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EFFECT OF STORAGE TEMPERATURES AND SEED MOISTURE CONTENTS ON VIABILITY OF *BRASSICA JUNCEA* SEEDS

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Freshly harvested seeds of mustard (*Brassica juncea* cv Pusa bold), were conditioned to five different moisture levels *viz.*, 15,10,7,5,2.5 and 1 per cent. These were packed in tri-layered aluminium foil packets and stored at five different temperatures i.e. ambient, 20, 4, –10 and –20° C. Viability measurements were made at three months interval. The results indicated that the seeds stored with 15% moisture lost their viability earlier as compared to seeds at lower moisture contents. The seeds stored at ambient temperature were the first to lose viability followed by those stored at 20,-20 and –10° C. Viability was relatively prolonged when the seeds are stored at 10° C. Seeds stored at 10 per cent moisture content maintained high viability for the entire period of the study at all temperatures of storage except the ambient and 20° C where the viability was lost in 9 and 18 months respectively. Lowering the seed moisture to 7 per cent and below could prolong the storage life even at ambient conditions.

Key words : *Brassica juncea*, seed viability, storage temperature, moisture content

The age of a seed cannot be considered solely as a function of time, for environmental factors during storage have a definite impact on this. It has long been recognized that the greater the moisture content and storage temperature of orthodox seeds either singly or in combination, the shorter is the period of survival (Roberts, 1973). Even at temperatures above 0° C many crop species can be stored up to 28 years with only minor losses provided the seed moisture is sufficiently low (Horoschailov and Zhukova, 1980). Further improvement in longevity in all orthodox species almost certainly occurs below –20° C, but this is the lowest temperature at which detectable changes in viability with time have been examined in some detail (Roberts and Ellis, 1977). Below this temperature changes in viability may occur at an extremely slow rate that their detection becomes difficult.

Mustard is one of the important oil seed crops of India. The climatic conditions of India greatly accelerate the seed aeging phenomenon under ambient storage. An experiment was designed to work out the suitable

regimes (moisture and temperature) for short, medium and long-term storage of mustard seeds.

MATERIALS AND METHODS

Freshly harvested seeds of *Brassica juncea* cv Pusa bold were procured from Indian Agricultural Research Institute, New Delhi. Seeds were conditioned to different moistures *viz.*, 15, 10, 7, 5, 2.5, 1 per cent by either drying at 15° C and 15% RH or by adding required quantities of water to seeds in aluminium foil pouches, sealing them and storing at 4° C for five days in order to equilibrate moisture within and among the seeds. Ultralow moistures (2.5 & 1%) were achieved by freeze-drying the partially dry seeds. Seed moistures were then determined following ISTA rules (ISTA 1985). In each environment, between 20-25 sub-samples of 300 seeds per lot were sealed in aluminium foil bags and placed in different temperatures viz., ambient, 20, 4, –10 and –20° C. Samples were withdrawn at regular intervals and tested for their viability. Each germination test comprised 100 seeds divided equally among four replicates carried out in Petri plates lined with two layers of moist filter papers at 20° C and the seedlings were evaluated on the seventh day following ISTA rules (ISTA, 1985). The data were statistically analysed using MSTAT:C package.

RESULTS AND DISCUSSION

Seed longevity of mustard seeds was significantly affected by the storage temperature and seed moisture. Seeds at higher hydration level (15% m.c.) lost their viability completely within six months at ambient temperature. These seeds when stored at 20°C retained more than 80% viability up to 9 months. Under sub-zero temperatures (–10 & –20° C), these lots could be stored for 12 and 9 months respectively. The longest period these seeds could however be stored was at 4° C for a period of 18 months. (Fig. 1a). Christensen and Kaufman (1969) postulated that above 10-13% seed moisture, sprouting, heating and fungal invasion can quickly destroy viability. Halder and Gupta (1980) also reported that seed deterioration took place very quickly when the internal moisture was raised to above 10 per cent. Harrington (1960) proposed a 'rule of thumb' that states: every 1 per cent decrease in seed moisture between the levels of 5 and 14 per cent doubles the storage life of the seed. Ibrahim and Roberts (1983) however demonstrated that seed longevity in lettuce was promoted when seed moisture content was increased to 15 or 20 per cent. Their work is in line with that of Villiers (1975) and Villiers and Edgumbe (1975). They hypothesised that the mechanism of sub-cellular repair and turn-over become active at 15 per cent moisture, thereby allowing the seed to repair damaged components during the storage period. In the present study,

