Seed Research, Vol. 35(2): 252-254, 2007

Short Communication

Seed Coat Discolouration: Its Effect on Seed Quality during Storage in Frenchbean

H.S. YOGEESHA, K. BHANUPRAKASH, T.S. AGHORA AND L.B. NAIK

Indian Institute of Horticultural Reserarch, Hessaraghatta Lake Post, Bangalore 560 089
hsy@iihr.ernet.in

Seed coat browning/discoloration in frenchbean (*Phaseolus vulgaris* L.) occur as the seeds age during storage. Though this problem is common in all types of food legumes, it is more severe in case of frenchbean. The discolored seeds are dull in appearance; hence, they are not preferred by the farmers as they think that seeds are old and of poor quality. The seed coats of many species contain soluble tannins, which upon polymerisation can form high molecular weight polymers, which are brown coloured condensed tannins [1]. The Maillard reaction is an alternative mechanism for browning in pulses and this could be arrested by seed treatment with amminoguanidine [2]. Hence, this study was taken up to know the effect of seed coat browning on seed quality in frenchbean and to know the role of amminoguanidin in arresting seed coat browning and its effect on seed quality.

Arka Komal, a popular frenchbean variety with light brown seed coat, was taken for the study. Fresh seeds, packed in paper covers, were stored under room conditions and seeds with 8 per cent moisture content packed in sealed polythene covers were stored at controlled temperature maintained at 7°C. Seeds stored naturally for different periods were observed visually for seed coat browning and then tested for seed quality attributes such as seed germination per cent, root and shoot length, seedling dry weight and vigour index. Seedling vigour index was calculated by multiplying seedling length with germination percentage. In another study fresh seeds were subjected for accelerated ageing for 3-8 days at 45°C with 100 per cent RH. These aged seeds were compared with fresh seeds for seed coat browning and other seed quality parameters such as germination per cent, root and shoot length and vigour index as in the first-experiment. In the experiment involving aminoguanidine seed treatment, different concentrations of aminoguanidinium hydrogen carbonate ranging from 25 mM to 100 mM was prepared by dissolving it in potassium phosphate buffer of pH 7.5. The seeds were made to absorb the chemical by placing on Whatmann No. 1 filter paper saturated with different concentrations of aminoguanidine solution for 12 h so that they attained 40 per cent mc. Seeds were then dried under-shade and brought back to original moisture of 11 per cent. Four replicates of 50 seeds each were used for seed quality analysis. Germination test was conducted at constant temperature of 25°C using between paper method. The first count was recorded on 5th day and the final germination on 10th day. The data was analyzed using ANOVA technique.

Seeds stored at 7°C for one year showed no discoloration but seeds stored at ambient conditions showed rapid seed coat browning. However, there was no significant reduction in per cent germination (96%) and vigour in one-year-old seeds stored under ambient conditions. Whereas, the seeds stored for two years under ambient conditions, though maintained good germination (94%) and on par with fresh and one year old seeds, the vigour level, expressed in terms of first

Received March 2006 Revised August 2007 Accepted November 2007

count, root and shoot length, seedling dry matter and vigour index decreased (Table 1). Three days of accelerated ageing at 45°C and 100 per cent RH showed deep seed coat browning but germination (95%) and vigour were not affected significantly (Table 2). Six days of ageing resulted in significant drop in germination (74%) and vigour as expressed in terms of first count, root and shoot length, seedling dry weight and vigour index. Seed coat browning may be attributed to atleast two different chemical reactions in biological systems [2]. The seed coat of many species contain soluble tannins, which upon polymerisation can form high molecular weight polymers, which are brown coloured condensed tannins [1]. The Maillard reaction is an alternative mechanism for browning [2]. The brown pigment, isolated from darkened wheat embryos, increased as storage temperature and moisture content increased [3]. Similar observations were made in the present study. As the seeds aged both naturally and artificially, seed coat browning increased. However, seeds stored at low temperature and humidity showed hardly any change in colour. It appears that high temperature hastens seed coat browning. The relevance of the Maillard reaction to the loss of seed viability was investigated in two separate studies, which produced contradictory results. Wettlaufer and Leopold [4] observed decreased germination as Maillard products accumulated in soybean axes. The other study, however, did not detect any consistent correlation between seed viability and the Maillard products in either naturally or artificially aged seeds of soybean [5]. Similar observations were made in cowpea [6].

