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Effects of Seed Pelleting on Seed Quality of Cowpea (*Vigna unguiculata* L.) During Storage

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Abstract

An experiment was conducted during 2015-2016, to study the effects of seed pelleting on seed quality parameters of cowpea variety Himachal Lobia-1 during a storage period of one year. Seeds were checked for quality parameters at a monthly interval. Two formulations of *Rhizobium viz-a-vis* powder and liquid along with control (unpelleted) were used for experiment. The analysis of variance revealed that there were significant effects of seed pelleting and storage periods on germination, seedling length, seedling dry weight, seed vigour index-I and seed vigour index-II. Seeds pelleted with liquid formulation of *Rhizobium* gave maximum germination (93.55%) whereas unpelleted seeds gave minimum germination (91.45%) when seeds were germinated using between the paper methods. However, the germination decreased as the storage period increased. It ranged from 94.42% germination at 0 month to 89.52% at 12 months of storage. The interaction effects on germination due to seed pelleting and storage periods were found to be non-significant at 5% level of significance. Seed vigour index I was found to be maximum (2980.48) when fresh seeds were pelleted with liquid *Rhizobium* and minimum (2315.58) in unpelleted seeds stored for 12 months. Seed vigour index II also followed the same trend. It was found to be maximum (7451.34) in fresh seeds pelleted with liquid *Rhizobium* and minimum (6310.23) in unpelleted seeds stored for 12 months.

Keywords: Cowpea, quality, *Rhizobium*, seed pelleting

1. Introduction

Inoculation of legume seeds with *Rhizobium* spp. improves crop performance as it was demonstrated in laboratory and field experiments (O'Callaghan, 2016). Biological nitrogen fixation leads to significant reduction in production cost incurred on nitrogen fertilizers (Marcia et al., 2014). Seed pelleting of pulses with *Rhizobium* is yet another technology recommended for higher pulse yield. It ensures the buildup of sufficient bacterial population and to have the optimum symbiosis for enhanced crop productivity. Seed inoculation with arbuscular mycorrhizal fungi and nitrogen-fixing bacteria increased protein content in chickpea (Oliveira et al., 2017) and suppressed the root-infecting fungi in mungbean (Ramzan et al., 2016). Seed pelleting encloses the seed with the small quantity of filler material just large enough to produce the globular unit of standard size. The filler material creates natural water holding media and provides small amount of nutrient to young seedlings. Seed pelleting also serves as mechanism of applying needed material in such a way that they affect the seed or soil at the seed-soil interface. These materials can be nutrients, pesticides, growth regulators, biofertilizers etc. The seed pelleting focuses on better establishment and increased productivity by precision sowing and addition of various materials along with filler material that enhance the seed quality in many ways (Vanangamudi et al., 2010).

2. Materials and Methods

2.1. Planting material

The lab experiment was carried out at experimental laboratory of Department of Seed Science and Technology, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, HP (1250 m amsl) during April 2015-April 2016. Cowpea variety selected for lab trials was Himachal Lobia-1.

2.2. Treatment details

2.2.1. Factor 1: Rhizobium application: 03

(i) Control (unpelleted)
(ii) *Rhizobium* liquid formulation + clay + adhesive
(iii) *Rhizobium* powder formulation + clay + adhesive

2.2.2. Factor 2: Storage period: 05

(i) 0 month
(ii) 3 months
(iii) 6 months
(iv) 9 months

(v) 12 months
Replications: 4
Design: CRD (factorial)

Seeds were stored under room temperature in plastic boxes. The data on temperature and relative humidity during storage in the laboratory is given in Appendix-I.

Germination (%) was calculated as per the rules laid out by ISTA. Hundred seeds from all replications of each treatment were used for conducting the germination test. This was carried out by using paper roll method in the seed germinator at 25°C. The first and final counts were taken after 7 and 14 days, respectively.

Germination (%) was calculated by using the formula:

$$\text{Germination}(\%)=\frac{\text{Number of normal seedlings}}{\text{Total number of seeds}}\times 100$$

Seed vigour index-I (SVI-I) and seed vigour index-II (SVI-II) were calculated as per the formula given by Khare and Bhale (2000).

Seed vigour index- I (SVI-I) = Germination (%) × Seedling length (cm)
Seedling vigour index-II (SVI-II) = Germination (%) × Seedling dry weight (mg)
The statistical analysis for CRD (factorial) was done as per design of experiment as suggested by Gomez and Gomez (1984).

3. Results and Discussion

The analysis of variance revealed that there were significant effects of seed pelleting and storage periods on germination %, seedling length, seedling dry weight, seed vigour index-I and seed vigour index-II.

3.1. Germination (%)

The perusal of data presented in Table 1 indicated that different type of pelleting and different storage period had significant effects on germination. Among different types of pelleting, maximum germination (93.55%) was found with *Rhizobium* culture pelleted seeds (T_2) and minimum (91.45%) was found in unpelleted seeds (T_1). Different storage period had also exhibited significant effects on germination. Maximum germination (94.42%) was found at 0 month (S_0) which was at par with 3 months (93.75%). However, minimum germination (89.58%) was found at 12 months of storage (S_{12}). The interaction effects on germination due to seed pelleting and storage periods were found to be non-significant at 5% level of significance.

