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Vigour and viability of hardened and pelleted seeds of blackgram (*Vigna mungo* (L.) Hepper)

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Abstract: Seeds of blackgram (*Vigna mungo* (L.) Hepper) cv. Vamban 3 were given hardening treatment with 100 ppm $ZnSO_4$ and with 1% *Prosopis* leaf extract and pelleted with DAP (40 g) + $ZnSO_4$ (100 mg) + $FeSO_4$ (100 mg) + Ammonium molybdate (250 mg) kg^{-1} of seed. The seeds were tested initially under laboratory condition for germination and vigour performance along with the untreated control. The treated and untreated seeds were stored in cloth bag and polyethylene bag under ambient condition for six months in order to evaluate the storage potential of hardened and pelleted seeds. The results indicated that seeds hardened with *Prosopis* leaf extract and pelleting with inorganic nutrients recorded higher germination, seedling growth parameters and vigour index than $ZnSO_4$ hardened seeds and control. However, $ZnSO_4$ hardened seed showed high rate of germination, which accounted for 6.6 per cent faster germination over control seeds. Under storage, the reduction in germination, seedling growth and vigour index was minimal in $ZnSO_4$ hardened seeds compared to *Prosopis* hardened and pelleted seeds and control. The better storability of $ZnSO_4$ hardened seeds was also evident by recording a lower electrical conductivity and free amino acid in seed leachate throughout the six months of storage period. Similarly, dehydrogenase enzyme activity and protein content were not much affected due to the above treatment. However, much lower bruchid infestation and fungal infection were noticed in *Prosopis* hardened and pelleted seeds.

Key words : Blackgram, Hardening, Pelleting, Germination, Vigour, Storage.

Introduction

Blackgram (*Vigna mungo* (L.) Hepper), occupies a unique place among pulses for its use as seed and vegetable and it is grown both as pure and mixed crop. The low productivity in blackgram is due to the reason that it is grown mostly in marginal and rainfed areas. The main constraints in raising the productivity levels of blackgram in drylands are the inadequacy of soil moisture and poor fertility status of the soil. To overcome these adverse environmental conditions which prevent the germination and establishment of seedlings, seed hardening given as a presowing treatment is a boon for dryland agriculture. Short term hydration of seed before planting, greatly benefits stand establishment, but use of chemicals in soak water like potassium or sodium phosphate would give additional advantage (Basu, 1994).

In addition to seed hardening, coating (or) pelleting of seeds with nutrients will give an initial boost for germinating seeds and growing seedlings. Seed pelleting provides an opportunity to package effective quantities of materials such that they can influence the seed or soil at the seed soil interface (Scott, 1989). Normally, the hardened and pelleted seeds are sown immediately. However, there are circumstances under which, these hardened and pelleted seeds could not be sown immediately, either due to non-receipt of water or excessive rainfall or because of scarcity of labour. Under such situations, the sowing is to be postponed resulting in the storage of the hardened and pelleted seeds. Keeping these in view, an experiment was undertaken at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore-3, during September, 2001 to March 2002 in blackgram cv. Vamban 3 to evaluate the vigour and viability of hardened and pelleted seeds before and after storage.

Materials and Methods

The breeder seeds of blackgram cv. Vamban 3 obtained from the Agricultural Research Station, ble 1. Effect of seed hardening and pelleting on initial germintion and seedling vigour in blackgram cv. Vamban 3 under laboratory conditions

eatments	Rate of germination	Germination (%)	Root length (cm)	Shoot length (cm)	Drymatter production (g 10 seedling-1)	Vigour index
ɔntrol	12.1	94 (75.94)	13.5	23.1	0.25	3444
$\text{ı}SO_4$ hardening	12.9	95 (77.71)	16.1	26.5	0.27	4060
osopis hardening and ΛP + $ZnSO_4$ + $FeSO_4$ + nmonium molybdate lleting	11.4	98 (81.39)	17.1	28.4	0.28	4444
) (P=0.05)	0.03**	1.75**	1.84**	1.17**	0.010**	169**

Significant at 1% level (Figures in parentheses are arcsine transformed values)

ıavanisagar-638 451 were cleaned and graded ng BSS 7 x 7 sieve and the retained seeds re used for experimentation. The seeds were ıt preconditioned by keeping the seeds in ween two layers of moist gunny bag for ə hour. Then, the preconditioned seeds were ıked in 100 ppm $ZnSO_4$ solution at 1/3 volume seeds for three hours and air dried in shade their original moisture content.

