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STORABILITY OF RICE (*Oryza sativa* L.) SEED IN IMPROVED WAREHOUSES

K.A. METTANANDA, S.L. WEERASENA and Y. LIYANAGE
Seed Certification and Plant Protection Centre, Peradeniya

ABSTRACT

Storage temperature and relative humidity are important parameters determining seed viability. Moderate temperature (18-20°C) and RH (50-60%) are ideal storage conditions for many seeds. However, temperature and RH in most ambient seed stores in the dry zone of Sri Lanka are well above these values and are harmful for storage of agricultural seeds of many crops. An investigation was carried out in seed farms at Maha Illuppallama, Nikaweratiya, and Polonnaruwa during 2000/2001 to test the effect of store improvement, done by laying aluminium foil beneath the roof sheets, on in-store environmental conditions and its effects on storability of six rice cultivars in comparison to seed stored in conventional stores. The study revealed that aluminium foil reduced the day-time store temperature by a maximum of 7°C compared to normal stores. However, in-store RH at night increased up to 30% in the improved stores, compared to the normal stores depending on the time of the day. The effects of these changes in storage environment on the storability of rice varied between cultivars. Seed germinability of rice cultivars Bg 403, Bg 379-2, and At 353 were not affected significantly up to a period of 8 months. However, storability of cultivars Bg 300, Bg 352, and Bg 450 declined below the acceptable level (85% germination) after 5 months in the improved stores whereas it was maintained up to 8 months in the conventional stores. Moisture condensation at night due to reduced in-store temperature and obstruction of normal air convection at roof level due to aluminum foil lining would have increased the in-store RH at night. Seed moisture increased by 2- 3% due to high RH. Early decline of seed viability in some cultivars could be due to the increased seed moisture content. However, cultivars such as Bg 403, Bg 379-2, & At 353 have demonstrated an ability to maintain their viability even under high RH conditions. This may be due to their specific physical and /or genetic characters. Further research is needed to confirm this possibility.

KEY WORDS: Rice Seed Storage, Improved Warehouses, Aluminium Foil

INTRODUCTION

About 100,000 t of rice seed is used by farmers in Sri Lanka every year for cultivation. Nearly 20% of this quantity is supplied by the government and private sector as quality assured seed and the balance is farmer saved seeds. Majority of seed paddy is produced in dry zone areas where temperatures are high. Normally, seeds of 3- 3.5 months age class cultivars are produced in *yala* season for the use of next *yala* and the seeds of 4- 4.5 months age class cultivars are produced in *maha* season for the use in next *maha*. Therefore, seed produced in any season has to be stored for up to 8 months before being used for cultivation. In addition, storage for longer periods may be required in order to assure a continuous supply of certified seeds for cultivation in both seasons.

As in most other seeds, storability of rice is mainly determined by the storage conditions. Storability of rice seed could be improved by controlling the storage environment. The effect of storage conditions on the storability of a range of crops including cereals has been documented (Harrington, 1963; Justice and Bass, 1978; Bass, 1980; Copeland and Mc. Donald, 1985;

Copeland and Mc. Donald, 1995). Temperatures exceeding 25^0 C and relative humidities (RH) higher than 65% have been identified as harmful for storage of many seeds (Joao Abba and Lovato, 1999). However, temperature and RH conditions in most ambient seed stores in the dry zone of Sri Lanka are well above these optimum values which shorten the longevity of stored seeds.

Three existing conventional seed stores at Maha Illuppallam, Nikaweratita, and Pollonaruwa government seed farms were improved by laying aluminum foil (Gauge 300) under the roof sheets, to reduce the in-store air temperature. Seed and Planting Material Division of the Department of Agriculture is planning to improve most of its seed stores in the dry zone farms in this manner. However, information on the effect of these physical improvements on the storability of local rice cultivars under local conditions is not available.

An investigation was carried out during 2001 to study the effect of store improvement by laying aluminum foil under the roof sheets on the storability of six rice cultivars in the dry zone of Sri Lanka.

