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STUDIES ON EFFECT OF PRIMING TREATMENTS ON GERMINATION AND SEEDLING ESTABLISHMENT AND THEIR CORRELATION IN GUAR (*CYAMOPSIS TETRAGONOLOBA* L.)

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SUMMARY

Different seed priming treatments T_1 (H-D), T_6 (KNO_3, 0.5%) and T_8 (*Pseudomonas* culture) enhanced germination (6.66-12.66%) in good quality seed-lot of small seeded guar variety HG-365, whereas the treatment T_3 (GA_3, 50 ppm), T_5 (PEG-6000, -5 bar) and T_7 (*Rhizobium* culture) improved the germination percentage (6.67-11.00%) considerably over control in good quality seed-lot of medium bold variety HG-563. The treatments T_3, T_5, T_1 and T_6 enhanced field emergence (3.83-7.5%) in good quality lot of HG-365, whereas the treatments T_1 and T_3 enhanced seedling establishment (SET) percentage (6.00-6.33%) over control in marginal seed lot of HG-563. Similar trend was found for field emergence index (FEI) and mean emergence time (MET) for both the varieties. The SET was found significantly and positively correlated with standard germination, vigour indices (VI-I and VI-II), accelerating ageing (AA), and FEI and negatively with MET. These parameters can be used as reliable predictors of field emergence potential and seedling establishment. Overall, the treatment T_3 (GA_3, 50 ppm) was found commonly superior in all variety-lot combinations, for enhancing standard germination, final field emergence and reducing the mean emergence time.

Key words : Guar, priming, standard germination, vigour indices, mean emergence time, seedling emergence and establishment

The clusterbean (*Cyamopsis tetragonoloba* L.), commonly known as 'guar', is an important **kharif** legume crop of arid and semi-arid regions of the country. Being an important component of cropping system in these regions, it is a multipurpose crop cultivated for green manure, fodder and feed, vegetable and also enriches the soil fertility through atmospheric nitrogen fixation. Besides, guar has got great recognition as an industrial crop due to presence of water soluble natural polymer galactomannan gum. Moisture stress conditions prevailing during sowing and crop growth period greatly affect the production and productivity of the crop. Several improved seed invigoration techniques are being used in many parts of the world to reduce the germination time, synchronize germination, improved germination rate and increase plant stand (Lee and Kim, 2000). Among these the seed priming is a widely used technique to enhance seed performance, notably with respect to rate and uniformity of germination thereby enabling better crop establishment under a range of environmental conditions (Bradford, 1986). Therefore, present study was undertaken in field as well as laboratory of Seed Science & Technology, CCS Haryana Agricultural University, Hisar, Haryana in kharif season to assess the effects of different types of priming treatment (hydro-, halo-, osmo- and biopriming) on physiological and field parameters.

MATERIALS AND METHODS

The seed material consisted of two lots (L_1- 80, 77% and L_2-55, 67% germination) each of two popular varieties of guar [HG-365(V_1) and HG-563(V_2)]. The seeds of all the variety-lot combinations were treated at

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20°C with different priming treatments viz., T_1 (water soaking for 8 h), T_2 (T_1+thiram dressing @ 2 g/kg seed), T_3 (soaking in GA_3, 50 ppm for 12 h), T_4 (soaking in cytokinin, 100 ppm for 12 h), T_5 (soaking in PEG-6000, -8 bars for 12 h), T_6 (soaking in KNO_3, 0.5% for 8 h), T_7 (Treated with *Rhizobium* culture strain GRA6), T_8 (Treated with *Pseudomonas* culture strain WPS3), T_9 (Treated with GRA6)+WPS3 strains), and compared with T_0 (control).

After each treatment, the seeds were dried at room temperature under shade to the initial seed weight. The observations were recorded on physiological and biochemical quality parameters in laboratory as well as on field viz., standard germination (SG, ISTA), vigour indices (Abdul Baki and Anderson, 1973), dehydrogenase activity test (DHA, Kittock and Law, 1968), field emergence index (FEI, Maguire, 1962), mean emergence time (MET Ellis and Roberts, 1980) and seedling establishment (SET, field emergence expressed in percentage). The mean data recorded on different parameters were subjected to statistical and graphical analysis.

RESULTS AND DISCUSSION

Standard Germination

Highly significant mean sum of squares for treatment combinations, varieties, lots and their interaction indicated the presence of substantial amount of variation for all the parameters studied. Significant differences were also found among sources (varieties and lots) to respond to the priming treatments.

