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RESEARCH ARTICLE

Effect of seed priming on yield and yield components of soybean

■ **KUNAL V. JADHAV, N.V. KAYANDE, M.R. WANDHARE AND D.S. PHAD**

SUMMARY

The results exhibited that seeds primed with $CaCl_2$ @ 1% (T_3) and GA_3 @ 500ppm (T_4) recorded significantly higher germination percentage *i.e.* 84.67 per cent and 83.33 per cent, respectively over the untreated control T_1(76.00%). Treatment T_3 recorded higher number of initial plant stand (117 plants), followed by treatment T_4 (111 plants) and treatment T_5 (111 plants). This may likely contributed for boosting up economic yield in soybean cultivar, JS-335. The seed priming significantly influenced the seed yield and yield contributing characters of soybean. Highest value for seed yield per hectare was recorded by treatment T_3 $CaCl_2$ @ 1% (20.12 qt/ha) followed by treatment T_4- GA_3 @ 50 ppm (19.02 qt/ha), T_5- KNO_3 @1% (18.35 qt/ ha). All other treatments recorded higher yield than untreated control (14.05 qt/ha) showing to the corresponding favourable improvement in number of pods per plant, number of seeds per pod, test weight (g), seed yield per plot (g), seed yield per Ha (q).

Key Words : Seed priming , Yield, Components of soybean

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The improvement in seed quality in soybean [Glycine max (L.) Merill] by priming treatments is attributed to primary reduction of lipid peroxidation and quantitative changes in biochemical activities inducing greater amylase activity increasing per cent sugar during seed germination. Availability of good quality seed is the first and foremost requirement to achieve impact of high yielding variety. Rapid germination and emergence is an important factor of successful establishment. It is reported that the seed priming is one of the most important developments to help rapid and uniform germination and emergence of seeds and to increase seed tolerance to adverse environmental conditions (Heydecker and Coolbear, 1977 and Harris *et al.*, 1999). Seed priming has presented promising and even surprising results, for many seeds including the legume seeds (Bradford, 1986).

The advantage of seed priming in reducing the germination time and improving emergence uniformity is well established under laboratory conditions. The direct benefits of seed priming in all crops included: faster

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emergence, better, more and uniform stands, less need to re-sow, more vigorous plants, better drought tolerance, earlier flowering, earlier harvest and higher grain yield. The indirect benefits reported were: earlier sowing of crops, earlier harvesting of crops and increased willingness to use of fertilizer because of reduce risk of crop failure. Park *et al*. (1997) reported that priming aged seeds of soybean resulted in good germination and stand establishment in the field trials. Kazem *et al*. (2012) were reported that priming enhanced grains per plant, grain yield per plant and per unit area. The direct benefits of seed priming in all crops included: faster emergence, better, more and uniform stands, less need to re-sow, more vigourous plants, better drought tolerance, earlier flowering, earlier harvest and higher grain yield. The indirect benefits reported were: earlier sowing of crops, earlier harvesting of crops and increased willingness to use of fertilizer because of reduce risk of crop failure (Harris *et al*., 2001 a and b).This crop is, therefore, exposed many times to moisture and nutrient stresses during or immediately after germination. Considering the beneficial effects of seed priming on moisture use efficiency and seed quality parameters like, germination and vigour which help in maintenance of optimum plant population and to obtain expected yield level the present study was undertaken with the objectives as to study the effect of seed priming on field emergence of soybean and to find out the effect of seed priming on crop growth, yield contributing character and yield of soybean.

MATERIAL AND METHODS

The present investigation was carried out at PGI farm, Department of Agricultural Botany and Seed Technology Research Unit (STRU), Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. in *Kharif* 2015 with spacing 45cm×10cm.The experiment was laid out in a Randomized Block Design (RBD) with eight treatments and three replications. Freshly harvested seeds of soybean variety JS-335 were obtained from Seed Technology Research Unit, Dr. PDKV, Akola. The collected soybean seeds of variety JS-335 were treated with growth regulators and chemicals as detailed below.