mustard seeds at 15% moisture level lost their viability quickly at all temperatures. Higher metabolic activity resulting in heating and fungal invasion could have resulted in rapid ageing. It is however unclear if reduced germinability is related to chilling or freezing injury (Harrington and Kihara, 1960) that may have occurred as a result of low or sub-zero temperature storage of these seeds.

Seed lots with 10 per cent m.c. could be stored for maximum periods of 9 and 18 months respectively at ambient and 20° C. At lower temperatures *viz.*, 4, –10 and –20° C the same lots maintained good vigour and viability for over 33 months (Fig. 1b). These results imply that carryover seeds can be safely and economically stored for short duration (1-1$^1/_2$ years) at ambient or short term storage conditions if sufficient care is taken to package the material in moisture proof storage containers. Further drying of seeds to 7 per cent m.c. prolonged their shelf life to about 21 months. These seeds eventually lost their viability in 33 months (Fig. 1c). Seeds of this catagory retained their full complement of vigour and viability throughout the period of the study at temperatures other than ambient. These results are in confirmation with the statement of Toole and Toole (1946) that the moisture content and storage temperature generally interact in their effect such that maintenance of either low moisture or low temperature increases their storage life. Seed desiccated to 5 per cent m.c. stored well for entire period at all temperatures including the ambient. The IPGRI advisory committee for seed storage (1976) has recommened safer limits of moisture content as 4 to 7 per cent for long-term storage of orthodox seeds.

Desiccation to ultralow levels of moisture *viz.*, 2.5 and 1 per cent did not result in any appreciable loss of viability during their storage at different temperatures (Fig. 1d). Nutile (1964) studied the effect of excessive desiccation of vegetable seeds and catagorized nine vegetables according to seed resistance to desiccation injury and observed that the seeds of celery, eggplant and pepper were injured if the seed moisture was reduced from 4 to 1 per cent. Similar results were observed in beans and Peas. Woodstock *et al.* (1976) however concluded that freeze drying of pepper seeds to a moisture content of 2.5 per cent was superior to 3 per cent for storage for 12 months at 21-25° C or at 40° C. In the present study, it has been observed that freeze drying mustard seeds to ultralow moistures did not result in any noticeable injury and this effect persisted throughout the storage period at all temperatures. Ultra desiccated seeds have their metabolic activities reduced to a minimum and hence can be successfully stored for very long periods. The observation of the present study is in agreement with those of Cheng *et al.* (1990) who have shown that freeze drying can safely reduce the moisture content to ultralow levels and that this enhances seed vigour, storage life and the integrity of cellular ultrastructure. Ellis *et al.* (1993) reported the results of ultralow