The preconditioned seeds were also soaked ɛparately in 1% *Prosopis* (*Prosopis juliflora*) ɛaf extract, at 1/3 volume of seeds for one ıour and air dried in shade to their original ıoisture content. These seeds were pelleted ısing $ZnSO_4$ (100 mg), $FeSO_4$ (100 mg), ımmonium molybdate (250 mg) and DAP (40) kg^{-1} of seeds. The DAP granules were powdered nd sieved to get fine powder for proper pelleting. ıs an adhesive for pelleting, 10 per cent maida ruel @ 150 ml kg^{-1} was used. The seeds were elleted thoroughly without forming any aggregates ısing hand operated seed pelletizer.

The control as well as the hardened and elleted seeds were treated with appropriate train of *Rhizobium* sp. (multi strain rhizobial ulture for blackgram seeds). The culture was ıspended in 10% maida solution (adhesive) nd thoroughly mixed to have uniform coating. he treated seeds were again shade dried to heir original moisture content. The seed samples drawn from the above treatments were evaluated for the seed quality parameters *viz.* speed of germination (Maguire, 1962), germination (ISTA, 1999), root length, shoot length, drymatter production and vigour index (Abdul-Baki and Anderson, 1973). Equal quality of both treated and untreated seeds were packed in gada cloth bag and 700 gauge polythene bag and stored in ambient condition. The seed quality attributes *viz.* moisture content (%), rate of germination, germination (%), root and shoot length (cm), drymatter production (g 10 $seedling^{-1}$), vigour index, electrical conductivity (dSm^{-1}), free amino acid ($g\ g^{-1}$), dehydrogenase activity (OD value), protein content (%), bruchid infestation (%) and fungal infection (%) were observed on monthly basis for six months and data were recorded. The results were subjected to analysis of variance and tested for significance according to Panse and Sukhatme (1985). Percentage values were transformed into arcsine values prior to analysis.

Results and Discussion

The results of this experiment revealed that $ZnSO_4$ hardening treatment promoted early germination by registering a high speed of 12.89, which accounted for 6.6 per cent faster germination over control seeds. However, *Prosopis* leaf extract hardened and seeds pelleted with inorganic nutrients were slow in germination by recording 5.8 and 6.6 per cent less rate

Table 2. Seed moisture content, germination and seedling vigour of hardened and pelleted blackgram seeds under storage

Treatments	Containers	Moisture content (%)		Rate of germination		Germination (%)		Root length (cm)		Shoot length (cm)		Drymatter production (g/10 seedlings)		Vigour index	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final	Initial	Final
Control	Cloth bag	8.30	9.60	12.07	11.38	94 (75.92)	75 (60.01)	13.5	12.1	22.3	20.2	0.25	0.22	3365	2422
	Polythene bag	8.30	8.70	12.07	11.35	94 (75.92)	79 (62.73)	13.5	12.7	22.3	20.8	0.25	0.23	3365	2645
$ZnSO_4$ hardening	Cloth bag	8.35	9.59	12.85	11.84	95 (77.14)	77 (61.37)	16.1	14.1	26.5	22.4	0.27	0.25	4047	2767
	Polythene bag	8.35	8.67	12.85	12.33	95 (77.14)	82 (64.91)	16.1	15.1	26.5	23.2	0.27	0.25	4047	3135
Prosopis hardening	Cloth bag	8.30	9.70	11.37	10.41	98 (83.00)	69 (56.17)	17.1	12.0	28.4	19.2	0.28	0.21	4445	2122
and pelleting	Polythene bag	8.30	8.70	11.37	10.32	98	76	17.1	12.1	28.4	20.7	0.28	0.22	4445	2479
CD (P=0.05)															
Treatments (T)		NS		0.03**		0.63**		0.32**		0.47**		0.004**		59.87**	
Containers (C)		0.03**		0.03**		0.51**		0.26**		0.38**		NS		48.88**	
Period (P)		0.05**		0.06**		1.03**		0.52**		0.77**		0.006**		97.77**	
Treatment x Container		0.04**		0.05**		0.89**		NS		NS		NS		NS	
Treatment x Period		NS		0.10**		1.78**		0.89**		1.33**		0.01**		169.34**	