MATERIALS AND METHODS

Registered-class seeds of six rice cultivars - Bg 300, Bg 352, Bg 379-2, Bg 403, Bg 450 and At 353 from 2000/2001 *maha* harvest of Pollonnaruwa seed farm were used for the study. Two 20-kg polypropaline bags were considered as a treatment unit. One improved and one conventional seed stores at seed farms in Maha Illuppallama, Pollonanaruwa, and Nikaweratiya were used to store seeds of different cultivars for comparing the storability. Due to unavailability of several improved stores in each location, the selected three locations were considered as replications. Treatments were arranged in a split-plot-design where store condition as the main plot and cultivars as the sub plot. Temperature and RH were monitored in each store in all three locations using thermo-hygrographs with seven day charts. Using ISTA (1996) rules, percentage standard germination and seed moisture content were tested in all the treatments at monthly intervals beginning December, 2000. Data was subjected to statistical analysis using analysis of variance (ANOVA). Percentage data was transformed using arcsine angular transformation wherever necessary to homogenize variance.

RESULTS

Storage environment

Daily in-store temperature and RH behaviors in all three locations during the storage period were mostly comparable for similar type of stores. Figure 1 presents only the averaged data for each store type for the total storage period.

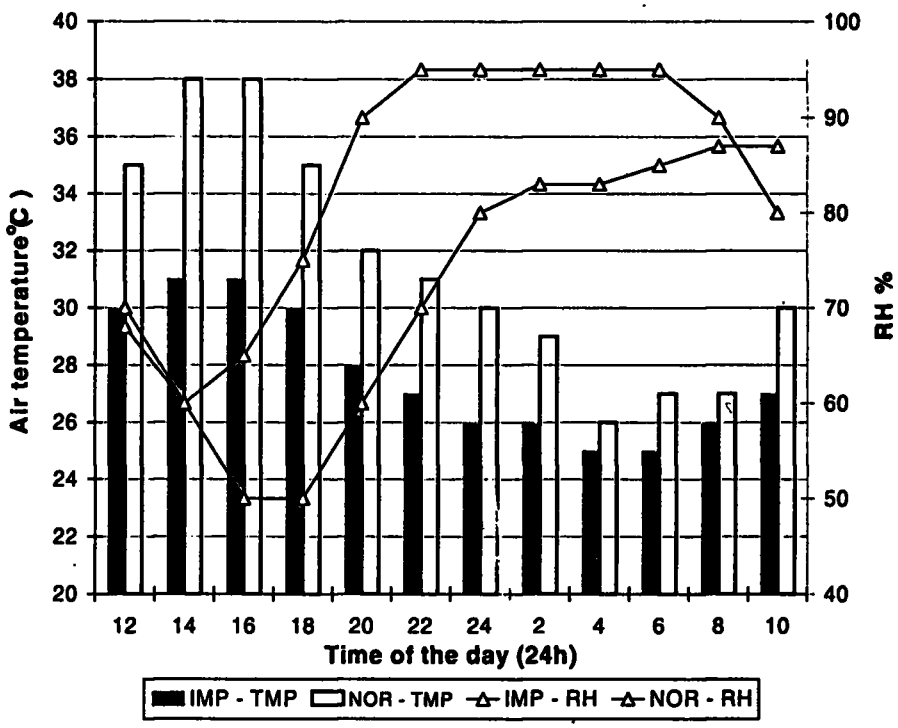

Figure 1. Daily averaged in-store air temperature (°C) and relative humidity (%) in improved and conventional stores during study period (RH- Relative humidity, TMP- Temperature, IMP- Improved stores, NOR- Normal stores)

As shown in Figure 1, in-store temperature in aluminum foil lined stores were 7°C lower (maximum) than in conventional stores in all three locations. However, night time RH was 30% higher (maximum) in the improved stores and the higher level was present for a longer period when compared to the conventional stores.

Standard germination

Percent standard germination of cultivars Bg 300, Bg 352 and Bg 450 declined below acceptable level (85%) after 5 months in the improved stores whereas it was maintained up to 7-8 months in the conventional stores (Figure 2, Group 1).

However, cultivars Bg 379-2, Bg 403 and At 353 have maintained their standard germination up to the acceptable level even up to 8 month in both improved and conventional stores (Figure 2, Group 2).

