The Bioscan 9(1): 111-114, 2014
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EFFECT OF SEED PRIMING ON FIELD PERFORMANCE AND SEED YIELD OF SOYBEAN [*GLYCINE MAX* (L.) MERILL] VARIETIES

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KEYWORDS
Soybean
Priming
Seed
Flowering

Received on :
08.09.2013

Accepted on :
07.01.2014

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ABSTRACT
A study was conducted to determine the importance seed priming on field performance and seed yield of Soybean. There were two varieties *viz.,* Phule Kalyani and JS-335 while six priming treatments *viz.,* Control (unprimed seeds), Hydropriming, KCl @10 ppm, $CaCl_2.2H_2O$ @ 0.5 %, KH_2PO_4 @ 50 ppm and GA_3 @ 20 ppm. The variety Phule Kalyani primed with $CaCl_2.2H_2O$ (0.5%) were superior in plant height, number of branches, number of pods per plant, number of seeds per pod, seed yield per hectare over those raised from the variety JS-335.

INTRODUCTION

Soybean [*Glycine max* (L.) Merill] has become a miracle crop of the twentieth century. It is a triple beneficiary crop, a unique food, a valuable feed and an industrial raw material with considerable potential.

The advantage of seed priming in reducing the germination time and improving emergence uniformity is well established under laboratory conditions. However, few detailed studies have been reported on the performance of osmotically treated seeds under field condition. Park *et al*. (1997) reported that the 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). The few studies available using the chemical seed priming in soybean seeds are promising, but their use as routine in seed quality enhancement and commercial application depends on getting more detailed information about their performance in the field. Keeping this view present investigation undertaken to study the importance of growth regulators on the field performance and seed yield of soybean.

MATERIALS AND METHODS

Samples of 500 grams of soybean seeds Cv. JS- 335 (V_1) and Phule Kalyani (V_2) were placed between germination towels wetted with tap water of pH 6.5 for 14 hour. After wards, primed seeds were allowed to dry back to their original moisture content under the shad for one day and in the sun for two days then stored and same seed used for sowing in kharif (M.K. Assefa, 2008).

Days to 50 per cent flowering

The day on which 50 per cent of plants showed flowers in the plot was considered as 50 per cent flowing. The number of days taken from the date of sowing to flowering was calculated and expressed in number as days taken for 50 per cent flowering.

Plant height

The plant height on five randomly selected and tagged plants were measured from the base of the plant to the tip of the shoot apex at physiological maturity. The average height of five plants was worked out and expressed in centimeters.

Number of branches per plant

The Number of branches per plant of five randomly selected and tagged plants were counted at physiological maturity. The average number of branches of five plants was worked out.

Number of pods and seed per plant

The number of pods and seeds harvested from five randomly selected and tagged plants in each treatment was counted and average was worked out and expressed as number of pods and seeds per plant.

Seed yield per hectare

The matured pods harvested from the net plot in each treatment were sun dried and the seeds were separated. The weight of the seeds from net plot area was recorded. The seed yields obtained from net plot were added to the seed yield of the net plot area for calculation of seed yield and were recorded as seed yield per hectare.

Statistical analysis

The data were statistically analyzed using analysis of variance appropriate for factorial randomized complete block design. Main and interaction effects were compared using LSD test at 0.05 level of probability, when the F-values were significant (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Field performance