** Significant at 1% level; NS : Non-significant (Figures in parentheses are arcsine transformed values)

of germination compared to control and $ZnSO_4$ hardening, respectively (Table 1) Unlike the rate of germination, the *Prosopis* hardened and pelleted seeds recorded significantly higher germination (98 per cent) when compared to control (94 per cent) and $ZnSO_4$ harde-ned seed (95 per cent). The probable reason for higher germination in *Prosopis* hardened and pelleted seeds could be of greater hydration of colloids, higher viscosity and elasticity of protoplasm, increase in bound water content, lower water deficit (May *et al.* 1962) and increased metabolic activity (Joseph and Nair, 1989).

Similarly, the effect of *Prosopis* leaf extract hardening and pelleting of seeds with inorganic nutrients was also much evident in growth of the seedling with 26.7, 22.9 and 12.0 per cent higher root and shoot growth and drymatter accumulation, respectively over untreated control (Table 1). Though the performance of $ZnSO_4$ hardening

Table 3. Biochemical changes of hardened and pelleted blackgram seeds

Treatments	Containers	Electrical conductivity (dSm^{-1})		Free amino acid (: g g^{-1})		Dehydrogenase activity (OD value)		Protein content (%)	
		Initial	Final	Initial	Final	Initial	Final	Initial	Final
Control	Cloth bag	0.176	0.419	0.50	7.00	0.317	0.195	22.3	20.5
	Polythene bag	0.176	0.387	0.50	5.00	0.317	0.209	22.3	20.8
$ZnSO_4$ hardening	Cloth bag	0.177	0.391	0.50	6.00	0.317	0.193	22.2	20.7
	Polythene bag	0.177	0.361	0.50	4.00	0.317	0.215	22.2	21.0
Prosopis hardening and pelleting	Cloth bag	0.177	0.457	0.50	8.00	0.318	0.206	22.2	20.0
	Polythene bag	0.177	0.420	0.50	6.00	0.318	0.236	22.2	20.3
CD (P=0.05)									
Treatments (T)		0.001**		0.04**		0.005**		0.07**	
Containers (C)		0.0008**		0.03**		0.004**		0.06**	
Period (P)		0.002**		0.06**		0.008**		0.11**	
Treatment x Container		0.001**		0.05**		0.007**		NS	
Treatment x Period		0.003**		0.10**		0.14**		0.19**	

** Significant at 1% level; NS : Non-significant

was slightly low with regard to seedling growth, its performance was also remarkable against untreated control with 19.3, 14.7 and 8.0 per cent increase respectively for the above growth parameters. The increased seedling growth and dry weight observed in this treatment might be due to greater early vigour and higher percentage of germination of the seeds that had reached autotropic stage well in advance than others (Jayaraj, 1977). The increase in dry weight might also be due to enhanced lipid utilization through glyoxalate cycle, a primitive pathway leading to faster growth and development of seedlings to reach autotropic stage well in advance of others and enabling them to produce relatively more quantity of drymatter. The vigour index registered by *Prosopis* leaf extract hardened seeds and seeds pelleted with inorganic nutrients (4444) and $ZnSO_4$ hardened seeds (4060) was 29.0 and 17.9 per cent higher respectively than the control (3444) (Table 1).

Under storage, the $ZnSO_4$ hardened seeds recorded a moisture content of 9.59 and 8.67 per cent and the *Prosopis* leaf extract hardened and seeds pelleted with inorganic nutrients recorded 9.70 and 8.70 per cent respectively in cloth bag and polythene bag after 6 months of storage. In addition to the moisture absorption by seed, the absorption by the pelleting

Table 4. Bruchid infestation and fungal infection in hardened and pelleted blackgram under storage

Treatments	Containers	Bruchid infestation (%)		Fungal infection (%)	
		Initial	Final	Initial	Final
Control	Cloth bag	0.0 (0.21)	7.0 (15.32)	7.0 (15.32)	19.0 (25.84)
	Polythene bag	0.0 (0.21)	7.0 (15.32)	8.0 (16.42)	14.0 (21.97)
$ZnSO_4$ hardening	Cloth bag	0.0 (0.21)	6.0 (14.16)	5.0 (12.89)	15.0 (22.78)
	Polythene bag	0.0 (0.21)	2.0 (7.99)	4.0 (11.45)	11.0 (19.36)
Prosopis hardening	Cloth bag	0.0 (0.21)	3.5 (10.76)	3.0 (9.90)	13.0 (21.13)
and pelleting	Polythene bag	0.0 (0.21)	1.0 (4.95)	2.0 (7.99)	8.0 (16.42)