TABLE 1
Mean performance of different variety-lot combinations for seed germination (%) after priming treatments

Treatment	Priming			
	V_1L_1	V_1L_2	V_2L_1	V_2L_2
T_0	74.67	51.33	75.33	66.67
T_1	81.33	44.33	79.33	60.00
T_2	68.00	36.00	80.67	63.33
T_3	76.67	54.33	82.00	46.67
T_4	76.67	20.00	65.33	47.33
T_5	69.33	36.67	83.33	56.00
T_6	81.33	39.33	72.00	63.33
T_7	78.00	31.00	86.33	47.33
T_8	87.33	38.67	78.33	46.00
T_9	77.33	22.00	81.33	36.00
S. Em	2.28	2.28	2.28	2.28
C. D. (P=0.05)	6.42	6.42	6.42	6.42
CV	6.41	6.41	6.41	6.41

Perusal of mean data (Table 1) indicated that in good quality seed-lot (L_1) of both the varieties, the standard germination was enhanced (6.66-12.66%) by the treatments T_1 (H-D), T_6 and T_8 in variety HG-365, whereas in variety HG-563 treatments T_3, T_5 and T_7 improved the germination percentage (6.67-11.00) over control. However, none of the treatments enhanced the germination effectively over control in marginal seed lots of both the varieties except treatment T_3 in HG-365. Ashrafi and Razmjoo (2010) showed the improvement in germination, germination rate, germination uniformity after hydropriming in safflower cv. Kuseh. Different methods and studies such as hydro-priming and osmo-priming of seeds have earlier been employed to improve the germinability and vigour potential in various crops (Maity *et al*., 2000 in moongbean; Singh *et al*., 2004 in okra; Pandita and Nagarajan, 2004 in bittergourd).

Vigour Index

The treatments T_1 and T_8 enhanced the magnitudes of both the vigour indices in L_1 lot of the variety HG-365 (Table 2). In L_1 lot of variety HG-563, the treatments T_2 and T_5 improved the VI-I and the treatments T_8 and T_7 enhanced the VI-II over the control. In marginal seed lot (L_2), only one treatment T_3 (GA_3, 50 ppm) responded positively for VI-I in the variety HG-365, whereas the treatments T_1, T_2 and T_6 responded fairly well as compared to control in L_2 lot of HG-563 variety. Soybean seeds primed with salt solutions of $CaCl_2$ (0.5%), KH_2PO_4 (50 ppm) and plant growth hormone (GA_3) were found effective to enhance germination, vigor indices and higher speed of germination significantly especially in marginal seed vigour-lots (Kiros *et al*., 2008).

Dehydrogenase Enzyme Activity

Measurement of the dehydrogenase enzyme activity is an important biochemical indicator of vigour potential of a seed-lot and plays crucial role in respiration during germination and seedling emergence. The treatments T_1, T_5, T_6, T_7, T_8 and T_9 enhanced dehydrogenase activity over control in L_1 lot of the variety HG-365, whereas in L_2 lot, all the treatments enhanced

TABLE 2
Mean performance of different variety-lot combinations for vigour indices after priming treatments

Treatment	Priming							
	Vigour index-I				Vigour index-II			
	V_1L_1	V_1L_2	V_2L_1	V_2L_2	V_1L_1	V_1L_2	V_2L_1	V_2L_2
T_0	19.53	8.43	22.78	14.10	1063.80	614.07	1100.27	595.07
T_1	22.66	6.12	21.41	9.95	1221.27	419.27	1268.07	649.13
T_2	18.36	5.97	24.46	10.63	823.27	427.87	950.80	697.53
T_3	21.84	11.08	22.02	8.15	1128.53	635.20	874.67	607.47
T_4	15.34	1.82	15.11	5.24	1150.73	208.00	852.93	512.93
T_5	18.88	5.03	24.55	9.15	1067.47	304.20	1101.80	533.33
T_6	21.06	6.17	19.25	9.40	1109.00	574.27	873.20	651.80
T_7	19.46	4.45	22.74	9.98	830.00	352.00	1330.00	431.33
T_8	22.18	4.92	21.09	7.04	1342.20	428.97	1083.33	435.87
T_9	19.15	2.78	22.53	6.08	964.33	192.53	1128.81	463.33
S. Em	0.94	0.94	0.94	0.94	46.71	46.71	46.71	46.71
C. D. (P=0.05)	2.64	2.64	2.64	2.64	131.77	131.77	131.77	131.77
CV	11.57	11.57	11.57	11.57	10.44	10.44	10.44	10.44

