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Mid storage invigouration for viability maintenance in cluster bean *[Cyamopsis tetragonoloba* (L.) Taub.]

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Abstract: Invigouration treatments can be successfully employed to prolong the shelf-life of unsold stock and highly useful for long term storage. Cluster bean seeds of low vigour could be invigourated using KH_2PO_4 (10^{-3}M) and recorded an improvement in germination initially and after four months of storage.

Key words: Cluster bean, invigouration, storability.

Introduction

Mid-storage seed invigouration treatments are physiological treatments that imply an improvement in physiological status of seed, thereby achieved improved germinability, greater storability and better performance than the corresponding untreated seeds (Basu, 1994).

The efficacy of hydration-dehydration treatment on vigour and viability maintenance has been studied extensively in number of crops (Basu *et al.,* 1974; Dharmalingam and Basu, 1978; Rudrapal and Nakamura, 1988; Basu, 1990 and Natarajan, 1998). This method is different from conventional pre-sowing treatment, where the short duration soaking and drying treatments are given to stored seeds with a sufficient time gap between treatment and sowing. The treatments are effective not only for viability maintenance, but also for increasing the productivity of resultant crop (Mandal and Basu, 1986).

Pulses are poor storers. These seeds lost their viability in a very short period of storage because of the high protein content. As other pulses, cluster bean seeds also lost their vigour within one year of storage period. The germination percentage of seeds is reduced below the standard germination (70 %) within an year. To improve the germinability of unutilized stock and as well as to prolong further storability with high vigour, the mid-storage invigouration treatments are highly warranted. These treatments would invigourate the low vigour seeds to achieve better emergence and establishment. Hence, the study was made.

Materials and Methods

Different methods were followed in mid-storage invigouration. They were soaking-drying, dipping-drying, moisture- equilibration-drying, moist sand conditioning-drying and moist sand conditioning and soaking-drying. These methods were tried in order to standardize an optimum method, suitable for invigouration of low vigour cluster bean seeds. The variety taken for the study was Pusa Navbhagar with a germination percentage of 70 and the moisture content of the seeds was 9 percent.

I. Standardization of methodology for mid-storage correction

One year old seeds of cluster bean cv. Pusa Navbhagar with a germination percentage of 70 and moisture content of 9 percent were given with mid-storage treatments, adopting

Table 1. Influence of mid-storage correction treatments on seed and seedling quality characteristics of cluster bean

Methods of mid-storage correction	Germination (%)	Root length (cm)	Shoot length (cm)	Dry matter production 10 seedling^{-1} (mg)	Vigour index	Electrical conductivity (dSm^{-1})
Control	70 (56.79)	11.3	11.9	137	1624	0.280
Moisture equilibration (24h)	78 (62.03)	12.3	14.1	146	2059	0.253
Moisture equilibration (48h)	72 (58.05)	11.5	13.1	153	1771	0.262
Soaking - drying	80 (63.43)	12.8	14.3	162	2168	0.240
Dipping- drying	77 (61.34)	12.0	13.9	143	1994	0.258
Moist sand conditioning -drying	77 (61.34)	12.0	14.0	148	2002	0.255
Moist sand conditioning -soaking drying	75 (60.00)	11.8	12.2	145	1800	0.270
Mean	**76 (60.67)**	**12.0**	**13.4**	**148**	**1917**	**0.260**
SEd	0.779	0.484	0.280	1.992	109.2	0.003
CD(P=0.05)	1.558	0.968	0.600	4.187	234.2	0.007

(Figures in parentheses indicate arc sine transformed values)

the following methods as explained by Basu (1994).

Soaking-drying

In this method, seeds were soaked in double the volume of water for 2h at room temperature (28$\pm$1°C) with occasional stirring. After decanting the excess amount of water, the seeds were surface dried with blotters and dried back to the original moisture content (9 percent) under shade.

Dipping-drying

Seeds were dipped in water for 5 min. with stirring. After that, the excess water was decanted and seeds were covered with a tray for 2-3h. Then dried back to its original moisture content (9 percent) under shade.