Treatments
T_1 : Control
T_2 : Hydro priming- for 2hr
T_3: Seed priming with calcium chloride - @ 1% for 2hrs.
T_4 : Seed priming with gibberellic acid -@ 50 ppm for 2hrs.
T_5 : Seed priming with potassium nitrate- @1%for 2hrs.
T_6 : Seed treatment with *Trichoderma viride* - @ 0.5%
T_7 : Seed treatment with Rhizobium culture - @ 2.0 %.
T_8 : Seed treatment with Carbendazim-@ 0.2%.

The observations were recorded on various parameters, *i.e.* seed quality parameters (germination %, seedling length, seedling dry weight, vigour index I and vigour index II), field emergence, morphological characters like initial plant stand, plant height at flowering, days to 50 per cent flowering, seed yield per plant, seed yield per ha. The data collected from the experiment was analyzed statistically by Randomized Block Design as per procedure given by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Table 1: Effect of seed invigoration on seed germination, seedling length(cm) , seedling dry weight (g) in soybean

	Germination percentage	Seedling length (cm)	Seedling dry weight (g)
T_1 : Control	76.00	23.07	0.813
T_2 : Seed priming with water @ 2 hrs	80.67	25.73	0.843
T_3 : Seed priming with $CaCl_2$ @1% for 2 hrs	84.67	26.80	0.943
T_4 :Seed priming with GA_3 @ 100 ppm for 2 hrs	83.33	26.87	0.927
T_5 : Seed priming with KNO_3 @1% for 2 hrs	82.00	26.20	0.920
T_6 : Seed treatment with *Trichoderma viride* @ 0.5 %	78.67	24.47	0.887
T_7 : Seed treatment with *Rhizobium* spp. @ 2%	80.00	24.00	0.840
T_8 : Seed treatment with carbendazim @ 0.2%	81.33	24.87	0.847
F test	Sig.	Sig.	Sig.
S.E.±	0.82	0.47	0.009
C.D. (P=0.05)	2.45	1.42	0.028

Effect of seed priming on seed quality :

In the present study treatment T_3 (seed priming with $CaCl_2$ -1%) and T_4 (seed priming with GA_3 - 50 ppm) exhibited higher germination *i.e.* 84.67 and 83.33 per cent, respectively over control as compare to other treatments (Table 1). Remaining treatments also contributed improving germination and field emergence than control. Seed priming with only water (T_1) could not significantly contribute for optimum plant stand and other quality studies. Beneficial effects of priming treatment may be through the improved physiological process for germination and protection against pests. Lower value for seed germination recorded by untreated control. The present finding confirms the finding of Jamdar and Chandrashekhar (2014) in castor, Agawane and Parhe (2015) in soybean and Pulok *et al*. (2015) in lentil.

Significant variation in seedling length, seedling dry weight, vigour index I and vigour index II was observed due to different seed invigoration treatments. Higher seedling length of 26.87 cm was observed in treatment T_4 (GA_3 @ 50 ppm) and treatment T_3 $CaCl_2$ @ 1% (26.80) which were statistically similar. All the other treatments recorded higher seedling length than untreated control. Control treatment recorded lower value for seedling length of 23.07 cm. Seedling dry weight is one of major component of seed quality in soybean. Most of the invigoration treatment recorded more seedling dry weight than control. Seedling dry weight is presented in Table 3. A higher seedling dry weight was recorded by treatment T_3- $CaCl_2$ @1 % (0.943 g) followed by T_4-GA_3 @50 ppm – (0.926 g) and T_5- KNO_3 @ 1% (0.920 g) which were statistically similar. Lower seedling dry weight was recorded by untreated control (0.813 g).

Higher vigour index I and vigour index II was recorded by treatment T_3-$CaCl_2$ @ 1% (2269.9 and 79.86), respectively followed by treatment T_4-GA_3 @

Table 2 : Effect of seed invigoration on vigour index I and vigour index II on soybean

	Vigour index I	Vigour index II
T_1 : Control	1753.1	61.81
T_2 : Seed priming with water @ 2 hrs	2075.5	66.14
T_3 : Seed priming with $CaCl_2$ @1% for 2 hrs	2269.6	79.86
T_4 :Seed priming with GA_3 @100 ppm for 2 hrs	2239.2	77.21
T_5 : Seed priming with KNO_3 @1 % for 2 hrs	2148.8	75.45
T_6 : Seed treatment with *Trichoderma viride* @0.5 %	1925.2	69.75
T_7 : Seed treatment with *Rhizobium* spp. @ 2%	1965.1	67.21
T_8 : Seed treatment with carbendazim @ 0.2%	2022.7	68.87
F test	Sig.	Sig.
S.E.±	41.3	1.00
C.D. (P=0.05)	123.8	3.00