dehydrogenase enzyme activity over control (Table 3. Similarly, treatments T_7, T_8, T_9, T_2 and T_1 substantially enhanced dehydrogenase activity over control in L_1 lot of the variety HG-563, whereas in L_2 lot, treatments T_1, T_2 and T_3 enhanced the dehydrogenase activity over control in. Steiner *et al*. (1989) reported that dehydrogenase enzyme activity test was found the best predictor of seedling emergence in wheat. Similar correlations were also reported by Kharb *et al*. (1994) in pigeon pea and Krishnappa *et al.* (1999) in ground nut.

TABLE 3
Mean performance of different variety-lot combination for Dehydrogenase Activity (DHA) after priming treatments

Treatments	Priming			
	V_1L_1	V_1L_2	V_2L_1	V_2L_2
T_0	0.197	0.205	0.469	0.204
T_1	0.458	0.439	0.556	0.572
T_2	0.229	0.400	0.584	0.406
T_3	0.185	0.414	0.346	0.306
T_4	0.179	0.448	0.381	0.248
T_5	0.264	0.447	0.493	0.224
T_6	0.318	0.371	0.439	0.207
T_7	0.282	0.352	0.825	0.201
T_8	0.304	0.309	0.688	0.197
T_9	0.289	0.337	0.686	0.206
S. Em	0.022	0.022	0.022	0.022
C. D. (P=0.05)	0.062	0.062	0.062	0.062
CV	10.31	10.31	10.31	10.31

Field emergence potential

For examining the effect of various priming treatments on field emergence potential in the field, three parameters, namely, field emergence index (FEI), mean emergence time (MET) and seedling establishment (SET) were considered (Table 4). Rapid and uniformity of seedling emergence can be assessed by FEI and MET taken for final seedling establishment. It was observed that the treatments T_3, T_5 and T_1, and T_6 enhanced field emergence (3.83-7.50%) effectively over control in V_1L_1, whereas the treatments T_1 and T_3 enhanced SET percentage over control in L_1 seed lot of V_2 (HG-563). Similar trend was found for FEI and MET in both the varieties meaning thereby the treatments which enhanced the SET percentage also emerged quickly (in less time) and uniformly. In L_2 seed-lot of both the varieties, none of the treatments was found promising as any of the treatments enhanced the SET percentage significantly. Among these, the treatments T_3 (GA_3, 50 ppm) was found superior in all variety-lot combinations. It was reported that the treatment GA_3 (50 ppm) gave superior results than other treatments in groundnut (Jha, 2007). Ashrafi and Razmjoo (2010) reported higher seedling emergence and seedling emergence rate after hydropriming in safflower cv. Kuseh. Similar results were also reported by Narayanareddy *et al.,* (2008) in sunflower and Singh *et al.* (2004) in okra. The promoting

TABLE 4
Mean performance of different variety-lot combinations for seedling emergence potential after priming treatments

Treatment	Priming											
	FEI				MET				SET			
	V_1L_1	V_1L_2	V_2L_1	V_2L_2	V_1L_1	V_1L_2	V_2L_1	V_2L_2	V_1L_1	V_1L_2	V_2L_1	V_2L_2
T_0	42.81	9.26	44.60	17.26	3.37	4.65	3.25	4.29	52.00	23.50	63.00	38.33
T_1	39.93	9.42	49.91	10.72	3.65	4.81	2.99	5.40	56.33	17.17	69.33	33.17
T_2	37.46	9.81	43.19	14.15	3.80	4.84	3.33	3.85	53.83	15.33	59.17	25.83
T_3	44.88	10.81	56.88	17.57	3.23	3.38	3.00	4.40	59.50	15.83	69.00	30.67
T_4	29.17	2.14	36.83	5.60	3.83	6.09	3.70	6.00	45.67	5.00	55.17	14.00
T_5	38.15	8.75	49.85	19.30	3.98	5.54	3.12	4.75	57.83	22.17	65.83	38.00
T_6	44.40	10.71	52.43	13.56	2.74	5.09	3.17	5.90	55.83	18.83	66.00	28.83
T_7	22.86	5.86	35.04	13.48	4.95	6.68	4.41	6.23	47.67	16.33	66.17	33.67
T_8	29.79	7.28	31.73	6.25	4.74	5.98	4.74	6.59	53.33	21.83	64.83	20.17
T_9	24.09	6.59	36.37	7.20	4.88	5.89	4.27	6.62	50.00	19.00	67.33	22.50
S. Em	1.92	1.92	1.92	1.92	0.26	0.26	0.26	0.26	2.14	2.14	2.14	2.14
C. D. (P=0.05)	5.42	5.42	5.42	5.42	0.72	0.72	0.72	0.72	6.02	6.02	6.02	6.02
CV	13.13	13.13	13.13	13.13	9.71	9.71	9.71	9.71	8.92	8.92	8.92	8.92