CD (P=0.05)	Bruchid infestation	Fungal infection
Treatments (T)	0.42**	0.35**
Containers (C)	0.35**	0.28**
Period (P)	0.69**	0.56**
Treatment x Container	0.60**	0.49**
Treatment x Period	1.20**	NS

** Significant at 1% level; NS : Non-significant; (Figures in parentheses are arcsine transformed values)

constituents would have attributed to the slight increase in moisture content of pelleted seeds. The $ZnSO_4$ hardened seeds recorded a higher rate of germination (11.84 and 12.33) than the *Prosopis* hardened and pelleted seeds (10.41 and 10.32) in both the containers after 6 months of storage (Table 2). In general, there was a reduction of 18 per cent in germination over a period of 6 months. However, the $ZnSO_4$ hardened seeds recorded a higher germination (77 and 82 per cent) than the *Prosopis* hardened and pelleted seeds (69 and 76 per cent, respectively) in cloth bag and polythene bag after 6 months of storage. However, in $ZnSO_4$ hardening treatment which received soaking and drying of seeds, the loss of germination was gradual throughout the storage period and maintained the viability better in storage. The higher reduction in germination of pelleted seeds could be due to the phytotoxic effect of inorganic fertilizers coated on the seeds over a period of time (Basaria Begam, 2001).

The reduction in root length, shoot length and drymatter production was minimal in $ZnSO_4$ hardened seeds compared to *Prosopis* leaf extract hardened and seeds pelleted with inorganic nutrients and control seed. This indicated better storability of $ZnSO_4$ hardened seeds and this results are in agreement with the observations made by many workers (Basu *et al.* 1974; Saha and Basu, 1982; Rudrapal and Basu, 1988). While, the $ZnSO_4$ hardened seeds registered higher vigour index of 2767 and 3135 respectively in cloth bag and polythene bag. *Prosopis* hardened and pelleted seeds recorded lower values of 2122 and 2479 in the respective containers. Decline in vigour index in this investigation was in accordance with the findings of Sabir-Ahamed (1989) in soybean and Basaria Begam (2001) in blackgram.

The increase in the electrical conductivity and free amino acid in the leachate of $ZnSO_4$ hardened seeds was minimal, probably due to better membrane stability caused by quenching of free radicals (Basu, 1976). In general, there was a reduction of 37.5 per cent in dehydrogenase activity over a period of 6 months. During this period, $ZnSO_4$ hardened seeds lost only 30.3 per cent of dehydrogenase activity compared to 40.9 and 36.3 per cent in *Prosopis* hardened and pelleted seed, and control seed, respectively. Similar trend was observed in the pattern of reduction in protein content also.

There was no bruchid infestation in any the treatments till the third month of storage. estation was first noticed in control (dry) ds followed by $ZnSO_4$ hardened and *Prosopis* rdened and pelleted seed. The lower bruchid estation in pelleted seeds could be due to repelling odour and unpalatable nature of emical constituents added in the pelleting xture. The fungal infection was also much wer in the *Prosopis* leaf extract hardened d seeds pelleted with inorganic nutrients. The w fungal infection in this treatment could due to the suppression of fungal activity the added chemicals. The fungal activity as more in the seeds stored in cloth bag mpared to 700 gauge polythene bag and this ight be due to the increase in moisture content seeds stored in cloth bag.

Thus, the results clearly indicated the romising effect of hardening with *Prosopis* af extract and pelleting with inorganic nutrients blackgram for improving the sowing quality y increasing the germination and seedling vigour. may also be argued that during soaking, eeds would become physiologically advanced y carrying out some of the initial steps of ermination that resulted in improved germination, eedling length, drymatter accumulation and vigour ndex. However, under storage, the $ZnSO_4$ hardened lackgram seeds performed better than the *Prosopis* ardened and pelleted seeds and could be stored afely in 700 gauge polythene bags upto 6 nonths without much loss in viability and vigour.

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