SHORT COMMUNICATION

Comparison of the Storage Potential of French bean (*Phaseolus vulgaris* L.) and Cowpea (*Vigna unguiculata* L walp) Genotypes after Natural and Artificial Ageing

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Variation in the longevity of French bean and cowpea seeds under ambient (20-43°C) and accelerated ageing conditions were studied in ten French bean and five cowpea lines differing in seed size and seed coat colour. Significant differences in the storability among the genotypes, storage periods and the interaction genotype and storage periods were observed. Germination%age in the various French bean genotypes ranged from 0-67 % after 15 months of storage under ambient conditions and by 30 months most genotypes were dead. In cowpea all genotypes, except IC 45409, retained germination values ranging from 66 to 96% after 3 years of storage under ambient conditions. Seed germination after accelerated aging was positively correlated with that after natural ageing under ambient conditions and negatively with seed weight. Under ambient storage conditions French beans are poor storers as compared to cowpeas.

Key Words: Accelerated ageing, Cowpea, French bean, Longevity, Natural ageing.

French bean (*Phaseolus vulgaris* L.) and cowpea (*Vigna unguiculata* L. Walp) are important grain legumes of India. These are used both as pulses and green vegetables. While cowpeas are recognized as distinctly tropical in adaptation, common beans are better adapted to sub-tropical or temperate climate.

Ageing during storage is a major cause of poor seed quality, particularly in tropical countries where high relative humidity of storage leads to an increase in seed moisture content. This combined with high ambient temperature results in rapid seed deterioration leading to a decline in seed vigour and ultimately reduced germination. Information related to the optimal storage conditions and periods for the safe storage of French bean and cowpea seeds is scant. Variable periods of longevity under different ambient conditions have been reported (Paiva *et al.*, 1972, Vieira and Fonseca, 1986; Aguirre and Peske, 1991). Pandey (1989) observed a decline in vigour and viability of French bean after second year of storage at 24-32^0 C and 10.0± 0.8% moisture content. Under the subtropical climatic conditions of Brazil, French bean seeds with 12-14% moisture content could maintain over 80% germination for 2 years (Aguirre and Peske, 1991). Planning for the safe storage of seeds can be efficiently done if information on relative storability of genotypes is also available. Further, for a rational improvement of seed storability and vigour, knowledge of the variability present in the germplasm and the inter-relationships among various seed characteristics is also important. However, relatively few storage studies have evaluated differences among genotypes in French bean and cowpea (Aguirre and Peske, 1991).

The objective of the present work was to study the variability between French bean and cowpea genotypes with respect to seed storability and the inter-relationship with some seed characteristics.

Seeds of ten French bean and five cowpea genotypes grown and harvested at Bhowali and Thrissur respectively, in 1995, were used for the experiment starting in the same year. These were selected for differences in their seed weights and seed coat colors. The details of accessions are given in Table 1. The initial seed moisture content was 8.7-10.3%. Seed moisture content was determined by drying ground seeds for one hour at 130°C, and was expressed on dry weight basis (ISTA 1985). Seeds were stored in paper envelops at ambient temperature (20-43°C) and in laminated aluminum foil packets at 5^{0}C. At 5°C seed moisture was 7.5-8.0% for all seed lots. Seed moisture during unsealed storage at ambient temperature varied from 8.4 -10.7% in French bean and 7.0-10.3% in cowpea. One lot of each genotype was accelerated aged at 42°C and 100% RH for 4 days.

Germination and vigour of seeds stored at ambient temperature was evaluated at periodic interval of 5 months in French bean and 6 months in cowpea and only once in 3 years for seed stored at 5°C. For the accelerated aged lots, germination was done once at the end of ageing period. Germination test was conducted following the ISTA guidelines (ISTA, 1985). Three replicates were used with 100 seeds in each replicate. Vigour was measured

Table 1. Initial germination and other seed characteristics of french bean and cowpea genotypes

