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INTERVARIETAL VARIABILITY FOR SEED LONGEVITY IN PEA (*PISUM SATIVUM*)

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ABSTRACT

Variability for seed longevity among 10 pea varieties was studied under accelerated ageing conditions of 80% relative humidity and 40 ± 1°C temperature. Germination and seedling vigour decreased in all the varieties with increase in duration of storage. However, varieties differed in the degree of germination decline even when stored under similar conditions and duration. On the basis of LD_{50} of germination, the varieties JP 888, T 163, Pant P 9 and EC 33866 were categorized as good storers; Rachna, Hans, PG 3 and KFPD 8 as moderate storers; and HFP 4 and Pusa 10 as poor storers. Seed size was not correlated with its viability in storage, however, seed size within a genotype was found to affect longevity only in some varieties. Seed longevity is genotypically controlled.

Key words: Longevity, seed, variability, pea.

Seed ageing manifests its effect through delayed emergence of roots, reduction in vigour, decreased tolerance to adverse conditions, lower metabolic and enzymatic activity, losses of membrane integrity, and finally, loss of germinability [1]. However, the rate of manifestation of these effects varies, not only from species to species, but also from variety to variety within a species, and from one seed lot to another in the same variety [2, 3]. The reasons for such variation are still not well understood. Moreover, variability for longevity at varietal level in different species is also not well studied. Keeping in view the importance of seed longevity and its lack of information in pea (*Pisum sativum*), the present study aims to elucidate the genetic variability for seed longevity at varietal level.

MATERIALS AND METHODS

Seeds of 10 pea varieties produced under similar conditions were collected from fresh harvest. The seeds were dried in sun to bring them to equal level of moisture content and then stored under ambient conditions until the start of the experiment. The seeds of all the varieties were graded according to size with the help of round-hole sieves of different diameters. In some varieties the seed was divided into three grades: small, medium and bold, whereas in other varieties only two grades namely, small and medium, were possible.

For increasing the rate of ageing, the seeds were stored at 40 ± 1°C under 80% relative humidity (RH) for up to 22 days or till visible differences appeared in the loss of viability, which could be measured by significant interaction between varieties and periods of storage. For creating the required RH, potassium hydroxide (KOH) solution was prepared as suggested by Solomon [4]. 100 ml solution was poured at the base of each desiccator. The seeds were spread over a wire mesh in a single layer and kept in the desiccator over the perforated porcelain disc. The desiccator was covered with an air-tight lid and kept at a constant temperature of 40 ± 1°C in an incubator. The seeds were taken out from the desiccator at different intervals and grown in three replications in plastic boxes filled with sterilized coarse quart sand. The length of roots and shoots of five random normal seedlings was measured. Statistical analysis for germination and seedling vigour was done using the factorial design [5].

Table 1. Effect of accelerated ageing on germination in pea

Variety	Germination after different days of storage (%)				
	0	8	10	12	mean
JP-888	78.8 (94.5)	66.6 (83.3)	69.3 (85.6)	60.9 (75.5)	68.9 (84.7)
T-163	85.3 (98.9)	73.5 (91.1)	68.9 (84.5)	58.7 (71.1)	71.6 (86.4)
EC-33866	73.3 (91.7)	79.5 (96.7)	67.0 (83.3)	53.9 (65.0)	68.4 (84.2)
Pant P-9	85.3 (98.9)	62.9 (76.7)	63.9 (77.8)	48.9 (56.7)	65.3 (77.5)
Rachna	69.7 (87.8)	70.7 (84.4)	53.6 (63.3)	39.9 (42.2)	58.5 (70.0)
Hans	73.2 (92.2)	55.1 (66.7)	41.8 (44.4)	33.5 (36.7)	50.9 (60.0)
PG-3	68.9 (86.6)	48.2 (55.6)	43.1 (44.5)	32.6 (34.4)	48.2 (55.3)
KFPD-8	76.9 (94.5)	57.6 (70.0)	42.4 (45.5)	30.9 (26.6)	52.0 (59.2)
HFP-4	88.2 (100)	43.1 (46.7)	36.0 (35.0)	25.8 (20.0)	48.2 (50.4)
Pusa-10	77.3 (95.0)	40.2 (41.7)	21.2 (13.3)	18.4 (10.0)	39.3 (40.0)
Mean	77.8 (94.1)	59.7 (71.3)	50.7 (58.3)	40.4 (44.1)	

C.D. at 5%: Variety = 4.28, period = 2.70, and Variety x period = 8.56

Note. Angular transformed values are given above and actual observed values below in parentheses.

