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Effect of Priming on Germination and Seedling Quality Parameters of Chickpea (*Cicer arietinum* L.)

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ABSTRACT

Chickpea (*Cicer arietinum* L.) is an important *rabi* pulse crop grown in India. An experiment was conducted to know the effect of different priming methods on germination parameters of chickpea. Among the treatments studied seeds soaked in GA_3 solution for 16 hrs enhanced the germination, root length, shoot length, seedling fresh and dry weight, vigour index and field emergence followed by GA_3 with 12 hours priming. Hydropriming for 12 hours and 16 hours duration showed moderate improvement on seed germination parameters. Irrespective of the priming duration, lowest germination and other seedling quality parameters were observed in seeds primed with KCl. Superiority of GA_3 to record highest effect on germination parameters may be due to its stimulation effect in the formation of enzymes which are important in the early phases of germination helping for faster radical protrusion and plumule elongation. The present study indicated that, priming with GA_3 was found to improve the germination and seedling quality parameters in chickpea. Correlation analysis showed that field emergence is highly depended on germination and vigour index.

Key words: *Chickpea, Germination parameters, Priming.*

Chickpea is an important *rabi* pulse crop grown in India in an area of 96.0 lakh ha with a production of 88.33 lakh tons (FAO, 2013). Rapid and uniform field emergence is essential to achieve high yield with good quality in annual crops (Subedi and Ma, 2005; Yari *et al*., 2010). Priming is a technique, which is applied to seeds before germination in which seeds are partially hydrated to a point where germination processes begin but radical emergence does not occur (Kaur, 2002). This method is used to improve speed of germination, vigour, seedling establishment and yield (Talebian *et al*., 2008). Afzal *et al*. (2002) reported that significant grain yield improvement was achieved in double cross hybrid maize treated with hydropriming. Moradi and Younesi (2009) reported that hydropriming showed significant improvement on germination (%) and mean time of emergence in sorghum. This study was undertaken to study the effect of different methods of seed priming on seed germination parameters of chickpea.

MATERIAL AND METHODS

A study was undertaken to assess the effect of priming treatments on germination parameters of chickpea *cv* JG-11. The experiment was conducted at Seed Research and Technology Centre, Rajendranagar, Hyderabad in completely randomized design with three replications. The experiment was conducted with 3 levels of priming viz., Hydropriming, KCl (1 %) GA_3 (20 ppm) and two levels of priming durations (12 hrs and 16 hrs) along with control. Treatments consisted of soaking of the seed in GA_3 (20 ppm) for 12 hrs, GA_3 (20 ppm) for 16 hrs, KCl (1 %) for 12 hrs, KCl (1 %) for 16 hrs, hydropriming for 12 hrs, hydropriming for 16 hrs and untreated seed used as control. Data was recorded for germination (%), root length (cm), shoot length (cm), fresh weight (g), dry weight (g), seedling vigour index and field emergence (%). Germination test was carried out by following the between paper method as per ISTA procedure. Field emergence percentage was calculated by taking the count on number of seedlings emerged at 12 days after sowing. Seedling vigour index was

calculated by using the formula given by Abdul Baki and Anderson (1973).

SVI = [Seedling length (cm) x germination (%)]

The data were subjected to an analysis of variance, using OPSTAT software and the difference between means were compared by Duncan tests. Correlation analysis was employed among seed quality parameters.

RESULTS AND DISCUSSION

Significant variation in root length, shoot length, seedling fresh weight, dry weight and vigour index were observed due to seed priming (Table-1). Seed priming with GA_3 (16 hours) recorded maximum root and shoot length followed by GA_3 (12 hours) and hydropriming (16 hours) (Table-2). Effect of hydropriming with two different durations was on par with each other for root and shoot length. Highest germination (%) was observed in seeds primed in GA_3 for 16 hours (93.5%) and GA_3 for 12 hours (90.50 %) whereas lowest germination (%) was recorded in KCl with 16 hours (73.4 %) and 12 hrs (81.50 %). Superiority of GA_3 to record higher germination (%) may be due to the role of gibberellins which are involved in the control of reserve hydrolysis on which the growing embryo depends. KCl when dissolved in water produces KOH which is a strong alkali and may be toxic to embryo. Meawel *et al*. (2010), reported that lowest germination (%) was observed in soybean seeds primed with KCl. However, Vanangamudi and Karivaratharaju (1986) reported that the use of KCl showed positive effect on germination of blackgram and greengram. Feng *et al*. (1997) reported the use of GA_3 in germination of soybean seeds, suggesting that gibberellic acid would play an important role during the germination process of seeds.