Initiation of flower buds is considered a shift from vegetative to reproductive stage of the seed crop growth. Varieties, seed priming treatments and their interaction significantly affected days to 50 per cent flowering. The plots sown with seeds of JS-335 variety took significantly lesser days (38.78) to 50 per cent flowering as compared (43.22) to the plots sown with seeds of Phule Kalyani variety. Plots having seed primed with $CaCl_2.2H_2O$ (0.5%) (39.50) significantly accelerated flowering. This could be because of their effect in the fast emergence of the seeds at the beginning. M. K. Assefa (2008) also reported that 50 per cent flowering was arlear in case of calcium chloride as compaired 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. The significant interaction effect was observed in plants raised from the Phule Kalyani seeds treated with $CACl_2$ (0.5%) (58.97 cm). 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 hypocotyl size and the consequent increase in first node height hence sufficient to positively affect plant height. Bensen *et al.* (1990), demonstrate the hypocotyl growth rate is directly associated with the amount of GA_3. The enhanced plant height may also be due to the improved and faster plant emergence in GA_3, $CaCl_2.2H_2O$, KH_2PO_4 and KCl primed seed plots which created cooperative competition among the plants for light and resulted in taller plants. The results agree with Harris *et al.* (2000) who reported that the seed priming of ten rice varieties resulted in taller plants (108 cm vs 94 cm) in two years. The data on number of branches per plant as influenced by germination stages, varieties, seed priming and their interaction effects during field performance are presented in Table 1. Significantly more number of branches per plant was recorded in plots having seed primed with $CaCl_2.2H_2O$ (0.5%) (T_4) 6.77, followed by plots having seed primed with GA3 (20 ppm) (T_6) 6.63. The variation in the number of branches might be due to the vigorous growth of the plants due to the priming.

Yield attributes

Grain yield is the manifestation of morphological, physiological, biochemical, biophysical and growth parameters. Improvement in yield according to Humphries (1979) could happen in two ways i.e., by adopting the existing varieties to grow better in their environment or by altering the relative proportion of different plant parts so as to increase the yield of economically important parts. The influence of seed priming by different chemicals significantly increased the seed yield. The number of pods per plant and the number of seeds per pod are the major yield components and determine the final seed yield; those significantly contribute to the seed yield and represent reproductive efficacy of a seed crop. The statistically analyzed results showed that the varieties, seed priming treatments and their interaction significantly influenced number of pods per plant, number of seeds per plant and yield per hectare.

The plants raised from the seeds of variety Phule Kalyani (V_2) recorded significantly greater number of pods per plant, number of seeds per plant and yield per hectare (73.51, 2.87 and 2811.2 kg, respectively) over those raised from the JS-335variety seeds (V_1) (64.08, 2.79 and 2439.8 kg, respectively). The plots having seed primed with $CaCl_2.2H_2O$ (0.5%) (T_4) showed significantly highest number of pods per plant, number of seeds per pod and yield per hectare (73.37, 2.93 and 2876.1 kg, respectively) followed by plots having seed primed with KH_2PO_4 (50 ppm) (T_5) for number of seeds per plant, 100 seed weight and GA_3 (20 ppm) (T_6) in number of pods per plant and yield while the lowest were recorded in plots having sown with unprimed seed (T_1) (62.10, 2.71 and 2302.8 kg and, respectively). These results are in line with the report of Aldesuquy and Ibrahim (2000) who have reported that the seed treatment with shikimic acid improved yield and yield components of cowpea plants by increasing the number of pods per plant and number of seeds per pod. Similar results were also reported by Basara *et al.* (2003) in canola and Rashid *et al.* (2004) in mungbean that the primed seed plants produced more grains pod per pod.

The better performance of seeds primed with $CaCl_2.2H_2O$ (0.5%) (T_4) might be due to the role of calcium in membrane integrity. Christiansen and Foy (1979) and Hecht-Buchholz (1979) reported seed calcium concentration and germination percentage were positively related suggesting the role of calcium as an important component in membrane stabilization and as an enzyme cofactor. The superiority GA_3 to record higher field performance may be due to its stimulation effect in the formation of enzymes which are important in the early phases of germination which helps for a fast radicle protrusion and hence and hypocotyl elongation (Riedell *et al.*, 1985 and Maske *et al.*, 1997). Feng *et al.* (1997) also reported the use of GA_3 in germination of soybean seeds, suggesting that the gibberellic acid would play an important role during the germination process of seeds. According to Graf *et al.* (1987), phosphorous reserves in the seed play very important role in the metabolism of germinating seed. The major phosphorous reserve in the seed, phytic acid, in addition to its nutritional role, is believed to act as a natural antioxidant. Beneficial effects of KCl have been reported by Vijayakumar (1982) in black gram, Rajandran (1982) in red gram, Basha (1982) in green