The growth promoting substance and nutrients present in the pelleting material helped for better seedling performance. Such beneficial influence of pelleting material in enhancing storability and seed quality was reported in cowpea (Maraddi, 2002), Bengal gram (Patil et al., 2002) and maize (Sharma, 1995). The enhancement in germination of seeds pelleted with *Rhizobium* might also be due to continuous supply of nutrients from pellet and increased cytokinin production which actively involved in cell division and production of growth regulating substances like auxin, gibberellins and cytokinin. Similar findings have been reported in brinjal (Satish kumar et al., 2014) and chilli (Jerlin et al., 2008). The higher germination in fresh pelleted seeds as compared to old pelleted seeds is due to age of seeds because loss of germination ability depends upon the time span as also reported by Aquilla (1987). The major reason for loss in germinability of seeds stored at ambient conditions seems to be the DNA degradation in seeds during ageing or impaired transcription or lipid peroxidation in seeds (McDonald and Copeland, 1995).

Table 1: Effect of seed pelleting on seed germination during storage

Treatments	Germination (%)					
	Storage Duration (Months)					
	S_0	S_3	S_6	S_9	S_{12}	Mean
T_1	93.25 (9.71)	92.75 (9.68)	91.75 (9.63)	90.25 (9.55)	89.25 (9.50)	91.45 (9.61)
T_2	96.00 (9.85)	95.00 (9.80)	94.50 (9.77)	92.25 (9.66)	90.00 (9.54)	93.55 (9.72)
T_3	94.00 (9.75)	93.50 (9.72)	93.00 (9.70)	90.75 (9.58)	89.50 (9.51)	92.15 (9.65)
Mean	94.42 (9.77)	93.75 (9.73)	93.08 (9.70)	91.08 (9.60)	89.58 (9.51)	

Figures in parenthesis are square root transformed.

Factor	T	S	T × S
SEm±	0.01	0.01	-
CD (*p*=0.05)	0.03	0.04	NS

S_0: (0 month); S_3: (3 months); S_6: (6 months); S_9: (9 months); S_9: (12 months); T_1: (Control); T_2: (*Rhizobium* culture pelleting); T_3: (*Rhizobium* powder pelleting);

3.2. Seed vigour index-I

The results on seed vigour index-I as influenced by seed pelleting and storage period are presented in Table 2. Maximum seed vigour index-I (2786.66) was found in *Rhizobium* culture pelleted seeds (T_2) and minimum (2563.37) was found in the unpelleted seeds (T_1).Storage period also influenced seed vigour index-I. Maximum seed vigour index-I (2869.07) was found in fresh pelleted seeds (S_0) and minimum seed vigour index-II (2471.99) was found at 12 months (S_{12}). The interaction effects due to seed pelleting and storage period were found to be significant at 5% level of significance. Maximum seed vigour index-I (2980.48) was found in T_2S_0 (*Rhizobium* culture pelleting + 0 month) and minimum seed vigour index-I (2315.58) was found in T_1S_{12} (control + 12 months).

The enhanced seed vigour index-I of pelleted seeds might be due to higher germination and increased seedling length. The reduced seedling vigour might be due to decreased germination and seedling length with increasing age of seeds.

Table 2: Effect of seed pelleting on seed vigour index-I during storage

Treatments	Seed vigour index-I					
	Storage duration (Months)					
	S_0 (0 month)	S_3 (3 months)	S_6 (6 months)	S_9 (9 months)	S_{12} (12 months)	Mean
T_1	2792.70	2752.03	2571.60	2384.95	2315.58	2563.37
T_2	2980.48	2947.25	2806.88	2640.38	2558.33	2786.66
T_3	2834.03	2800.15	2682.68	2599.78	2542.08	2691.74
Mean	2869.07	2833.14	2687.05	2541.70	2471.99	
Factor	T		S		T×S	
SEm±	13.61		17.57		30.45	
CD (p=0.05)	38.67		49.92		86.48	

The ageing or deterioration of seeds is a progressive process, which reduced germination capacity and growth of seedlings with increasing age (Floris, 1970).

3.3. Seed vigour index-II

The results on seed vigour index-II as influenced by different seed pelleting and storage periods are presented in Table 3. Maximum seed vigour index-II (6981.37) was found in *Rhizobium* culture pelleted seeds (T_2) and minimum (6546.27) was found in the unpelleted seeds (T_1). Storage period also influenced seed vigour index-II. Maximum seed vigour index-II (7130.85) was found at 0 month (S_0) and minimum seed vigour index-II (6419.89) was found at 12 months (S_{12}). The interaction effects due to seed pelleting and storage period were found to be significant at 5% level of significance. Maximum seed vigour index-II (7451.34) was found in T_2S_0 (*Rhizobium* culture pelleting + 0 month) and minimum seed vigour index-II (6310.23) was found in T_1S_{12} (control + 12 months).

The enhanced seed vigour index-II of pelleted was due to increased germination and seedling dry weight. The reduction in seedling vigour in old pelleted seeds was due to reduction in germination and seedling dry weight. The ageing or deterioration of seeds is a progressive process, which reduced germination capacity and growth of seedlings with increasing age (Floris, 1970).

Table 3: Effect of seed pelleting on seed vigour index-II during storage

Treatments	Seed vigour index-II					
	Storage Duration (Months)					
	S_0 (0 month)	S_3 (3 months)	S_6 (6 months)	S_9 (9 months)	S_{12} (12 months)	Mean
T_1	6765.67	6643.18	6566.47	6445.80	6310.23	6546.27
T_2	7451.34	7116.85	7029.49	6773.02	6536.14	6981.37
T_3	7175.53	6977.37	6806.71	6520.68	6413.30	6778.72
Mean	7130.85	6912.46	6800.89	6579.83	6419.89	
Factor	T		S		T × S	
SEm±	23.53		30.38		52.63	
CD (p=0.05)	66.84		86.29		149.47	

4. Conclusion

Seed pelleting is found to be a proven method to improve cowpea germination. Pelleting of fresh seeds with Rhizobium liquid culture improves seed quality parameters considerably.

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