5 and 8 respectively. The effects of seed enhancement treatment on number of abnormal seedling across the treatment were not effective very much.

The vigour index I and II decreases very significantly on ageing. This was primarily due to decrease in germination percent. As it had been observed that in two year and four year old seed lot in comparison to fresh lot loss in germination was much higher than seedling length and seedling dry weight. Pooled data revealed that enhancement treatment increases vigour index I and II significantly.

The field emergence data of fresh seed lots revealed that desi variety *viz*. Pusa 256 had more than 90 percent germination.

Table 3: Effect of seed enhancement treatments on the performance of Two year old Desi and Kabuli chickpeas

Treatments	Varieties														
	Pusa 256 (Desi Type)							Pusa 1053 (Kabuli Types)							
	Germination	Abnormal seedling	Seedling Length	Seedling Dry Wt	Vigour Index I	Vigour Index II	Field Emergence	Germination	abnormal seedling	Seedling Length	Seedling Dry Wt	Vigour IndexI	Vigour Index II	Field Emergence
Control	86	5	18.0	510	1548	43860	81	70	12	16.5	640	1155	44800	35
Osmopriming	87	5	18.5	512	1609	44544	82	69	14	16.5	651	1138.5	44919	30
Halopriming	88	6	18.5	511	1628	44968	82	69	13	16.25	648	1121.25	44712	28
Thiram	90	4	19.0	520	1710	46800	89	78	9	17.0	655	1326	51090	48
Neemoil	89	6	18.2	515	1624	45835	83	75	11	16.7	646	1256.25	48450	40
PVP	86	6	18.0	510	1548	43860	80	72	12	16.2	641	1170	46152	39
PVP + Thiram	91	4	19.0	522	1729	47502	88	79	10	17.0	649	1343	51271	46
PVP + Neemoil	89	5	18.5	517	1646	46013	81	78	12	16.7	647	1306.5	50466	42
PEM	87	6	18.0	512	1566	44544	83	74	14	16.4	639	1213.6	47286	41
PEM + Thiram	90	4	19.0	519	1710	46710	88	79	10	16.9	648	1335.1	51192	47
PEM + Neemoil	89	6	18.7	517	1668	46013	84	77	11	16.7	645	1285.9	49665	43
Mean	88.3	5.1	18.5	515	1635.2	45513	83.7	74.5	11.6	16.6	646.2	1241.0	48182	39.9
CD (P=0.05)	3.0	0.2	0.7	NS	56.4	1574.1	2.6	2.3	0.4	NS	NS	38.0	1399.9	1.5
SEM	1.03	0.06	0.25	4.65	19.12	533.58	0.87	0.79	0.14	0.19	10.15	12.88	474.5	0.50
CV	2.02	1.91	2.32	1.56	2.02	2.03	1.80	1.83	2.10	2.02	2.72	1.80	1.71	2.17

Table 4: Effect of seed enhancement treatments on the performance of four year old Desi and Kabuli chickpeas