Table 1: 50 Per cent flowering, plant height (cm) and no. branches per plant of soybean as affected by varieties (V), seed priming treatments (T) and their interactions (V × T)

Treatments	50 per cent flowering			Plant height (cm)			No. branches per plant		
Varieties	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled
V_1: JS-335	39.83	38.7	39.3	43.43	42.28	42.85	5.51	5.41	5.46
V_2: DS-228	44.4	43.1	43.7	54.24	53.08	53.66	7.52	7.41	7.47
SEm ±	0.2	0.2	0.1	0.11	0.12	0.05	0.03	0.03	0.01
C D at 5%	0.7	0.6	0.3	0.33	0.35	0.17	0.08	0.10	0.05
Priming treatments									
T_1: Control	44.5	42.8	43.7	43.49	42.03	42.76	5.97	5.87	5.92
T_2: Water	43.2	41.8	42.5	46.62	45.50	46.06	6.43	6.33	6.38
T_3: Potacium Chloride	42.0	41.2	41.6	47.41	46.33	46.87	6.57	6.47	6.52
T_4: Calcium Chloride	40.5	39.2	39.8	54.17	52.95	53.56	6.83	6.70	6.77
T_5: Pot.di-hy.phosphate	41.5	40.7	41.1	49.08	48.13	48.61	6.63	6.50	6.57
T_6: Gibrelic acid	41.0	39.7	40.3	52.21	51.13	51.67	6.67	6.60	6.63
SEm ±	0.4	0.4	0.2	0.20	0.21	0.09	0.05	0.06	0.03
CD at 5%	1.2	1.1	0.5	0.58	0.61	0.29	0.14	0.16	0.08
Interactions									
V_1T_1: JS-335+ Control	42.3	40.7	41.5	38.54	36.91	37.72	5.00	4.87	4.93
V_1T_2: JS-335+ Water	41.0	39.7	40.3	41.31	40.38	40.85	5.40	5.40	5.40
V_1T_3: JS-335+ Potacium Chloride	39.7	38.7	39.2	41.80	41.02	41.41	5.53	5.47	5.50
V_1T_4: JS-335+ Calcium Chloride	38.0	37.3	37.7	48.73	47.57	48.15	5.80	5.73	5.77
V_1T_5: JS-335+ Pot.di-hy.phosphate	39.3	38.3	38.8	43.17	42.08	42.62	5.67	5.47	5.57
V_1T_6: JS-335+ Gibrelic acid	38.7	37.7	38.2	47.00	45.70	46.35	5.67	5.53	5.60
V_2T_1: DS-228+ Control	46.7	45.0	45.8	48.43	47.16	47.80	6.93	6.87	6.90
V_2T_2: DS-228+ Water	45.3	44.0	44.7	51.93	50.61	51.27	7.47	7.27	7.37
V_2T_3: DS-228+ Potacium Chloride	44.3	43.7	44.0	53.02	51.64	52.33	7.60	7.47	7.53
V_2T_4: DS-228+ Calcium Chloride	43.0	41.0	42.0	59.61	58.32	58.97	7.87	7.67	7.77
V_2T_5: DS-228+ Pot.di-hy.phosphate	43.7	43.0	43.3	55.00	54.18	54.59	7.60	7.53	7.57
V_2T_6: DS-228+ Gibrelic acid	43.3	41.7	42.5	57.42	56.57	56.99	7.67	7.67	7.67
Mean	42.1	40.9	41.5	48.83	47.68	51.67	6.52	6.41	6.63
SEm ±	0.6	0.5	0.2	0.28	0.29	0.13	0.07	0.08	0.04
CD at 5%	NS	NS	NS	0.82	0.86	0.41	NS	NS	NS

Table 2: No. pods per plant, no. seeds per pod and seed yield (kg/ha) of soybean as affected by varieties (V), seed priming treatments (T) and their interactions (V × T)