Moisture-equilibration-drying

The seeds were placed in a moisture saturated atmosphere, created by using two enamel trays of equal size (45 x 30 x 8 cm), where the bottom tray was filled with water to half of its depth, into which a perforated plastic tray was placed upside down over which a germination paper was spread to hold the seeds in a single layer on its surface, and the upper enamel tray was placed over the bottom one and this assembly was made completely airtight and was incubated at room temperature (28+ 1°C). In this assemblage, the seeds were kept for a duration of 24h and dehydrated back to the original moisture content (9 percent) under shade.

Moist sand conditioning-drying

In this method, sterilized air-dry sand was pre-moistened with water to 60 percent and then seeds were thoroughly

Table 2. Influence of mid-storage seed invigouration treatments on seed and seedling quality characteristics of clusterbean

Seed invigouration treatments (T)	Periods in months (P)											
	Germination (%)			Root length (cm)			Shoot length (cm)			Drymatter production 10 seedling^{-1} (mg)		
	P_0	P_4	M	P_0	P_4	M	P_0	P_4	M	P_0	P_4	M
Control	75(60.00)	60 (50.77)	65 (53.73)	9.8	8.1	9.0	10.2	8.2	9.2	130	118	124
Water	78 (62.03)	68 (55.55)	73 (58.69)	11.2	10.5	10.9	10.6	9.3	10.0	144	130	137
NaCl(10^{-3}M)	80 (63.43)	72 (58.05)	76 (60.67)	11.2	10.8	11.0	11.3	10.5	10.9	155	140	148
KI(10^{-3}M)	84 (66.42)	1 76 (60.67)	80(63.43)	11.3	10.9	11.1	12.0	11.2	11.6	170	154	162
KH_3PO_4(10^{-3}M)	86 (68.03)	78 (62.03)	82 (64.90)	11.5	11.1	11.3	12.3	11.8	12.1	175	158	167
Ascorbic acid (10^{-3}M)	77(61.34)	70 (56.79)	74 (59.34)	10.6	10.0	10.3	9.5	8.6	9.1	160	148	154
Na_2HPO_4(10^{-3} M)	82 (64.90)	74 (59.34)	78 (62.03)	11.3	10.8	11.1	11.3	10.6	11.0	150	140	145
Turmeric (1%)	76 (60.67)	64(53.13)	70 (56.79)	11.1	10.4	10.8	9.7	8.6	9.2	160	146	153
Simaruba(l%)	78 (62.03)	64(53.13)	71(57.42)	11.3	10.5	10.9	10.3	9.2	9.8	156	144	150
Prosopis(l%)	78 (62.03)	64(53.13)	71 (57.42)	11.0	10.4	10.7	11.5	10.6	11.1	157	142	150
Pungam(l%)	86 (68.03)	68(55.55)	77(61.34)	11.5	10.8	11.2	12.0	11.5	11.8	158	143	151
Redchilli (1%)	84 (66.42)	76 (60.67)	80 (63.43)	10.7	10.0	10.4	11.2	10.7	11.0	167	150	159
Fenugreek (1%)	76 (60.67)	66 (54.33)	71 (57.42)	10.3	9.4	9.9	10.5	9.2	9.9	151	140	146
Mean	**80 (63.43)**	**69 (56.17)**	**75 (60.00)**	**11.0**	**10.3**	**10.6**	**11.0**	**10.0**	**10.5**	**156**	**143**	**150**
	T	P	Tx P	T	P	Tx P	T	P	Tx P	T	P	Tx P
SEd	1.29	0.51	1.83	0.10	0.26	0.30	0.11	0.22	0.33	15.85	6.20	22.0
CD (P=0.05)	2.66	1.04	3.76	0.23	0.66	NS	0.27	0.57	NS	32.58	12.78	NS

(Figures in parentheses indicate arc siie transformedvalues)

mixed with moist sand at the ratio of 3:1 (3 parts of sand and 1 part of seed) and kept covered for 24h for the slow absorption of moisture. Then the seeds were sieved and dried under shade to bring back its original moisture content (9 percent).