Table 3 : Effect of seed invigoration on days to field emergence, initial plant stand and days to 50 per cent flowering on soybean

	Days to field emergence	Initial plant stand	Days to 50% flowering
T_1 : Control	6.00	96.33	45.33
T_2 : Seed priming with water @ 2 hrs	4.33	102.67	41.67
T_3 :Seed priming with $CaCl_2$ @2 hrs	4.00	117.00	40.33
T_4 :Seed priming with GA_3 @2 hrs	4.33	111.33	41.67
T_5 : Seed priming with KNO_3 @2 hrs	4.67	111.00	42.67
T_6 : Seed treatment with *Trichoderma viride* @0.5 %	5.67	102.00	43.33
T_7 : Seed treatment with *Rhizobium* spp. @ 2%	5.67	103.67	43.67
T_8 : Seed treatment with carbendazim @ 0.2%	6.00	109.33	43.67
F test	Sig	Sig.	Sig
S.E.±	0.27	1.79	0.48
C.D. (P=0.05)	0.81	5.44	1.46

50 ppm treatment (2239.2) and (77.21), respectively. Control treatment recorded the lower value for both parameter vigour index I and vigour index II, (1753.1 and 61.81), respectively. There exists positive correlation among germination, seedling length, seedling dry weight, vigour index I and vigour index II. Christiansen and Foy (1979) and Hecht-Buchholz (1979) reported that seed calcium concentration and germination percentage were positively correlated which suggests the role of calcium as an important component in membrane stabilization and as an enzyme co-factor. These finding was in agreement with the result of Assefa *et al.* (2008); Jamdar and Chandrashekhar (2013); Subbaraman and Selvaraj (1989); Shehzad *et al.* (2012) and Negalur *et al.* (2002) noted that the soybean seed (var TAMS 38) with initial 70 per cent germination when invigorated with different chemicals including thiram showed increased germination, field emergence, vigour index and seedling dry weight. The enhanced growth of plumule and radical associate with field emergence and seed vigour thus, form important factor for establishment of initial crop stand.

Effect of seed priming on field emergence :

Rapid field emergence is the most important aspect in seed invigoration treatments. Treatment T_3 *i.e.* $CaCl_2$ @ 1% recorded the least number of days required for field emergence (4 days), followed by treatment T_2 *i.e.* hydropriming (4.33 days), T_4 GA_3 @ 50 ppm (4.33 days) and T_5 KNO_3 @ 1 % (4.67 Days). This shows that seed priming treatment likely to contribute for rapid emergence. Treatment T_1 and T_8 recorded more number of days required for field emergence (6 days) each. The

Table 4 : Effect of seed invigoration on plant height at flowering, pods per plant on soybean

	Plant height at flowering (cm)	Pods per plant
T_1 : Control	36.13	32.87
T_2 : Seed priming with water @ 2 hrs	41.67	38.53
T_3 : Priming with $CaCl_2$ @1% for 2 hrs	43.13	41.27
T_4 : Priming with GA_3 @100ppm for 2 hrs	43.20	39.20
T_5 : Priming with KNO_3 @ 1% for 2hrs	41.67	39.80
T_6 : Seed treatment with *Trichoderma viride* @0.5 %	38.80	37.87
T_7 : Seed treatment with *Rhizobium* spp. @ 2%	38.00	38.87
T_8 : Seed treatment with carbendazim @ 0.2%	37.60	39.87
Mean	40.03	38.53
F test	Sig.	Sig.
S.E.±	0.42	0.95
C.D. (P=0.05)	1.26	2.88

Table 5 : Effect of seed invigoration on seed yield per plant and seed yield per ha on soybean

	Seed yield per plant (g)	Seed yield per hectare (Q/ha)
T_1 : Control	9.57	14.86
T_2 : Seed priming with water @ 2 hrs	11.27	16.06
T_3 : Seed priming with $CaCl_2$ @1% for 2 hrs	13.23	21.49
T_4 :Seed priming with GA_3 @100 ppm for 2 hrs	12.30	19.02
T_5 : Seed priming with KNO_3 @1 % for 2 hrs	12.37	19.05
T_6 : Seed treatment with *Trichoderma viride* @0.5 %	10.90	15.44
T_7 : Seed treatment with *Rhizobium* spp. @ 2%	10.93	15.75
T_8 : Seed treatment with carbendazim @ 0.2%	11.30	17.17
Mean	11.48	17.36
F test	Sig.	Sig.
S.E.±	0.31	0.73
C.D. (P=0.05)	0.93	2.20

results are in accordance with Rehman *et al*. (2014) and Shabbir *et al*. (2013).