Accession no.	Initial seed germination (%)	Germination after accelerated ageing (AA) %	MC after AA%	Wt increase after imbibition (%)	100 Seed weight (G)	Germination after ambient storage (%)	Germination after 3 years of storage at 5°C (%)	EC umhos/cm/ gdw	Seed coat colour
French bean						**After 15 months**			
IC 16903	91	8	23.3	21.2	41.6	16	90	0.336	Violet
IC 37846	100	18	18.7	9.8	21.5	58	100	0.342	Fawn
IC 84548	90	2	21.6	17.6	33.2	0	90	0.257	White specks on purple
IC 84549	92	6	19.0	23.1	34.2	0	90	0.393	White specks on purple
IC 84564	95	33	19.5	8.4	19.8	67	94	0.291	Fawn
IC 145918	100	10	18.2	6.2	21.7	22	98	0.238	Black
IC145919	99	24	18.4	7.4	22.5	62	98	0.253	Black
IC 145923	95	0	23.2	19.0	29.0	0	95	0.692	Yellowish brown
IC 145924	90	6	22.6	20.4	30.0	4	92	0.892	Orange
IC 196464	99	4	23.2	12.6	36.0	40	98	0.376	Violet mottled
Cowpea						**After 3 years**			
IC32865	98	75	19.5	9.40	6.67	66	96	0.309	White
IC44646	96	77	18.6	7.6	6.05	82	95	0.234	Black
IC44723	94	89	17.8	8.4	8.76	96	92	0.264	Red
IC44792	96	86	17.5	8.3	7.93	94	96	0.243	Black
IC45368A	98	64	20.4	12.0	9.63	82	98	0.247	Red
IC45409	98	14	23.2	12.5	10.00	16	98	0.324	White

as radical length of 20 seeds at 25°C after 120 hours. Electrical conductivity of leakage from seeds was measured for three replicates of 10 seeds each placed overnight in 25 ml of distilled water at 20°C. Rate of water uptake was measured by immersing 10 seeds in 10 ml of distilled water at 25°C. Seeds were removed from water after 8 hours, blotted dry and weighed. Changes in weight due to imbibition were expressed in terms of% weight increase as compared to air-dry weight of seeds. For studying the storability of ten French bean and five cowpea genotypes over seven storage periods, the design adopted was Factorial Completely Randomized Design with three replicates for each of the crops.

The initial germination of various genotypes varied from 90-100% and the 100 seed weight varied from 19.8 to 41.6 g in French bean and 6.0 to 10.0 g in cowpea (Table 1). Large variability among genotypes was observed in seed germination, seedling vigor and storability during both long-term storage (ambient temperature) and accelerated ageing (42°C and 100% RH). Statistical analysis of the germination data of both French bean and cowpea revealed significant differences between genotypes, storage periods at ambient temperature and the interaction genotypes and storage periods.

At five months after storage statistical analysis of germination data revealed no significant difference among French bean genotypes. At this time ageing effect was still not detected in most genotypes though a decline in vigour was observed in others (Figs 1 and 2). At

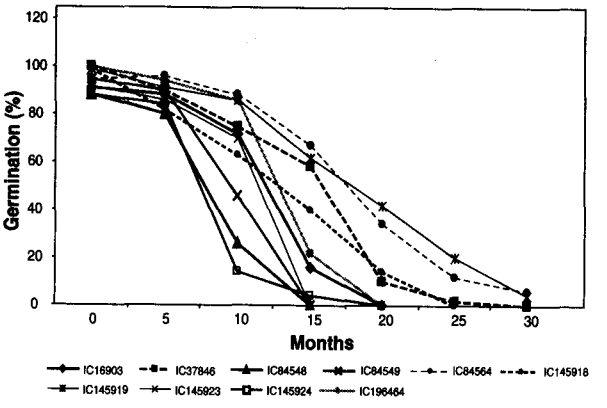

Fig. 1 Seed germination in different genotypes of french bean during ambient storage

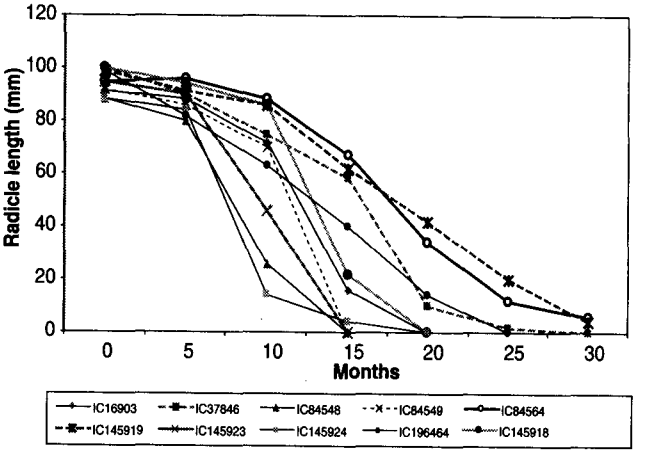

Fig. 2 Seedling vigour in different genotypes of french bean during ambient storage