Moist sand conditioning and soaking-drying

Seeds were conditioned in moist sand for 24h following the method of moist sand conditioning-drying and the moistened seeds were soaked in water for 2h followed by drying back to its original moisture content (9 percent) under shade.

The seed samples subjected to different methods of mid storage treatments were evaluated for the seed and seedling quality parameters *viz.* germination, root length, shoot length, drymatter production and vigour index.

Among the different methods of seed invigouration, soaking-drying method was found to be very effective. In this invigouration treatment the germination percentage and vigour of the seedling were increased to 15 and 33 per cent respectively than the untreated control seeds. The other methods were also found to be very effective but superior performance was recorded for soaking-drying method. Hence, soaking-drying method was selected for further study. The effectiveness of soaking drying method was reported by many scientists (Rudrapal and Nakamura, 1988 and Ramamoorthy and Natarajan, 1997).

Doijode and Raturi (1987) reported that in garden pea hydration-dehydration treatment improved the germination percentage and seedling vigour. While Bhattacharya and Basu (1990) stated that the loss of vigour and viability of garden pea cultivars could be effectively controlled by soaking-drying and as well as by moisture equilibration-drying method and this was also proved by Ramamoorthy *et al.* (1992).

In soybean, Saha and Basu (1982) suggested that moisture equilibration of stored seeds with a water saturated atmosphere for 24h followed by soaking in water for 2h and then drying back to the original weight significantly reduced the loss of germinability of seeds during subsequent storage. Saha *et al.* (1990) also reported that soaking-drying treatments of stored seeds greatly reduced the loss of vigour and viability under accelerated as well as natural ageing conditions. Mandal *et al.* (2000) also found the superiority of soaking-drying and moist sand conditioning-drying method for improvement of germination and seedling vigour in soybean.

II. Influence of different chemicals and botanicals on mid-storage correction

With the standardized method of soaking-drying using the following chemicals *viz.*, sodium chloride (10^{-3} M), potassium iodide (10^{-3} M), potassium dihydrogen phosphate (10^{-3} M), ascorbic acid (10^{-3} M), sodium dihydrogen phosphate (10^{-3} M) and botanicals *viz.* turmeric rhizome powder solution (1%), leaf extracts of *Simaruba glauca* (1%), *Prosopis juliflora* (1%), *Pongamia pinnata* (1%), red chili *(Capsicum annum)* powder solution (1%) and fenugreek *(Trigonella foenum-graecum)* seed powder solution (1%) the cluster bean seeds variety Pusa Navbhagar with a germination percentage of 70 and moisture content of 9 percent were invigourated. The seeds were soaked for a duration of 2h in these chemicals and botanicals. Then the solution was decanted and seeds were dried under shade to the safer moisture level of 9 percent (original moisture content) and treated with bavistin @ 2 g kg^{-1} of seeds to protect against fungal development.

Then, the seeds were subjected to different seed quality evaluations initially and four months after as detailed below along with the control. The experiment was statistically analysed, adopting the procedure described by Gomez and Gomez (1984). Wherever necessary, the percentage values were transformed to angular (arc sine) values, before carrying out the statistical analysis. The critical difference (CD) was worked out at 5 per cent (P = 0.05) level and wherever "F" value is non-significant it is denoted by "NS".

Result and Discussion

In the present study, irrespective of the chemicals and botanicals, all the treatments were found to be very effective.

Irrespective of the chemicals and botanicals, all the treatments proved their superiority over the untreated seeds initially and after four months of storage. Among the treatments, KH_2PO_4 (10^{-3}M) recorded 15 percent higher germination than the control, initially and it was followed by *Pongamia pinnata* leaf extract (1%). Subramanian and Misra (1980) reported that seed treatment with KH_2PO_4 resulted in maintenance of higher water balance in the tissue and enhanced the photo synthetic activity and ultimately contributed to increase in establishment. Mukhopadhyay *et al.* (1997) reported the use of potassium phosphate (dibasic) in hydration-dehydration treatment for the improvement of immediate and post storage seed germinability and revealed the relationship between germination improvement and the reduction in volatile aldehyde production.