All the seed priming treatments maintained superiority over untreated control (96 plants) for initial plant stand. Treatment T_3 recorded higher number of initial plant stand (117 plants), followed by Treatment T_4 (111 plants) and treatment T_5 (111 plants) which were at par with each other. Treatment T_3-$CaCl_2$ @ 1% (40.33 days), T_4-GA_3 @ 50 ppm (41.67 days), exhibited less number of days required for 50 per cent flowering than untreated control and the treatment were at par. A maximum day to 50 per cent flowering was taken by control treatment (45.33 days) (Table 3). Assefa *et al.* (2008) also reported that 50 per cent flowering was earlier in case of calcium chloride as compared to other priming treatments and mentioned that this could be because of their effect in the fast emergence of the seeds at the beginning.

Basically, plant height is a genetically controlled character, but several studies have indicated that the plant height can be increased or decreased by different seed quality enhancement practices. Among all treatment T_4-GA_3 @ 50 ppm (43.20 cm) found superior over all the treatments followed by T_3 - $CaCl_2$ @1 % (43.14 cm). Treatment T_1 untreated control recorded the lowest value for plant height (36.13 cm) (Table 4). Therefore, it can be concluded that seed priming accelerate the physiological process in plant which may be likely to contribute increase in the plant height. The beneficial effect of exogenous application of GA_3 to seeds might be due to the translocation of GA_3 to the aerial part of plants, and this perhaps occurs to an extent that is enough to increase hypocotyls size and the consequent increase in first node height hence, sufficient to positively affect plant height the amount of GA_3. The enhanced plant height may also be due to the improved and faster plant emergence in GA_3, $CaCl_2$, which created co-operative competition among the plants for light and resulted in taller plants. The results agree with Rehman *et al.* (2014) who reported that osmopriming with $CaCl_2$ reduced crop branching and flowering and maturity times and had the maximum plant height, number of branches, tillers, pods and seeds per pod followed by MLE in Linseed.

Effect of seed priming on yield and yield contributing characters in soybean :

All the seed priming treatments produced more number of pods per plants than untreated control (32.87 pods). Treatment T_3- $CaCl_2$ @ 1% recorded higher number of pods per plant (41.27 pods) followed by T_5-KNO_3 @1% (39.80 pods) and T_4-GA_3 @ 50 ppm (39.20 pods) (Table 4). Higher seed yield per plant was recorded by treatment T_3- $CaCl_2$ @ 1% (13.23 g), followed by treatment T_4- GA_3 @ 50 ppm (12.30 g) and treatment T_5- KNO_3 @1% (12.37 g). Lowest seed yield was recorded by untreated control (9.57 g). Highest value for seed yield per hectare was recorded by treatment T_3- $CaCl_2$ @ 1% (20.12 qt/ha) followed by treatment T_4- GA_3 @ 50 ppm (19.02 qt/ha), T_5- KNO_3 @1% (18.35 qt/ ha). All other invigoration treatment recorded higher yield than untreated control (14.05 qt/ha) (Table 5). Seed priming treatment increase the seed yield per hectare. The results are in accordance with the findings of Assefa *et al.* (2008) in soybean, Narayanreddy and Biradarpatil (2012) in sunflower, Chavan *et al.* (2014) and Agawane and Parhe (2015) in soybean.

Conclusion :

On the basis of these observations, it may be concluded that soybean seeds positively responded to treatments of priming. Nevertheless, priming generally improves the most parameters of soybean varieties through improving germination per cent, days to field emergence, days to 50 per cent flowering, plant height, number of pods per plant and seed yield. The highest benefit of priming can be obtained from seeds primed with $CaCl_2$ (1% for two hours) treatment.

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