Treatments	Varieties Pusa 256 (Desi Type) Germination	abnormal seedling	Pusa 1053 (Kabuli Types) Seedling length	Seedling dry Wt	Vigour index I	Vigour index II	Field Emergence	Germination	abnormal seedling	Seedling length	Seedling Dry wt.	Vigour index I	Vigour index II	Field emergence
Control	81	8	16.5	452	1336	36612	74	65	14	16.0	637	1040	41405	14
Osmopriming	85	9	16.5	492	1406	41820	75	67	17	16.0	650	1075	43550	8
Halopriming	87	8	16.9	471	1474	40977	82	67	15	16.4	640	1102	42880	19
Thiram	87	7	17.2	472	1500	41064	86	65	16	16.7	632	1088	41080	25
Neemoil	84	9	16.2	466	1360	39144	72	62	15	15.7	638	973	39556	10
PVP	83	9	16.1	479	1340	39757	72	60	16	15.6	641	939	38460	17
PVP + Thiram	86	7	16.9	462	1453	39732	84	57	14	16.4	643	934	36651	37
PVP + Neem oil	85	9	16.1	479	1372	40715	82	56	15	16.6	643	932	36008	4
PEM	85	9	16.6	453	1411	38505	82	58	14	16.7	617	968	35786	10
PEM + Thiram	87	8	16.6	453	1448	39411	86	59	17	16.4	631	972	37229	16
PEM + Neem oil	82	8	16.5	446	1357	36572	79	56	17	16.6	631	932	35336	12
Mean	84.7	8.2	16.5	465.9	1405	39482	79.4	61.0	15.4	16.3	636.6	996.2	38903	15.6
CD (P=0.05)	3.3	0.2	0.6	18.5	51.7	1428.0	3.3	1.9	0.6	0.5	NS	31.3	1573.9	0.7
SEM	1.12	0.08	0.22	6.28	17.5	484.06	1.13	0.66	0.22	0.16	6.79	10.60	533.52	0.24
CV	2.30	1.67	2.27	2.33	2.16	2.12	2.47	1.86	2.43	1.73	1.85	1.84	2.38	2.67

However, it was only 87 percent in kabuli variety Pusa 1053. This is largely because of high germination and seedling length in Desi variety. In the two year old seed lot, effect of ageing was more pronounced in kabuli type. The mean field emergence in control of Pusa 256 and Pusa 1053 were 81 and 35 respectively. The difference in comparison to fresh seed lot were much widen at incremental rate in both Desi and kabuli variety. The seed lot with four year of ageing gives only 74 and 14 emerged seedlings in the field for Pusa 256 and Pusa 1053 respectively. It was observed that after enhancement treatment significantly helped in narrowing the gap of field emergence value. The effect of thiram alone or in combination with polymers improved the field emergence very significantly. The comparative effectiveness of treatment was more pronounced in Kabuli type.

The effect of osmo priming and halopriming was not very much significant in increasing field establishment of chickpea. But it was observed that primied seed exhibits greater germination rate and faster and uniform field emergence. The evidence was in agreement with Lin and Sung (2001) and Basra *et al., (*2005). The was also differential treatment effect observed between desi and kabuli types.The desi type shows better response to treatments in respect of faster and uniform field emergence.

In addition Electrical Conductivity (EC) test was conducted on all the lots of desi and kabuli chickpeas. This test was used to measure the leakage of electrolytes from seed and had be used as vigour test to predict field emergence. This test became an important approach for monitoring large seeded legume seed quality (Hampton, 1995). The mean table of EC indicated as presented in Table 5 revealed that EC value of fresh lots was lower than old seed lots among both desi and kabuli type. The EC value shows lower margin of difference during initial 2yrs of storage as compared to further 2yrs of storage. The differences were more pronounced in kabuli types. Kabuli types were more prone to deterioration in the loss of semi permeability of membrane resulting, thereby in higher leakage of ions in aged seed. Increased membrane permeability resulting in an increased EC of seed leachate has been reported in different crops with ageing (Singh and Dadlani, 2003)

The perusal of correlation data as in Table 6 indicates that field emergence was significantly correlated with first count and germination percentage. However, there is no significant correlation was found between field emergence and seedling length, seedling dry weight and vigour index- I & II.