TABLE 5
Correlation coefficients among laboratory and field emergence parameters after priming

	SG	VI-I	VI-II	DHA	FEI	MET	SET
SG	1.00	0.954**	0.933**	0.256	0.844**	-0.731**	0.899**
VI-I		1.00	0.927**	0.321*	0.915**	-0.768**	0.948**
VI-II			1.00	0.314*	0.832**	-0.714**	0.884**
DHA				1.00	0.254	-0.216	0.316*
FEI					1.00	-0.850**	0.951**
MET						1.00	-0.733**
SET							1.00

*,**Significant at P=0.05 and P=0.01 levels, respectively.

effects of the different treatments on speed of emergence and field establishment may be due to enhanced hydration of all seed parts and thus reducing the damage of embryonic axis (Ramadevi and Gopalkrishnan, 2001).

Relationship between Laboratory Tests and Seedling Establishment

According to the correlation coefficients as given in Table 5, the standard germination was found significantly and positively correlated with VI-I (0.954**), VI-II (0.933**), FEI (0.844**), SET (0.899**) and negatively with MET (-0.731**). Similarly, the SET showed highly significant and positive association with SG (0.899**), VI-I (0.948**), VI-II (0.884**), FEI (0.951**), DHA (0.316*) and negative with MET (-0.733**). Interestingly, these parameters were also found significantly correlated among themselves. The relationships between SG and VI-I (0.954**) and SG and SET (0.899**) are clearly shown in Figs. 1 and 2, respectively. Therefore, these parameters can be used as reliable predictors of field emergence potential and seedling establishment. Similar results were reported in soybean (Yaklich and Kulik, 1979), pigeonpea (Kharb *et al*., 1994) and maize (Mathews and Hosseini, 2006).

CONCLUSIONS

Seed priming technique is usually used to invigorate the quality of a seed lot for better performance under stress and sub-optimal conditions. From the results