RESULTS AND DISCUSSION

Germination. Not much difference was observed in the initial germination of varieties, which ranged between 86.6–100%. Ageing caused considerable decline in germination in all the varieties. There were varietal differences in the extent of loss of viability (Fig. 1) and as indicated by significant interaction between varieties and periods (Table 1).

The varieties T 163, EC 33866 and Pant P 9 were able to maintain germination above 75% up to 10 days of ageing, and JP 888 up to 12 days as compared to the initial germination percentage (at the time of placement in experiment). Pusa 10 had a maximum decline (13.3% germination) 10 days after ageing (Fig. 1c) whereas minimum decline (83.3% germination) was recorded in EC 33866 (Fig. 1a). The mean germination (Table 1) was highest (86%) in the variety T 163 and lowest in Pusa 10 (40% germination). Fourteen days after storage, the varieties T 163 and Rachna showed a steep fall in germination to 47.8% and 17.8%, respectively, while HFP 4 lost its viability completely (Fig. 1). T 163 with 57.8% germination even after 18 days of ageing was the best storer (Fig. 1a). The LD_{50} value for germination (i.e., the number of days in storage at which the germination was reduced to 50%) was highest (16 days) in this variety. On the basis of LD_{50}, the varieties EC 33866, JP888, Pant P 9 and T 163 were categorised as good storers; Rachna, Hans, PG 3 and KFPD 8 as moderate storers; and Pusa 10 and HFP 4 as poor storers (Fig. 2). The variability for longevity among the varieties indicated that this character is under genetic control. Varietal differences for longevity have been reported in rice [3] and in bean [6].

Root and shoot length. All the varieties except, EC 33866 and JP 888, showed significant reduction in root growth during the 8-12 day period of ageing treatment. Pusa 10 and HFP 4 suffered maximum root length reduction by 42% (i.e., 58% of the root growth in control). After 12 days of ageing the roots of the varieties T 163 and Rachna showed no sign of ageing as compared to the control. After 10 days of storage, maximum reduction in shoot length was recorded in Pusa 10 and minimum in PG 3. The reduction in shoot growth as compared to the respective controls was