Treatments	No. pods per plant			No. seeds per pod			Seed yield (kg/ha)		
Varieties	2011	2012	Pooled	2011	2012	Pooled	2011	2012	Pooled
V_1: JS-335	64.71	63.46	64.08	2.81	2.78	2.79	2473.8	2405.7	2439.8
V_2: DS-228	75.01	72.01	73.51	2.88	2.86	2.87	2842.2	2780.2	2811.2
SE ±	0.31	0.15	0.42	0.020	0.026	0.003	16.2	10.6	9.6
CD at 5%	0.90	0.43	1.31	0.058	0.076	0.008	47.4	31.0	30.0
Priming treatments									
T_1: Control	64.90	59.30	62.10	2.73	2.70	2.71	2360.5	2245.0	2302.8
T_2: Water	67.70	65.30	66.50	2.80	2.79	2.79	2540.3	2467.7	2504.0
T_3: Potacium Chloride	69.47	67.90	68.68	2.84	2.82	2.83	2635.3	2556.7	2596.0
T_4: Calcium Chloride	73.63	73.10	73.37	2.94	2.92	2.93	2894.8	2857.3	2876.1
T_5: Pot.di-hy.phosphate	72.07	70.70	71.38	2.88	2.85	2.87	2741.5	2686.0	2713.8
T_6: Gibrelic acid	71.38	70.10	70.74	2.87	2.84	2.86	2775.5	2743.2	2759.3
SE ±	0.53	0.26	0.73	0.034	0.045	0.005	28.0	18.3	16.7
CD at 5%	1.56	0.75	2.26	0.100	0.132	0.014	82.1	53.6	51.9
Interactions									
V_1T_1: JS-335+ Control	58.47	54.73	56.60	2.67	2.63	2.65	2267.3	2137.3	2202.3
V_1T_2: JS-335+ Water	62.20	60.40	61.30	2.80	2.77	2.78	2356.7	2229.3	2293.0
V_1T_3: JS-335+ Potacium Chloride	63.73	63.73	63.73	2.82	2.78	2.80	2451.0	2340.3	2395.7
V_1T_4: JS-335+ Calcium Chloride	69.00	68.67	68.83	2.90	2.88	2.89	2663.3	2629.0	2646.2
V_1T_5: JS-335+ Pot.di-hy.phosphate	67.93	66.87	67.40	2.83	2.80	2.82	2545.3	2525.7	2535.5
V_1T_6: JS-335+ Gibrelic acid	66.90	66.33	66.62	2.83	2.78	2.81	2559.3	2572.3	2565.8
V_2T_1: DS-228+ Control	71.33	63.87	67.60	2.79	2.76	2.78	2453.7	2352.7	2403.2
V_2T_2: DS-228+ Water	73.20	70.20	71.70	2.80	2.80	2.80	2724.0	2706.0	2715.0
V_2T_3: DS-228+ Potacium Chloride	75.20	72.07	73.63	2.87	2.85	2.86	2819.7	2773.0	2796.3
V_2T_4: DS-228+ Calcium Chloride	78.27	77.53	77.90	2.97	2.95	2.96	3126.3	3085.7	3106.0
V_2T_5: DS-228+ Pot.di-hy.phosphate	76.20	74.53	75.37	2.93	2.90	2.92	2937.7	2846.3	2892.0
V_2T_6: DS-228+ Gibrelic acid	75.87	73.87	74.87	2.91	2.90	2.90	2991.7	2917.3	2954.5
Mean	69.86	67.73	71.38	2.84	2.82	2.87	2658.0	2592.9	2625.5
SE ±	0.75	0.36	1.03	0.048	0.064	0.006	39.6	25.8	23.6
CD at 5%	2.21	1.06	3.08	NS	NS	NS	116.1	75.8	73.4

gram and Vanangamudi and Karivaratharaju (1986) in black gram and green gram.

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 plant height, number of branches, number of pods per plant, number of seeds per pod, seed yield. The highest benefit of priming can be obtained from seeds primed with $CaCl_2.2H_2O$ (0.5%) treatment.

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