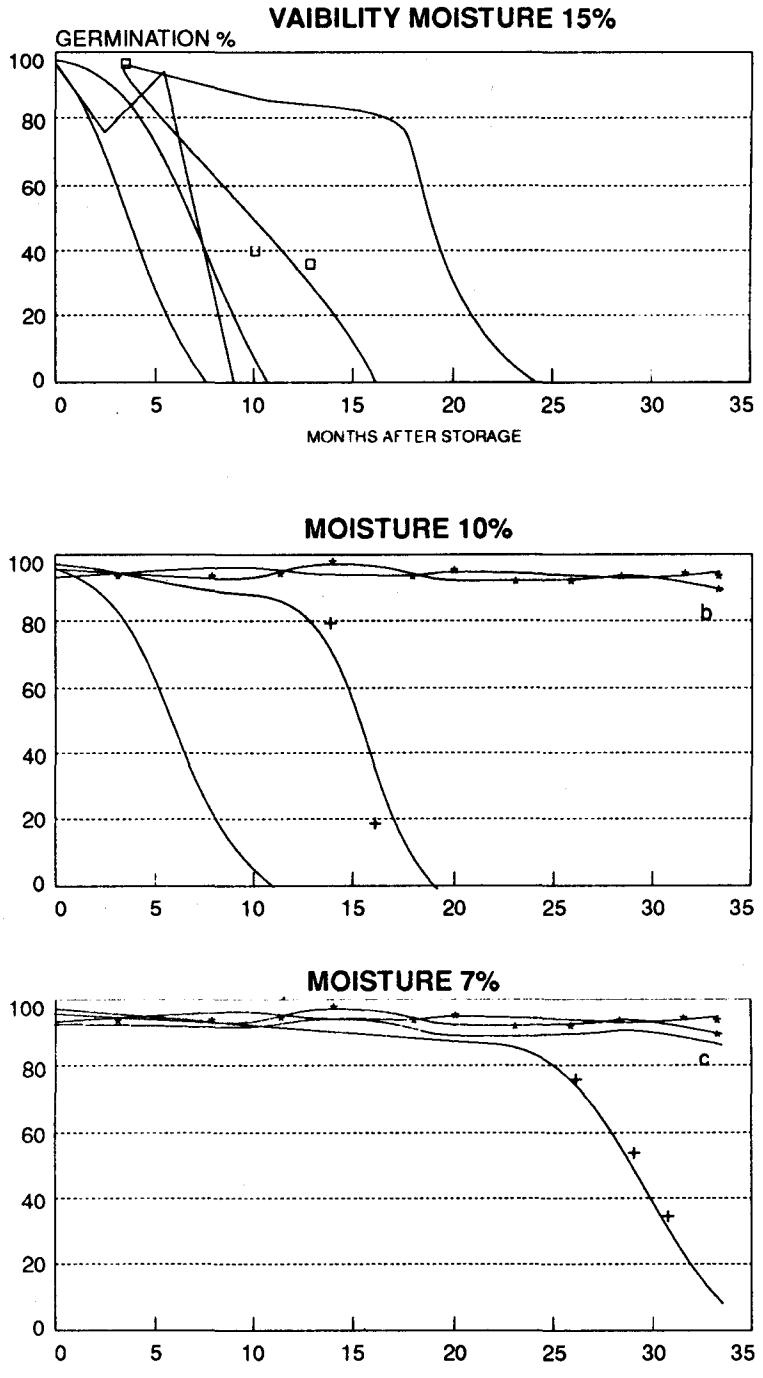

Fig.1 (a-c). Influence of different moistures and storage temperatures on the survivability of *Brassica juncea* cv Pusa bold seeds

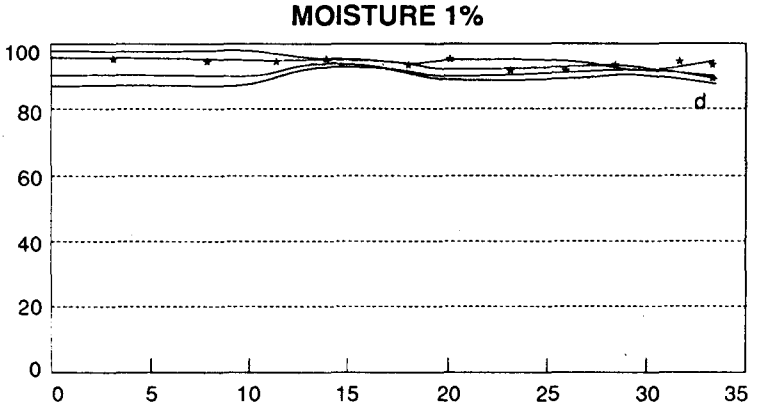

Fig.1 (d). Influence of different moistures and storage temperatures on the survivability of *Brassica juncea* cv Pusa bold seeds

storage of 17 crucifers for over 25 years. They observed that in 10 accessions no significant increase in germination ability was detected whilst only one accession showed significant decrease in germination. These results alongwith those of the present study suggest that ultradry storage of seeds, ie. storage at less than 5 per cent m.c. is a promising technique and might as well enable the cost of regeneration to be reduced or even avoided in some applications.

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