Introduction
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Since the introduction of high-yielding wheat cultivars significant success has been achieved in the production of wheat in the State of West Bengal. The area under wheat in West Bengal has shown a rise from 0.17 million hectares in 1969-70 to 0.44 million hectares in 1975-76 with a corresponding rise in annual production from 0.47 million metric tonnes to over 1 million metric tonnes (Anon, 1976). The target of area and production of wheat for 1980-81 was fixed at 0.64 million hectares and 1.4 million tonnes respectively as against the achievement of 0.51 million hectares and 0.79 million tonnes during 1979-80 (Anon, 1980).

In eastern India, the large scale cultivation of wheat has, however, posed a number of technological problems among which preservation of seed is of paramount importance. Wheat seed harvested in April-May, passes through the monsoon and shows a significant fall in germinability by the time of next planting in November-December. Monsoon storage in West Bengal considerably raises the ambient relative humidity and as a result the seeds kept in gunny bags absorb a lot of moisture from the atmosphere. This, coupled with the prevailing high temperatures, greatly hasten the ageing process.
of the seed. Although in the western districts of this State the average relative humidity is not very high, in the southern and northern districts, the average relative humidity would be about 80 per cent and the average temperature around 30°C during the storage period. It is no wonder that this State has been regarded as a "poor" place for seed storage (Harrington and Douglas, 1970; Agrawal, 1976). This is especially true for wheat seeds which show a very rapid decline in viability.

Farmers in West Bengal require about 50 thousand tonnes of seed every year and if we have to import the whole of it, it would cost the State an amount of about 20 crores of rupees at the existing price rate for seed wheat. A considerable part of the seed requirement is met by supplies from the traditionally wheat growing States of Punjab, Uttar Pradesh and Haryana. It is not merely a question of the cost involved, but the farmers in the remote and often difficult-to-reach areas are not assured to get their quota in time and the quality of the seed also deteriorates due to moisture absorption during the long time taken in transit. This system is undesirable and the best solution is to develop a methodology by which a high level of germinability of our own produce could be maintained.

For the preservation of germinability, thorough sun-drying after harvest, followed by storage in sealed containers such as metal bins, tins
etc. or thick polythene bags with outer gunny coverings or earthenware vessels with inner polythene linings have been recommended. Some progressive farmers use metal bins or store seed in sealed polythene bags, but storage in gunny bags or earthenware vessels is still the predominant mode of storage. Sealed storage of thoroughly dried seed would carry the same safely to the next sowing but dependence on sun-drying at ambient humidity level and the difficulties of total exclusion of air, besides the cost factors of storage in metal bins, still stand in the way of acceptance of this method by our farmers. Stored seed which have not been dried properly would deteriorate faster in metal bins than those stored in gunny bags.

Incidentally, storage of wheat seeds in certain years has been problematic even in the traditionally wheat growing States of India. Occasional rains during harvesting and threshing would cause significant deterioration of the seeds. The maintenance of vigour and viability of rain-soaked seeds becomes especially serious in cases where the germination process is too advanced; even sprouting taking place in large number of instances. Further, an increase in seed moisture content either in the standing ready-to-harvest crop or in the threshing floor would advance
the physiological and pathological deterioration of the seed. Drying to a safe moisture content would reduce such deterioration. It, however, needs to be mentioned here that under ordinary conditions, the ageing process of the partially deteriorated rain-soaked seed cannot be completely halted. More specific alternative methods should be standardised for controlling further deterioration in storage.

The growth of the fungi on grain before and during storage at relatively high moisture contents may lead to a significant reduction in germinability which would be reflected on the productivity of the crop grown from such seeds. Insects are also very important agents initiating spoilage of stored wheat. Not only do they destroy enormous quantities of grain, but they often provide the conditions that make it possible for fungi to develop. Insects can develop in stored grain that is much too dry for fungal development, and through their respiration, can produce sufficient moisture to enable fungi to grow. In such situations, the fungi may, in the end, cause more direct damage to the grain than the insects, mainly through the heat they produce. The most injurious insects are beetles and moths belonging to the orders Coleoptera and Lepidoptera.
A study of wheat seed germinability from harvest to next sowing would show a downhill journey of the seed from the highest point of vigour and viability at physiological maturity to a lower level at sowing. The fall in germination percentage could be compensated by a corresponding adjustment of the seed rate but compensation for the loss of vigour may not be possible.