10 months after storage significant difference (p=0.05) in the maintenance of viability among most genotypes was observed and these differences became marked as the storage duration progressed. At ambient temperature germination was maintained at a high level for most genotype for five months it then declined rapidly for some cultivars viz. for IC 84548, IC 84549, IC 145923 and IC145924 germination dropped to 0 by 15 months of storage (Fig. 1). For others the decline was gradual. The germination%age of various genotypes varied from 0–67% at 15 months of storage. By 30 months all accessions except IC 84564 and IC145919 were dead.

In cowpea germination started to decline after one year in IC 45409 and was only 16 per cent after 3 years of storage whereas the other accessions maintained high germination values of 66-96% (Fig. 3), however, vigour started to decline after 12 months of storage in the various genotypes. Thus, genotypes such as IC 37846, IC 145919 and IC 145918 of French bean and IC45409 and IC 44792 of cowpea had similar germination before storage but showed large difference in storability during ambient storage as well as accelerated ageing (Table 1 & Fig 1, 3).

A loss in vigour of French bean after 3 weeks and in germination after 9 weeks has been reported by Kueneman (1983) under high temperature (32°C) and high RH (90%). Pandey (1989) observed a 38% reduction in germination after 3 years of storage at 24-32°C and 10± 0.8% moisture content. Various other reports have indicated storability of French bean varying from 8-53 months after harvest under ambient laboratory conditions (Deakin 1974, Vieira and Fonseca 1986, Aguirre and Peske 1991). Aguirre and Peske (1991) have reported that bean seeds with moisture content below 11.5% can be hermetically stored up to 8 months at 30°C without significant loss in their germination, although cultivar differences in storability of French bean have been observed with some cultivars maintaining 80% germination for 15 months after harvest whereas others maintaining this level of germination for longer period (20 months) under ambient conditions of Brazil. Further, it was observed that the decline in germination started at 6.1 – 16.2 months depending on the cultivars; however, viability was lost for all cultivars at approximately 38 months after harvest at 12% moisture under ambient conditions. Similarly, variability in the longevity of cowpea genotypes was observed by Vieira and Fonseca (1986), where 80% germination was maintained for

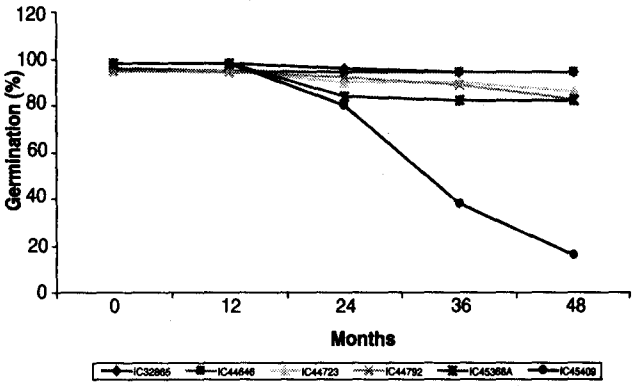

Fig. 3: Germination percentage of different cowpea genotypes during ambient storage