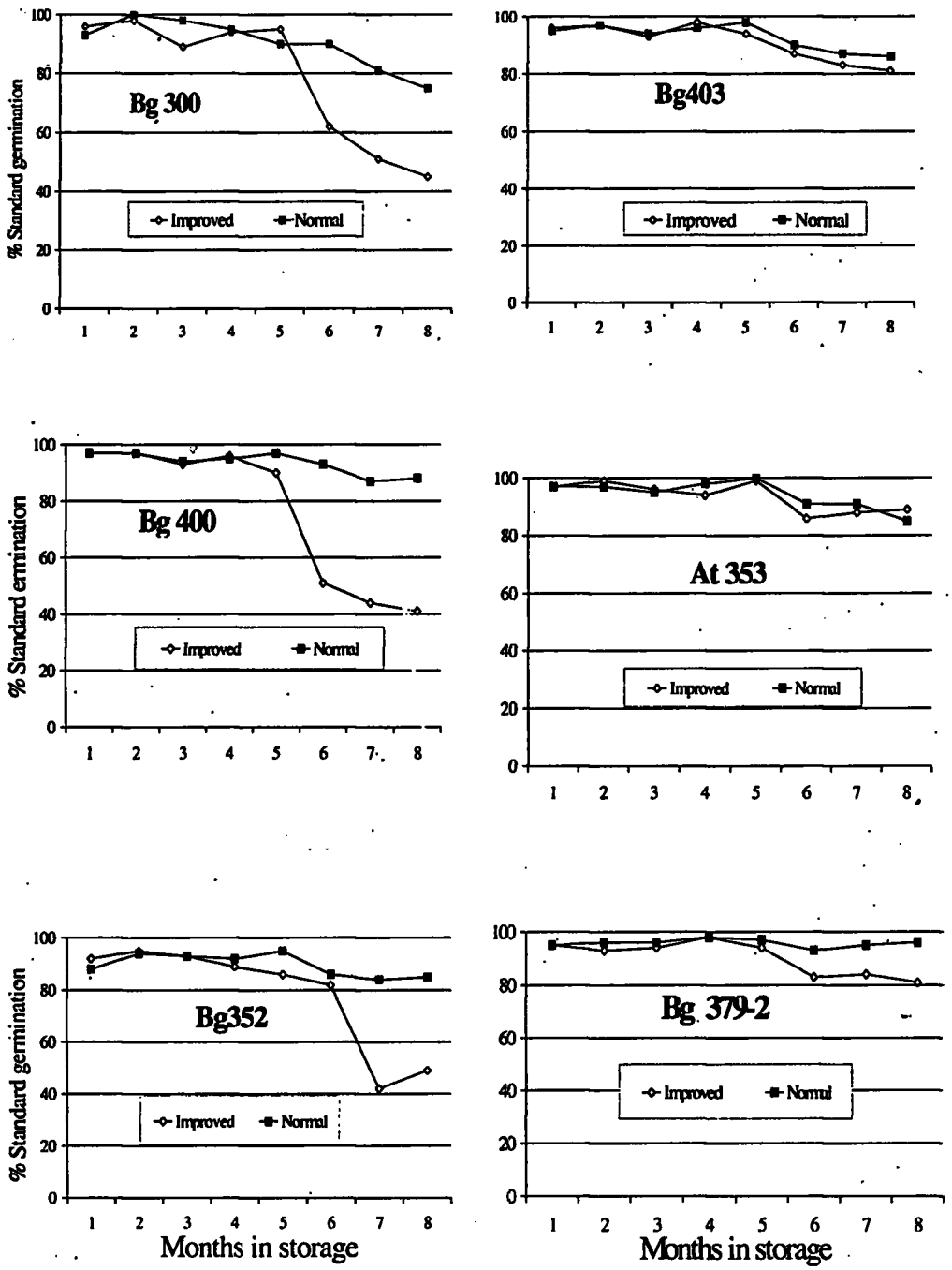

Figure 2. Effects of storage environment on % standard germination of six rice cultivars in the dry zone of Sri Lanka

Seed moisture content

Seed moisture contents at the beginning were equal in all treatments. However, moisture increased with the increase of storage period. Results of a trend analysis showed that the increase of percentage seed moisture was significantly higher in the improved stores whereas it was not significant in the normal stores. Seed moisture content was 2-3% higher in the seeds stored in the improved stores toward eight months of storage as compared to initial moisture content, irrespective of the cultivar (Figure 3, Table 1).