Seed priming with GA_3 (16 hours) recorded significantly higher fresh and dry weight than other treatments. Treatment with GA_3 for 12 hours and hydropriming with both priming durations were on par for fresh weight. Seed priming increased the seedling vigour index to 2264.57 and 1980.23 in seeds soaked in GA_3 for 16 hours and 12 hours duration respectively compared to control (1709.38). Higher field emergence was observed in the seeds primed for 16 hours (90.0 %) and 12 hours (86.33 %) with GA_3. Significantly lower field emergence was recorded in the seed primed with KCl for 16 hrs. Meawel *et al*. (2010) also reported the negative effect of KCl on seedling quality parameters of soybean. Thus priming with GA_3 (16 hrs and 12 hours) and hydropriming (16 hours) were found to enhance seedling quality parameters including vigour index, germination and field emergence. Tiwari *et al*. (2014) reported that KNO_3 and tap water significantly enhanced the seed germination, seedling length, seedling dry weight and vigour index in pigeonpea over control.

Correlation analysis

Correlation analysis was carried out between the various parameters to know their interdependence and it was found that all the parameters studied showed significant and positive association with field emergence (Table-3). Field emergence was found to be significant and positively correlated with germination ($r = 1.000$) and vigour index ($r = 0.951$) ($p<0.01$). Germination was found to be significantly and positively correlated with vigour index ($r = 0.945$), dry weight ($r = 0.891$) and field emergence ($r = 1.000$) ($p<0.01$). Vigour index was found to be significantly and positively correlated with root length ($r = 0.993$), shoot length ($r = 0.925$) and dry weight ($r = 0.968$) ($p<0.01$).

Since field emergence depended on germination which again depended on vigour index, regression equations were drawn between field emergence – germination and field emergence – vigour index to understand their interdependence and to assess the possibility to predict field emergence based on the levels of germination and vigour index.

Regression analysis of field emergence with germination

Regression analysis of field emergence with germination gave a better understanding of the level of its dependence on germination and to predict it based on germination.

The regression equation (Fig-1) obtained was as follows:

$Y = 0.258 + 0.95$ germination ($R^2 = 0.99$) ($p<0.001$).

Table 1. Analysis of variance of seed priming for different parameters in chickpea.

Source	df	Root length	Shoot length	Germi-nation	Fresh weight	Dry weight	Vigour index	Field emergence
Replications	2	0.09	0.35	1.85	7.50	0.003	6096.85	1.190
Treatments	6	18.45**	3.26 **	465.09 **	44.83 **	0.10 **	767631.90 **	458.65**
Error	12	0.85	0.425	7.69	5.50	0.014	11072.29	6.25
Total	20	6.055	1.275	144.32	17.49	0.04	237542.70	141.46

* Significant at 5 % level ** Significant at 1 % level

Table 2. Influence of seed priming on germination parameters of chickpea.

Treatment	Root length (cm)	Shoot length (cm)	Germi-nation (%)	Fresh weight (cm)	Dry weight (cm)	Vigour index	Field emergence (%)
Hydropriming (12 hrs)	12.48^{cd}	7.04^{cd}	87.30^{bc}	42.78 ^{b}	2.16 ^{bcd}	1704.46^{c}	83.83^{bc}
Priming with GA_3 (12 hrs)	13.76^{b}	8.12^{b}	90.50^{ab}	44.23 ^{b}	2.33 ^{b}	1980.23^{b}	86.33^{ab}
Priming with KCl (12 hrs)	11.30^{de}	6.87^{d}	81.50^{d}	40.08 ^{c}	1.95 ^{cde}	1480.97^{d}	75.67^{d}
Hydropriming (16 hrs)	13.53^{bc}	7.38^{bc}	89.33^{b}	43.57 ^{b}	2.25 ^{bc}	1868.13^{b}	85.17^{b}
Priming with GA_3 (16 hrs)	15.10^{a}	9.12^{a}	93.50^{a}	47.78 ^{a}	2.57 ^{a}	2264.57^{a}	90.00^{a}
Priming with KCl (16 hrs)	10.27^{e}	6.29^{d}	73.43^{e}	39.35 ^{c}	1.89 ^{de}	1216.65^{e}	70.83^{e}
Control	12.07^{d}	6.45^{d}	84.17^{cd}	41.00 ^{c}	2.10 ^{cde}	1558.89^{cd}	80.00^{c}
Grand Mean	12.65	7.32	85.68	42.69	2.18	1724.84	81.69
SE (m)	0.381	0.290	1.190	0.73	0.07	49.57	1.28
CD	1.186	0.904	3.708	2.28	0.21	154.45	3.99

* Figures with the same letters in each column are not significantly

Table 3. Correlation of seed quality parameters following priming.