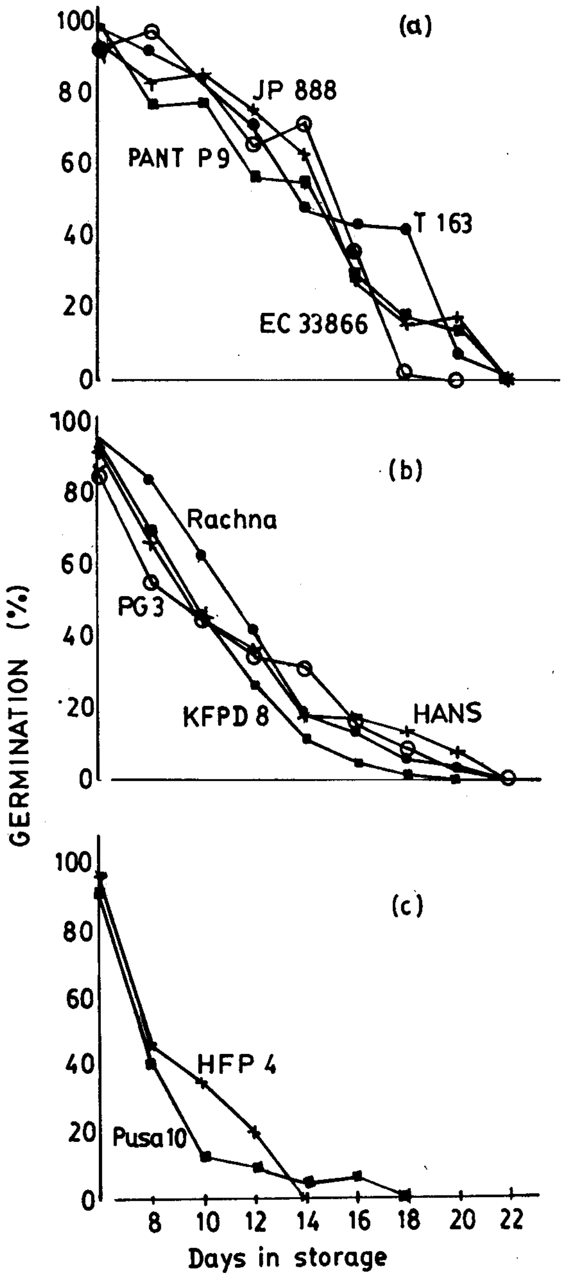

Fig. 1. Pattern of germination in different pea varieties after different periods of seed storage: a) good storer, b) moderate storer, and c) poor storer.

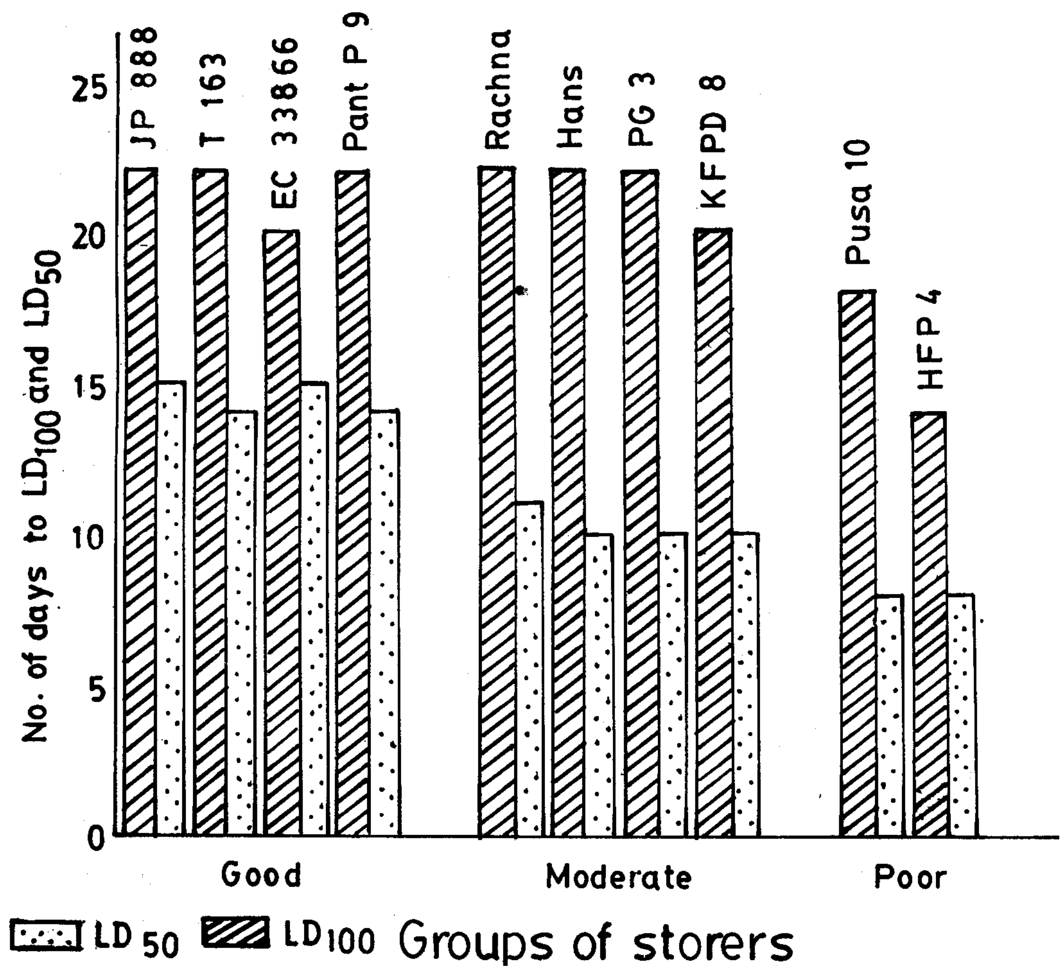

Fig. 2. **Grouping of varieties into good, moderate and poor storers on the basis of LD_{50} and LD_{100} based on germination.**

significant only after 12 days of ageing (15-30% less shoot development) in JP 888, KFPD 8, Pusa 10, EC 33866 and HFP 4.