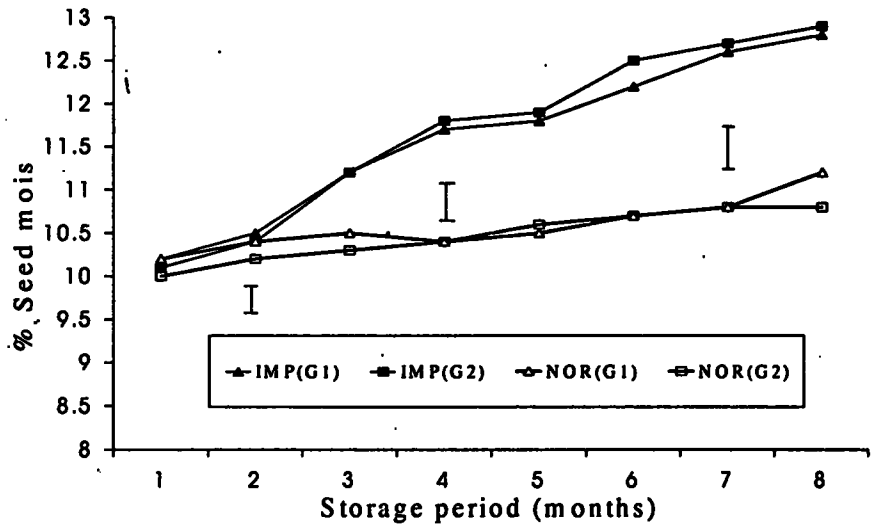

Figure 3. Average % seed moisture content of cultivar Bg 300, Bg 352, and Bg 450 (Group 1) and cultivar Bg 379-2, At 353, and Bg 403(Group 2) in different months after storage in different store conditions (IMP= Improved, NOR - Normal store, G1 – Group 1, G2 – Group 2, Vertical bars = SED).

Table 1. Results of the statistical analysis of data[1]

	Standard Germination (%)			*Seed Moisture Content(%)*		
Source of variation	*2M*	*4M*	*7M*	*2M*	*4M*	*7M*
Store condition (SC)	ns	ns	**	ns	*	**
Cultivar (CV)	ns	ns	**	ns	ns	ns
SC x CV	ns	ns	**	ns	ns	ns

[1]** Significant at 1% level probability, ns- not significantly different, M – months in storage

DISCUSSION

Moisture condensation due to reduced in-store temperature and obstruction of normal air convection at roof level due to aluminum foil as well as slow convection flow due to reduced in-store temperature would have increased in-store RH at night increasing the seed moisture content in the improved stores. This would have caused for early failure of seeds of some cultivars in stores. Previous workers also have reported a similar response to increased seed moisture content with regard to the longevity of maize seed (Mettananda *et al.*, 2001). Rice cultivars Bg 379-2, Bg 403 and At 353 have

demonstrated an ability to maintain their viability even under relatively high RH condition possibly due to cultivar-specific physical /genetic characteristics. This argument is supported by the findings of Lopez and Crispin (1971), who reported that variability in seed longevity could occur not only between species but also between cultivars. Reduced storage temperature by 1°C would double the storage life of seed according to basic principles of seed technology (Harrington, 1992). The results of this study proved that increased RH beyond 70% is more detrimental and it could override the beneficial effects of reduced temperature in seed storage. The ability of Bg 379-2, Bg 403 and At 353 to withstand high RH in storage environments is an important criterion for exploitation under the tropical conditions in Sri Lanka.

CONCLUSIONS

Lowering in-store temperature by a layer of aluminum foil under the roof sheets is not favourable for rice seed storage in woven polypropylene bags in the dry zone of Sri Lanka. There is a varietal variation in sensitivity of seed viability to storage environment. Cultivars, Bg 300, Bg 352 and Bg 450 are highly sensitive to increased RH in the stores whereas cultivars Bg 379-2, Bg 403 and At 353 can be considered as tolerant to increased RH in storage. The character responsible for this tolerance could be used to improve the storability of rice cultivars in future breeding programmes. The effect of using dehumidifiers at night and /or packing seeds in moisture resistant materials such as polythene lined poly-sacks should be investigated in order to utilize the advantages of lowered in-store temperature in the improved stores in promoting seed storability.

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