The seed invigouration effect obtained with KI (10^{-3} M) and red chilli powder (1%) were found to be the next best and followed by Na_2HPO_4 (10^{-3} M), turmeric rhizome powder (1%), pungam leaf extract (1%) which were at par and was followed by ascorbic acid (10^{-3} M), NaCl (10^{-3} M) and water. The other invigouraiton treatments with *Simaruba glauca* (1%), *Prosopis juliflora* (1%) and *Trigonella foenum-graecum* seed powder (1%) also recorded an improvement in germination of 9 percent than the control seeds, both during initial and after four months of storage. As like germination, the other vigour parameters estimated through seedling length and drymatter production were found to be the maximum with KH_2PO_4 (10^{-3}M), followed by *Pongamia pinnata* leaf extract (1%) for the reasons discussed earlier. However, the seeds invigourated with *Pongamia pinnata* leaf extract (1%), recorded a low germination of 68 percent after four months of storage, while red chilli powder (1%) and KI(10^{-3}M) maintained the germination even after four months of storage at higher levels than pungam.

The electrical conductivity of the seed leachate after four months of storage was also lower in seeds treated with KH_2PO_4 (10^{-3}M), KI (10^{-3}M), Na_2HPO_4 (10^{-3}M), *Pongamia pinnata* leaf extract (1%) and red chili powder (1%), due to the protection given by these chemicals/plant products against the membrane damage. Pal and Basu (1993; 1994) and De *et al.* (1998) also reported the effect of turmeric rhizome powder and redchilli powder in storing seeds of blackgram, and this technique recorded improvement in germination as capsicin the active ingredient of chilli fruit acted as an inhibitor of lipid peroxidation (Brand *et al.,* 1990; Dey and Ghosh, 1993).

The present study highlighted that, cluster bean seeds could invigourated using KH_2PO_4 (10^{-3} M) and recorded an improvement in germination of low vigour seeds with a germination per cent of 75 to 86 percent.

Table 3. Influence of mid storage seed invigouration treatments on Vigour index and Electrical conductivity (dSm^{-1}) in cluster bean

Seed invigouration treatments (T)	Periods in months (P)					
	Vigour Index			Electrical conductivity (dSm^{-1})		
	P_0	P_4	M	P_0	P_4	M
Control	1500	978	1239	0.268	0.280	0.274
Water	1700	1346	1523	0.255	0.275	0.265
NaCl(KTM)	1800	1534	1667	0.240	0.258	0.249
KI(10^{-3}M)	1957	1680	1818	0.245	0.255	0.250
KH_2PO_4(10^{-3} M)	2047	1786	1917	0.240	0.252	0.246
Ascorbic acid (10^{-3} M)	1548	1302	1425	0.254	0.272	0.263
Na_2HPO_4(10^{-3} M)	1853	1584	1718	0.248	0.260	0.254
Turmeric (1%)	1581	1216	1399	0.251	0.270	0.261
Simaruba(l%)	1685	1261	1473	0.253	0.271	0.262
Prosopis(l%)	1755	1344	1550	0.252	0.268	0.260
Pungam(l%)	2021	1516	1769	0.248	0.266	0.257
Redchilli (1%)	1840	1573	1707	0.250	0.268	0.259
Fenugreek (1%)	1581	1228	1404	0.255	0.273	0.264
Mean	**1759**	**1404**	**1582**	**0.251**	**0.267**	**0.259**
	T	P	TxP	T	P	TxP
SEd	48.86	19.17	69.10	1.6	0.65	2.3
CD (P=0.05)	100.4	39.39	142.0	3.40	1.35	NS

(Figures in parentheses indicate arc sine transformed values)

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