SEED SIZE, GERMINATION AND SEEDLING VIGOUR

A simple question arises whether the differences for seed longevity at varietal level were really of genetic nature alone or they were linked with the variation in seed size in the different varieties. To compare the effect of seed size within the same genotype, the seeds of all the 10 genotypes were graded based on size, and their germination and seedling growth compared. For the sake of brevity, data of only two genotypes, i.e., T 163 (good storer) and HFP 4 (poor storer), are presented, though the results on the other genotypes are also discussed briefly. The seed size groups in some varieties (e.g., Rachna, KFPD 8 and T 163) showed a differential response with respect to germination after different periods of storage, while in others seed size had no interaction with ageing. In T 163, three grades, i.e , bold, medium and small, were compared statistically up to 18 days of ageing (Table 2). Initially, there was not much difference in the germination of these three grades. Small seeds were inferior to the control after 8 days of storage while medium and bold seeds showed signs of damage due to ageing only after 10 and 14 days of ageing, respectively. In HFP 4 only two grades, i.e., medium and small could be made. The interaction between seed size and duration of storage was not significant. It was observed that smaller seeds of the good storer (T 163) variety were able to tolerate ageing better than the seed of same size in a poor

Table 2. Effect of seed size on germination in pea

Seed grade	Germination after different days of storage (%)							
	0	8	10	12	14	16	18	mean
				T 163				
Small	88.2 (100)	69.5 (85.6)	66.6 (83.3)	63.4 (80.0)	43.1 (46.6)	41.1 (43.3)	41.1 (43.3)	59.0 (68.6)
Medium	88.2 (100)	77.1 (93.3)	66.1 (83.3)	50.2 (53.3)	41.2 (43.3)	35.0 (33.3)	33.0 (30.3)	55.8 (62.4)
Bold	82.7 (96.7)	82.7 (96.7)	77.1 (93.3)	71.6 (90.0)	54.7 (63.3)	41.2 (43.3)	41.1 (43.0)	64.4 (75.2)
Mean	82.2 (98.9)	76.4 (91.1)	69.9 (86.6)	59.6 (74.4)	44.3 (51.0)	41.2 (40.0)	41.4 (38.9)	
CD at 5%: Grades = 4.36, periods of storage = 6.66, and grades x periods = 11.53.								
				HFP-4				
Small	88.2 (100)	45.0 (50.0)	28.1 (23.3)	18.4 (10.0)	— —	— —	— —	44.9 (45.8)
Medium	88.2 (100)	41.2 (43.3)	43.0 (46.7)	33.0 (30.0)	— —	— —	— —	51.4 (55.0)
Mean	88.0 (100)	43.1 (46.7)	35.6 (35.0)	25.7 (20.0)	— —	— —	— —	— —
CD at 5%: Grades = 5.50, periods of storage = 7.77, grades + period = NS.								

Note. Angular transformed values are given above and actual observed values below in parentheses.

storer variety, which could be exclusively due to genetic factors. Mean germination of each grade of all the varieties differed significantly over various ageing treatments except EC 33866 and Pusa 10. In seven genotypes, i.e., JP 888, T 163, PG 3, Hans, KFPD 8, HFP 4, and Rachna the larger seeds (bold or medium category) were significantly better than their small seeds. Bold seeds had relatively higher germination even under longer periods of storage as compared to the smaller seeds in JP 888, PG 3, Hans, KFPD 8, HFP 4 and T 163. Tiwari and Gupta [7] also observed similar relationship in sunflower. For root and shoot length, interaction between seed grades and ageing treatments were nonsignificant in all varieties except for root growth in Hans. Pusa 10 and HFP 4 with severe reduction in germination even with shorter periods of ageing (10 days) were also more severely affected in terms of root and shoot growth. The varieties categorized as good storer on the basis of their germinability also had better root and shoot growth after longer periods of ageing. The genetic basis of longevity is further confirmed by negligible interference of seed size within a variety.

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