Table 1. Effect of natural ageing on seed quality attributes in frenchbean

Storage period	First count (%)	Germination (%)	Root length (cm)	Shoot length (cm)	Dry wt. of five seedlings (g)	Seedling vigour index
Fresh	97	99	18.4	22.0	0.690	4020
6 months at ambient	98	98	18.6	23.3	0.770	4106
1 year at ambient	92	96	18.1	21.3	0.668	3782
2 years at ambient	84	94	16.6	20.8	0.547	3516
1 year at 7°C	99	99	18.4	21.3	0.698	3930
C.D. @ 5%	5.3	NS	1.3	NS	0.071	352

Table 2. Effect of accelerated ageing on seed quality attributes in frenchbean

A.A. period (days)	First count (%)	Germination (%)	Root length (cm)	Shoot length (cm)	Dry wt. of five seedlings (g)	Seedling vigour index
3 days	88	95	18.9	20.5	0.697	3743
6 days	61	74	17.2	14.1	0.581	2316
7 days	43	43	10.0	9.7	0.492	516
8 days	1	2	4.0	0.7	0.0	9
Fresh	100	100	18.6	21.6	0.673	4020
C.D @ 5%	11.5	8.5	4.5	2.8	0.109	415

In the present study also, there was no decline in germination and vigour although there was a considerable change in seed coat colour in one year naturally aged and three day accelerated aged seeds of frenchbean. Since, the observation on discoloration is based on visual; the intensity of discoloration could not be measured. As the intensity of Maillard products accumulation increases in seeds, the germination may get affected. The seeds stored for two years under natural conditions with deep discoloration did show loss in vigour but not in per cent germination. This showed that it is difficult to attribute loss of viability and vigour to seed coat discoloration though it is one of the symptoms of ageing. In another experiment, the role of amino guanidine in arresting seed coat discolouration and seed quality was studied. Seed treatment with amino guanidine (25-100mM) resulted in drastic reduction in germination and vigour (Fig. 1) when tested immediately after treatment hence, further study on storage was terminated. Seed germination ranged from 35-57 per cent in seeds treated with aminoguanidine at various concentrations, as against 92 per cent in seeds without treatment.

Seed discolouration in frenchbean occurs rapidly during open storage under high temperature. It cannot be correlated with loss in germination and vigour at least during early storage period. Effect of accelerated ageing on seed coat discoloration and seed quality is similar to natural ageing. Aminoguanidine is harmful to seed quality hence, cannot be used for seed treatment to arrest seed discoloration. Seed coloring may be taken up in order to mask the changes in seed coat colour and to make attractive to the farmers.

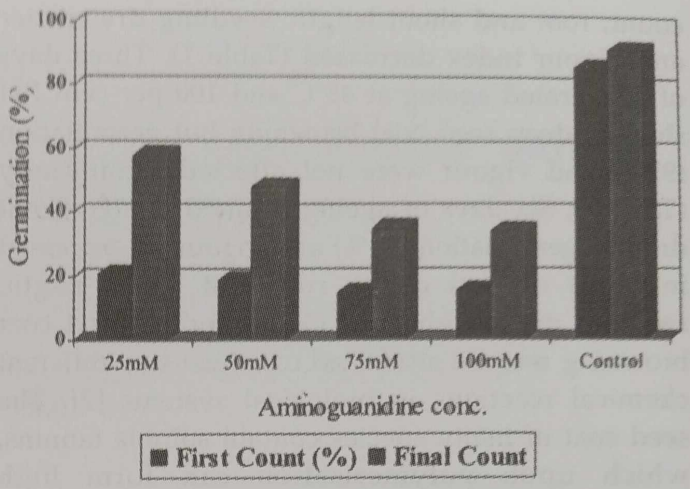

Fig. 1. Effect of aminoguanidine on seed quality of frenchbean cv. Arka Komal

REFERENCES

1. NOZZOLILLO, C. & M. DE BEZADA (1984). Browning of lentil seeds, concomitant loss of viability, and the possible role of soluble tannins in both phenomena. *Canadian J. Plant Sci.*, **64**: 815-824.

2. TAYLOR A.G., T.G. MIN & D.H. PAINE (2000). Maillard reactions cause browning in bean seed coats during ageing: Inhibition by Aminoguanidine. In: *Seed Biology - Advances and Applications* (ed.) M. Black, K.J. Bradford and J. Vazquex-Ramos, CAB International pp. 189-196.

3. MCDONALD, C.E. & M. MILNER (1954). The browning reaction in wheat germ in relation to 'sick' wheat. *Cereal Chem.*, **31**: 279-295.

4. WETTLAUFER, S.H. & A.C. LEOPOLD (1991). Relevance of Amdori and Maillard products to seed deterioration. *Plant Physiol.*, **97**: 165-169.

5. BAKER, E.H. & K.J. BRADFORD (1994). The fluorescence assay for Maillard product accumulation does not correlate with seed viability. *Seed Sci. Res.*, **4**: 103-106.

6. PATEL P.N. & A.E. HALL (1988). Inheritance of heat-induced brown discoloration in seed coats of cowpea. *Crop Sci.*, **28**(6): 929-932.