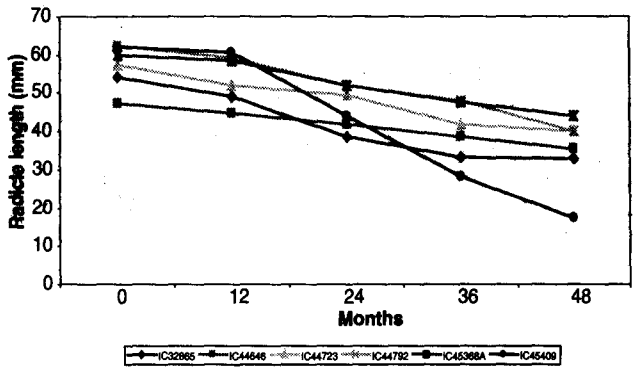

Fig. 4: Seedling vigour in different cowpea genotypes during ambient storage

periods varying from 27 – 35.2 months in the various cultivars. Under the ambient conditions of Brazil viability was lost after 18 months to 56 months after harvest (Aguirre and Peske, 1991). % germination after accelerated ageing was positively (p=0.01) correlated with germination after natural ageing at ambient temperature and negatively with 100 seed weight (Table 2). After accelerated ageing germination varied from 0-33% among French bean genotypes and from 14-89% among cowpea genotypes (Table 1). Genotypes which maintained higher germination during accelerated ageing also retained higher germination at ambient temperature after 15 months of storage in French bean and 3 years in cowpea. Measurements of seed moisture content (mc) revealed an increase during accelerated ageing from a mean of 10.1% to 17.5-23.2% for the various genotypes (Table 1). Decline in germination after both accelerated and natural ageing was negatively correlated with the seed moisture (Table 2). The differences in equilibrium seed moisture of various genotypes could be one of the explanations for differences in deterioration. Seeds which showed a rapid fall in germination after ageing absorbed moisture rapidly from the high humidity

Table 2. Correlation Coefficients between various seed traits

Traits	Moisture content after accelerated aging	Initial moisture content	100 seed weight	Germination after ambient ageing	EC
French bean					
Initial moisture content	0.611				
100 seed weight	0.729*	0.787**			
Germination (%) after ambient aging	-0.484	-0.803**	-0.611		
EC	0.578	0.565	0.222	-0.522	
Germination (%) after accelerated aging	-0.618	-0.670*	-0.692	0.871**	-0.440
Vigor (radical length, mm)	-0.524	-0.560	0.489	0.727*	0.632
Cowpea					
Initial moisture content	0.594				
100 seed weight	0.711*	0.783**			
Germination (%) after ambient aging	-0.402	-0.781**	-0.584		
EC	0.498	0.423	-0.188	-0.511	
Germination (%) after accelerated aging	-0.590	-0.695	-0.676*	0.836**	-0.384
Vigour (radical length, mm)	-0.512	-0.424	0.472	0.701*	0.586

conditions of accelerated ageing reaching moisture content of over 20%. In contrast seed lots which retained a high germination imbibed slowly and equilibrated at lower moisture content. Increase in weight of seeds after eight hours of imbibition at 25°C revealed that some genotypes are poor imbibers (less than 10% increase) as compared to others (more than 17% increase) (Table 1).

Seed moisture and storage temperature are the most important factors influencing seed survival during storage (Roberts, 1972). For every 1% reduction in moisture content from 14.0-10.5% storage potential of French bean seeds has been reported to increase 1.6-1.7 fold (Aguirre and Peske, 1991). In both French bean and cowpea there was no significant change in the germination in any of the genotypes at 5°C (Table 1).

Difference in the storage potential of cultivars within species of grain legumes have been found to be associated with various other seed characteristics like seed size (Singh *et al.*, 1972, Tiwari and Gupta, 1981) and seed coat pigmentation (Deakin, 1974). Large seeded French bean cultivars lost viability faster than cultivars of small seeds (Aguirre and Peske, 1991). Although a negative correlation between seed weight and% germination after accelerated ageing has been observed in both French bean and cowpea but germination at ambient temperature was not associated with 100 seed weight (Table 2). Vieira and Fonseca (1986) have shown that cultivars with white seed coats and/ or large seeds lost germination faster than cultivars of other colours and/ or small seeds. Such an association between seed coat colour and loss of germination was not observed in this study although seeds with black coat colour had lesser leachate conductivity than seeds having relatively lighter coats (Table 1).

Differences in tolerance to ageing treatment have also been reported in cultivars of cotton by Bourland and Ibrahim (1982). Similarly, Burris (1980) found significant genotypic effects for germination and vigour in storability of soybean seeds, which were correlated with vigour. He suggested that selection for vigour might be used for improving storability. Also such genetic variability may have potential for incorporating resistance to viability loss especially when seeds are stored under adverse conditions.

The correlation observed between seed germination after accelerated ageing and after natural ageing under ambient conditions in both French bean and cowpea indicate that differences in seed storage potential among cultivars can be identified by carrying out an accelerated ageing test before storage as has been shown for a number of other species (Tekrony, 1995). Use of accelerated ageing in selection of genotypes tolerant to the adverse storage conditions may alleviate problems of low seed quality and poor storability.

Results show that the two grain legume species *viz.* French bean and cowpea differ greatly in their loss of germination during storage. Under adverse storage conditions French beans are poor storers as compared to cowpeas. Results also highlight the differences in storability of seeds among various genotypes. In French bean IC 84564 and IC 145919 and in cowpea IC 32865 and IC 44646 were better storers than the other accessions studied.

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