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Table 5: Mean table of electrical conductivity

Types	Varieties	EC(μmhos/cm/g) Fresh	2 Yrs Old	4 Yrs Old
Desi	Pusa 256	9.27	10.10	11.35
Kabuli	Pusa 1053	16.62	17.45	19.50

Table 6: Correlation matrixes of seed vigour parameters in chickpea

Characters	First count	Germination	Seedling dry weight	Seedling length	Vigour index-I	Vigour index-II	Field emergence	Speed of emergence	Electrical conductivity
First count	1								
Germination	0.631**	1							
Seedling dry weight	0.852**	0.687**	1						
Seedling length	0.744**	0.566*	0.901**	1					
Vigour index-I	0.806**	0.594*	0.925**	0.99**	1				
Vigour index-II	0.774**	0.679**	0.967**	0.867**	0.863**	1			
Field emergence	0.5*	0.48*	0.485	0.383	0.405	0.438	1		
Speed of emergence	0.034	0.241	0.14	0.276	-0.243	-0.115	-0.185	1	
Electrical conductivity	-0.551*	-0.371	-0.636**	-0.771**	-0.740**	-0.633**	-0.501*	-0.122	1

REFERENCES

Abdul Baki, A. A. and Anderson, J. D. 1973. Vigour determination in soybean seed by multiple criteria. *Crop Sci*. **13:** 630-632.

Agawane, R. B. and Parhe, S. C. 2015. Effect of seed priming on crop growth and seed yield of soybean [Glycine max (L.) Merill]. *The Bioscan*. **10(1):** 265-270.

Anonymous 2004. Handbook of ISTA, Zurich, Switzerland.

Basra, S. M. A., Farooq, M. and Tabassum, R. 2005. Physiological and biochemical aspects of seed vigor enhancement treatments in fine rice (*Oryza sativa* L.). *Seed Science and Technology*. **33:** 25-29.

Chand, M., Singh, D., Roy, N., Kumar, V. and Singh, R. B. 2010. Effect of growing degree days on chickpea production in Bundelkhand region of Uttar Pradesh. *J. Food legumes*. **23:** 41-43.

Gaur, P. M., Tripathi, S., Gowda, C. L. L., Ranga Rao, G. V., Sharma, H. C., Pande, S. and Sharma, M. 2010. *Chickpea Seed Production Manual*. ICRISAT, Patancheru, Andhra Pradesh, India. pp. 1-22.

Hampton, J. G. and Tekrony, D. M. 1995. *Hand Book of Vigour Test Methods*. *ISTA, Zurich, Switzerland*. pp. 27-56.

Harris, D., Joshi, A., Khan, P. A., Gothkar, P. and Sodhi, P. S. 1999. On-farm seed priming in semi-arid agriculture: development and evaluation in maize, rice and chickpea in India using participatory methods. *Experimental Agriculture*. **35:** 15-29.

Jamadar, M. I. and Chandrashekhar, S. S. 2015. Effect of chemical and biological seed treatments on germination performance of gch-7 hybrid castor(*Ricinus communis* L.).*The Bioscan*. **10(1):** 37-41.

Jukanti, A. K., Gaur, P. M, Gowda, C. L. L. and Chibbar, R. N. 2012. Nutritional quality and health benefit of chickpea (*Cicer arietinum* L.): A Review. *British J. Nutrition*. **108:** 12-26.

Kumar, J., Nisar, K., Kumar, A.M.B., Walia, S., Shakil, N.A., Prasad, R. and Balraj, S. and Parmar, B. S. 2007. Development of polymeric seed coats for seed quality enhancement of soybean (*Glycine max*). *Indian J. Agricultural sciences*. **77(11):** 738-743.

Lin, J. M. and Sung, J. M. 2001. Pre-sowing treatment for improving emergence of bitter gourd seedlingunder optimal temperatures. *Seed Science and Technology*. **29:** 39-50.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical methods for agricultural workers, *I.C.A.R. Pub.,* New Delhi. pp. 14-33.

Singh, K. K. and Dadlani, M. 2003. Effect of packaging on vigour and viability of soybean (*Glycine max* (L.) Merrill) seed during ambient storage. *Seed Res*. **31(1):** 27-32.

Solanke, R. B., Kore, S. S. and Sudewad, S. M. 1997. Detection of soybean seed borne pathogens and effect of fungicides. *J. Maharashtra agric. Uni*. **22(2):** 168-170.