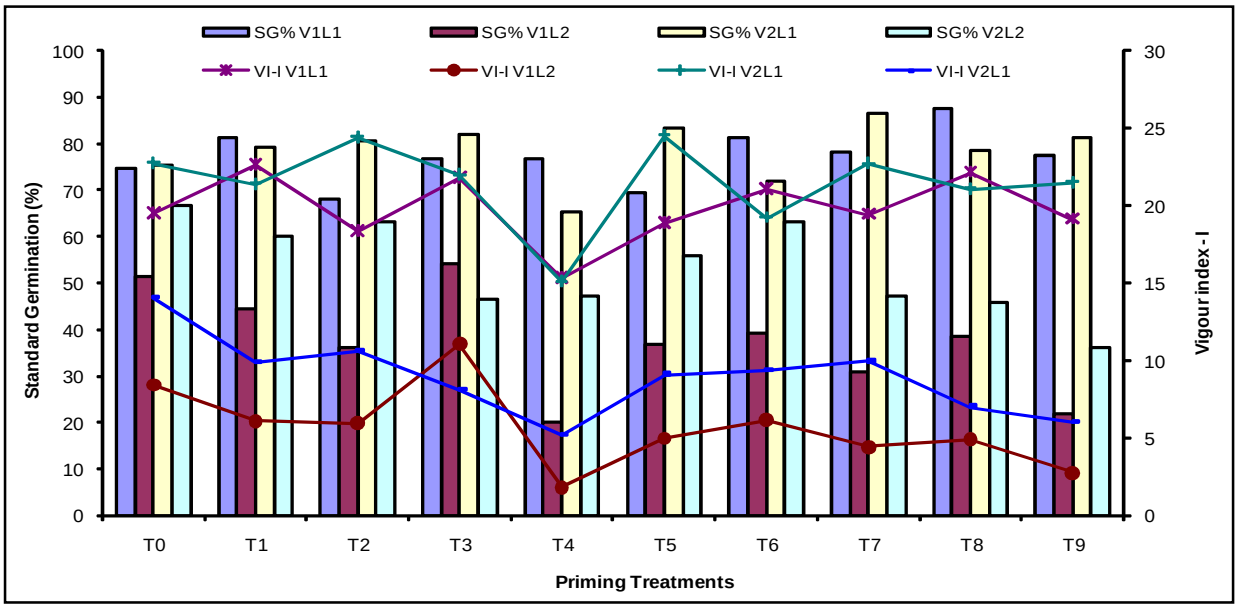

Fig. 1. Effect of priming treatments on germination and vigour index-1.

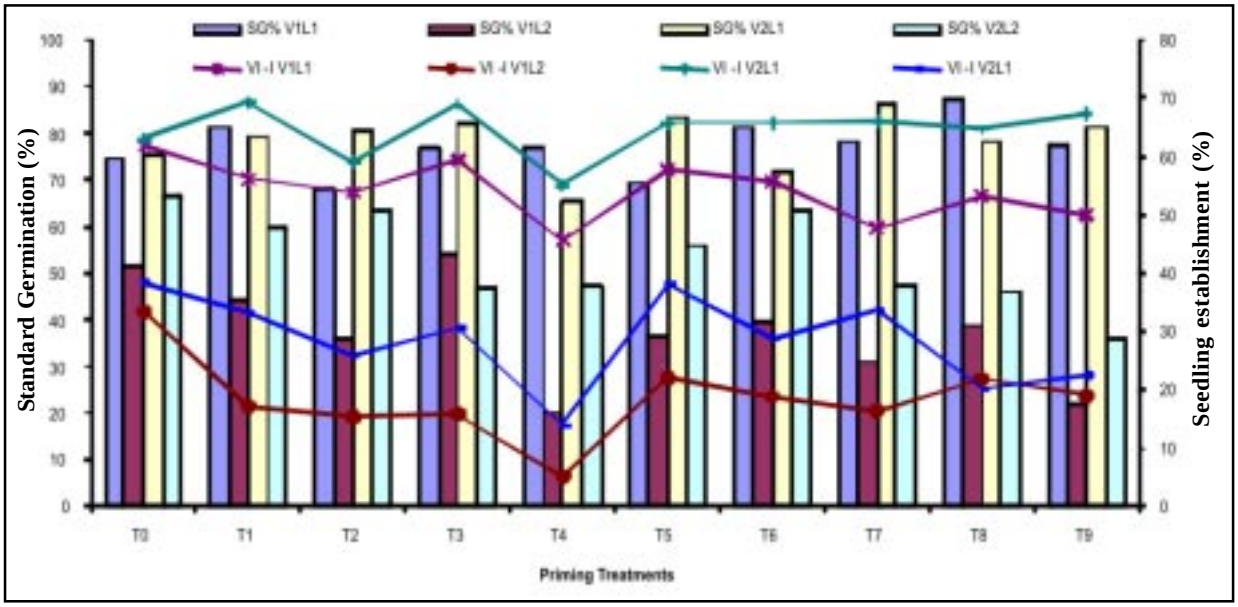

Fig. 2. Effect of priming treatments on germination and seedling establishment.

under stress and sub-optimal conditions. From the results of study, it can be concluded that in good quality seed-lots (L_1) of both the varieties, the standard germination was enhanced by the treatments T_1 (H-D), T_6 (KNO_3, 0.5%), and T_8 (*Pseudomonas* culture) in variety HG-365, whereas the treatments T_3 (GA_3, 50 ppm), T_5 (PEG-6000) and T_7 (*Rhizobium* culture) improved the germination percentage in variety HG-563. Similar results were found for vigour indices also. There was overall improvement in the SET, FEI and MET in the good quality seed lot of both the varieties after treatment with T_3, T_5, T_1 and T_6. However, there was no noticeable improvement in the marginal seed lot of both the varieties for these parameters. Though a variable response to the treatments was observed in this investigation, yet the treatment T_3 (GA_3, 50 ppm) was found the most promising and effective for improving the germination and field emergence potential in guar crop.The seedling establishment was found significantly and positively correlated with standard germination, vigour indices, field

time which can be used as reliable predictor of field emergence potential and seedling establishment in the field.

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