It appears that the practice of storage of wheat seed in gunny bags and other moisture-pervasive containers would continue for the present. The cultivators, however, take out stored seeds for sun-drying and then re-store them till sowing. It would be of great advantage if they could incorporate some simple methodology to maintain germinability in their existing methods of storage.

Seed treatment for viability maintenance

Investigations were undertaken in this laboratory to develop a simple method of seed treatment to retain seed germinability and to improve seedling vigour and productivity of the resultant crop. Employing the soaking-drying method, Basu et al. (1974) and Basu and Dasgupta (1974) could significantly slow down the deterioration of seeds stored under ambient conditions. But the
soaking-drying treatments are effective only after several months of storage under ambient conditions. The storability of high-vigour seeds is significantly reduced in treatments involving prolonged soaking. Very short-term immersion or alternative methods of hydration need to be developed for high-vigour seeds. It would be of great advantage if the seeds could be treated soon after harvest when they are more vigorous.

Dry-dressing of effective chemicals, in which the seed need not be dried back, would also be easier. The large efficacy of seed halogenation treatment especially in mustard, as demonstrated in this laboratory (Basu and Rudrapal, 1980), would also suggest the feasibility of employing halogenation treatments in other materials.

Under the ambient storage conditions of West Bengal, storage fungi and insect pests cause considerable damage to stored seeds. This is also true for the hydration-dehydration treatments, especially when the treated seeds are stored in unsealed containers and gunny bags. It is therefore necessary to study the feasibility of combining the hydration-dehydration treatments with pesticidal treatments as a practical solution to the storage problem of wheat seeds.
Soaking-drying treatment with a range of chemicals have been attempted. Many wheat growing areas in West Bengal suffer from micronutrient deficiency. It would be worthwhile to investigate whether the micronutrients could be used in the hydration-dehydration treatments for the maintenance of germinability as well as to overcome to some extent to deficiency of such nutrients in the soil encountered during crop growth.

In West Bengal, 7.4 per cent of the total cultivated lands are saline. The hydrated-dehydrated seed usually shows considerably higher germinability and gives vigorous seedlings. Whether the mid-storage hydration-dehydration treatments can alleviate salinity stress and perform better than untreated materials would be a matter of great practical importance to wheat growers especially in the southern districts of West Bengal.

Scope of the present investigation

The present investigation was taken up against the aforesaid background with the view to developing effective means of controlling the rapid decline in germinability of wheat seed in ordinary storage and to maintain the yield potential of the crop. Studies have also been made to elucidate the possible mode of action of seed treatments in the preservation of germinability.
The following experiments were carried out for the purpose:

i) Determination of the pattern of decline in vigour and viability of important wheat cultivars under ambient conditions.

ii) Standardization of dipping-drying treatments for the maintenance of vigour, viability and productivity.

iii) Effect of varietal response on hydration-dehydration treatment for the maintenance of vigour, viability and productivity.

iv) Studies on compatibility of insecticidal and fungicidal formulations with the hydration-dehydration treatments.

v) Studies on the effect of seed treatment with micronutrients.

vi) Studies on the effectiveness of hydration-dehydration treatments in the alleviation of salinity stress.

vii) Studies on dry dressing treatment with calcium oxychloride for the maintenance of vigour and viability.

viii) Physiological and biochemical studies on hydration-dehydration treatments.

The results obtained from the aforesaid experiments, their possible interpretations and the major conclusions drawn from the studies are presented in this thesis. The investigations were conducted in the College of Agriculture, Calcutta University between February, 1978 and December, 1981.