Response of Garden Pea Seeds to Elevated Nitrogen and Carbon Dioxide During Seed Storage

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An experiment was conducted using garden pea (*Pisum sativum* L.) seed germplasm conserved in laminated aluminium foil pouches along with nitrogen, carbon dioxide, and/or in partial vacuum under ambient conditions for 5 years. Seeds of *cv* Green Pearl were viable for 5 years under ambient conditions. High seed quality in terms of viability and vigour was preserved with carbon dioxide storage followed by nitrogen. It is beneficial to pack well-dried seeds along with carbon dioxide in laminated aluminium foil pouches for the maintenance of high viability till next growing or for short-term conservation of seed germplasm. The modified atmosphere storage is effective for preservation of genetic diversity and useful especially in absence of cold storage facility.

Key words: Garden pea, Seed germplasm, Conservation, Gaseous storage, Viability, Vigour, Storability

Garden pea (*Pisum sativum* L.) is an important vegetable crop of temperate and sub-tropical regions. Its fresh green seeds and pods are used for culinary purposes. Seeds are also valued for germplasm conservation. The crop is commonly raised through the seeds. High seed quality plays an important role in crop growth, establishment and production. Further, its maintenance is dependent on suitable storage conditions. The process of seed deterioration is predominantly governed by seed moisture, storage temperature and oxygen contents (Bass, 1980). Further greater level of oxygen in storage container affects the seed viability and storability (Roberts and Abdalla, 1968). Seed storage in elevated oxygen levels increases the deterioration process while in partial vacuum it preserved high seed quality as well as enhanced the storage life (Barton, 1960). Replacement of air with nitrogen or carbon dioxide in storage containers lowers the seed deterioration thereby maintaining higher seed viability and vigour (Bass and Stanwood, 1978; Doijode, 2004). The utility of the gaseous storage differs in different crops and helps in better retention of high quality in terms of viability and vigour which is prerequisite for successful conservation programme. The present experiment was conducted with the view to harness the benefits of gaseous storage during conservation of seed germplasm in garden peas.

Materials and Methods

Garden pea seeds cv Green Pearl (containing 9.2% moisture content) were packed in triple layered laminated aluminium foil pouches along with nitrogen, carbon dioxide and air or in partial vacuum by PAC-vacuum and gas sealing machine. The pouches were impervious in nature, triple sealed all the four sides and there was no escape of gases. To compare seed storability, seeds were packed in paper bags and stored at ambient conditions (16-35°C; 25-90% RH) for 5 years. Seed viability and vigour were determined periodically in stored seeds. One hundred seeds of each replicate were germinated on triple layer moist rolled crepe kraft paper at alternate temperature of 20°C and 30°C for 16 and 8 hours respectively in seed germinator. Seedlings were evaluated for normal and abnormal nature and germination count was taken on normal seedlings. Seedlings with well developed root and shoot systems were considered as normal. Seedling characters such as shoot and root length and seedling dry weight were recorded on 7 days old seedlings and final count was taken after 14 days of sowing. Dry weight was recorded on seedlings dried at 65°C for 48 hours. Seedling vigour was compared by means of vigour indices I and II which were calculated by multiplying percentage germination with seedling length and dry weight respectively. The data was statistically analyzed for variance and means were compared by using protected least significant difference test at 0.05 probability level.

Results and Discussion

Seed quality in terms of viability and vigour was decreased with increase in storage period. Garden pea seeds were viable for 5 years in various treatments. The percentage of germination varied from 11 to 79 during 5th years of storage. The initial viability 92 per cent was maintained for first three years of storage when seeds were packed along with carbon dioxide

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unlike it reduced to almost 50 per cent in control. Similarly seeds stored in nitrogen also exhibited higher viability and vigour during conservation but lower as compared to carbon dioxide storage (Fig. 1).

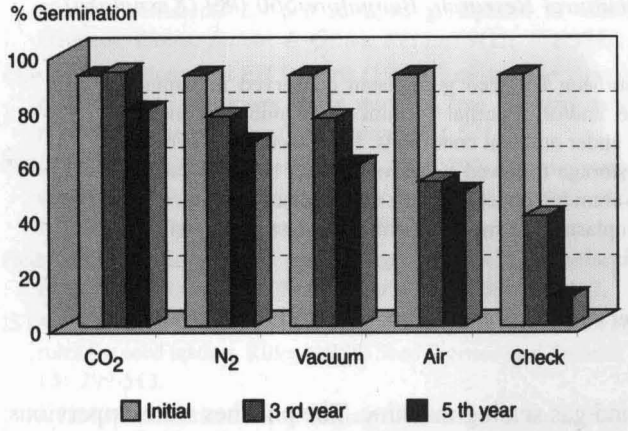

Fig. 1: Seed viability during gaseous storage in garden peas under ambient conditions

There were almost 6 and 7 times increased storage potential in nitrogen and carbon dioxide stored seeds respectively over the control after 5 years of storage. Seed conservation devoid of oxygen was able to maintain an appreciable level of seed quality during storage. Seedling vigour was compared by means of seedling characters as well as vigour indices which was greater for seeds stored in gaseous environment (Table 1). A high level of seed viability and vigour was able to obtain in seeds with carbon dioxide storage.

Garden pea seeds are moderate storer under ambient conditions. A fairly high level of viability was preserved for 5 years under ambient conditions with carbon dioxide storage as compared to only for two years in control. Seeds stored in carbon dioxide environment in laminated aluminum foil pouches exhibited higher seed germination and seedling vigour even after 5 years of ambient storage. Removal of air especially the oxygen is beneficial for maintenance of high seed quality during storage. It promotes the process of seed deterioration especially under ambient conditions (Harrington, 1960). The percentage of germination was decreased with increase in level of oxygen in storage (Roberts and Abdalla, 1968). Seed storage in modified atmosphere is superior over the seeds sealed in air (Harrison and McLeish, 1954). Thus seed storage with nitrogen or carbon dioxide is beneficial in maintaining high quality during seed germplasm conservation. In certain crops such as onion and amaranths seed conservation with nitrogen showed greater viability and vigour on storage (Doijode, 2000 and 2001) and with carbon dioxide in cabbage (Doijode, 2004). There is greater loss of seed viability during initial stages of storage. Several valuable germplasm accessions were lost due to improper handling and non-availability of suitable storage facility. Further, seed longevity is governed by initial level of vigour of an accession. Thus, it is advantageous to pack well dried seeds of an accession in laminated aluminium foil pouches along with carbon dioxide for better retention of high viability and vigour in ambient condition before it is utilized in breeding and /or for long term germplasm conservation.

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Table 1. Seedling characteristics and vigour during gaseous storage of seeds in garden peas

Storage environment/ Year of storage (yrs)	Shoot length (cm)		Root length (cm)		Dry wt. (mg)		Vigour		Vigour index-I		Vigour index-II	
	3	5	3	5	3	5	3	5	3	5	3	5
CO_2	3.7	1.8	7.3	8.3	39.7	25.4	47.8	16.5	1020	798	3084	2005
N_2	4.7	2.4	9.1	8.8	34.8	21.3	50.8	16.9	971	758	2425	1452
Vacuum	4.1	1.8	8.3	8.3	39.2	24.7	55.3	12.2	959	601	2991	1466
Air	3.7	2.1	6.8	6.8	21.9	23.7	35.6	10.6	584	433	793	1162
Check	1.8	–	6.4	–	12.9	–	24.5	2.5	321	–	495	–
CD at 5%	1.1		NS		7.9		9.7		299		300	

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