Traits	Root length (cm)	Shoot length (cm)	Germi-nation (%)	Fresh weight (cm)	Dry weight (cm)	Vigour index	Field emergence (%)
Root length	1.000	0.923**	0.936**	0.822*	0.965**	0.993**	0.942**
Shoot length		1.000	0.786*	0.791*	0.970**	0.925**	0.800*
Germination			1.000	0.840*	0.891**	0.945**	1.000**
Fresh weight				1.000	0.847	0.831**	0.841*
Dry weight					1.000	0.968**	0.901**
Vigour index						1.000	0.951**

* Significant at 5 % level ** Significant at 1 % level

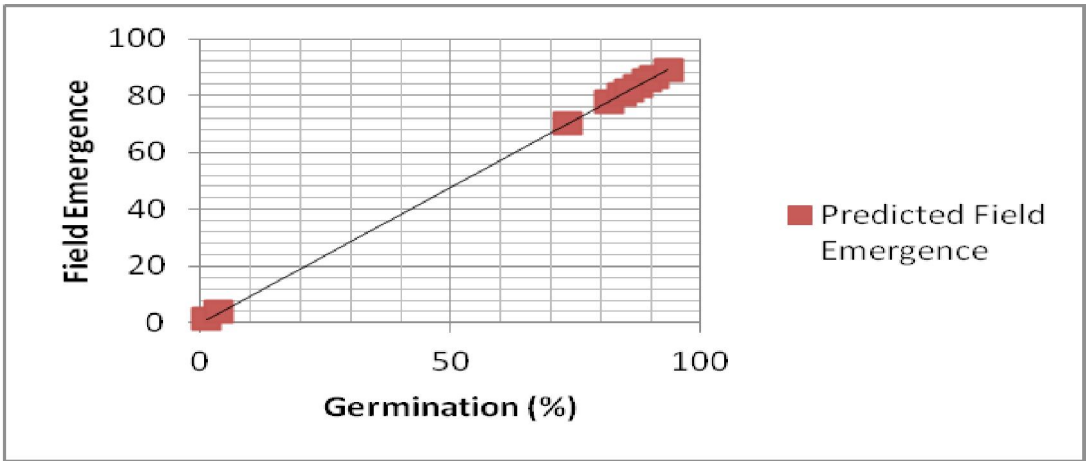

Fig.1. Dependence of field emergence on germination
Y = 0.258 + 0.95 germination (R^2 = 0.99) ($p<0.001$)

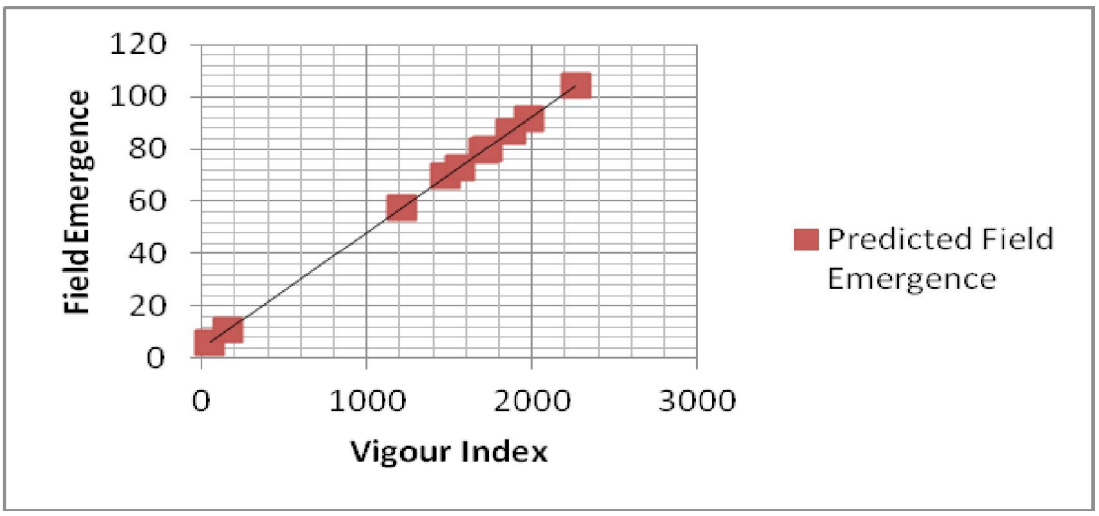

Fig.2. Dependence of field emergence on Vigour Index
Y = 3.88 + 0.04 vigour index (R^2 = 0.9435) ($p<0.001$)

This indicated that for every one percent increase in germination, field emergence would increase by 0.95 %. The high R^2 value (0.99) showed that variation in field emergence could be attributed to germination to an extent of 99.0%.

Regression analysis of field emergence with vigour index

Regression analysis of field emergence with vigour index gave a better understanding of the level of its dependence on vigour index and to predict it based on vigour index.

The regression equation (Fig-2) obtained was as follows:

Y = 3.88 + 0.04 vigour index (R^2 = 0.9435) ($p<0.001$).

This indicated that for every one unit increase in vigour index, field emergence would increase by 0.04 units. The high R^2 value (0.9435) showed that variation in field emergence due to vigour index could be to an extent of 94.35%. Thus it could be concluded that field emergence of chickpea depended more on germination and vigour index than on other seedling parameters.

The present study indicated that seeds primed with GA_3 (16 and 12 hours) and hydropriming (16 hours) were found to enhance seedling quality parameters in chickpea. Regression analysis reveals that field emergence of chickpea highly depended on germination and vigour index than other parameters.

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