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Influence of Harvesting and Threshing Methods on Storability of Rice Varieties

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Present investigation is an attempt to study the effect of different harvesting and threshing methods on storability of rice varieties *viz.,* CR1009 Sub1, improved white ponni and CO51. The seeds collected from different harvesting and threshing methods *viz.,* manual harvesting and manual threshing, manual harvesting and mechanical threshing (axial flow thresher) and combine harvesting (with pneumatic wheel). The collected seeds were cleaned, graded and treated with water soluble polymer @ 4 ml + 12 ml water.kg^{-1} compared with control seeds. The treated seeds were stored under ambient temperature in both super grain bag and gunny bag containers along with control. The quality parameters were recorded initially and at monthly intervals for a period of 12 months to assess the storability of seeds. The result revealed that among the harvesting and threshing methods, CR1009 Sub 1 seeds obtained by manual harvesting and manual threshing registered maximum germination, longer root and shoot length, highest dry matter production, vigour index, lowest pathogen incidence and seed leachates. Between the containers, seeds stored in super grain bag registered higher germination, vigour index, lower pathogen incidence and seed leachates in CR1009 Sub 1 seeds irrespective of the harvesting and threshing method. The study concluded that different varieties of rice seed *viz.,* CO51, CR1009 Sub 1 and improved white ponni harvested and threshed by different methods and coated with water soluble polymer @ 4 ml + 12 ml of water.kg^{-1} of seed and packed in super grain bag maintained seed quality above minimum seed certification standards up to twelve months.

Key words: Rice, Harvesting and threshing, Storability, Seeding vigour

`Farm mechanization is one of the realistic approaches to improve agriculture production and has the obvious advantages of reduction in human drudgery, reduction in cost of cultivation, enhancement of working efficiency and timeliness of working. Different types of farm operations starting from land preparation to seed storage are involved in agriculture. All these operations are labour intensive and time consuming when carried out with manual labourers. Failure to complete farm operations within the stipulated time may sharply reduce the crop production. Seed quality is the most important factor influencing crop growth, development and yield processes and could increase yield by 5-20% (Rickman *et al.,* 2006). Seed deterioration during storage is a gradual and inevitable process causing considerable losses. Seeds tend to loose viability and vigour during storage and information on storability of seed lots from harvest until the next planting season and also for carry over purposes is of immense importance in any seed production programme. In storage, viability and vigour of the seeds is regulated by many physico-chemical factors such as moisture content of the seed, atmospheric humidity, temperature, and initial seed quality, physical and chemical composition of seed, gaseous exchange, storage structure and packaging materials. The polymer coating keeps the seeds intact, as its acts as binding material; it covers the minor cracks and aberration on the seed coat thus blocking the fungal invasion. It may also acts as a physical barrier, which reduces leaching of inhibitors from seed covering and restricts oxygen movement and thus reducing the respiration of embryo, thereby reducing the ageing in seeds (Vanangamudi *et al*., 2003). Harvesting rice crop using combine has been widely accepted and practiced to overcome the peak demand of farm labourers and to minimise the field losses incurred during manual harvesting. However, for reasons not known our farmers hardly use combines for rice as seed crop. With the available limited information and to verify the myth, the study was initiated to assess the effect of different harvesting and threshing methods on seed storability of rice varieties.

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Material and Methods

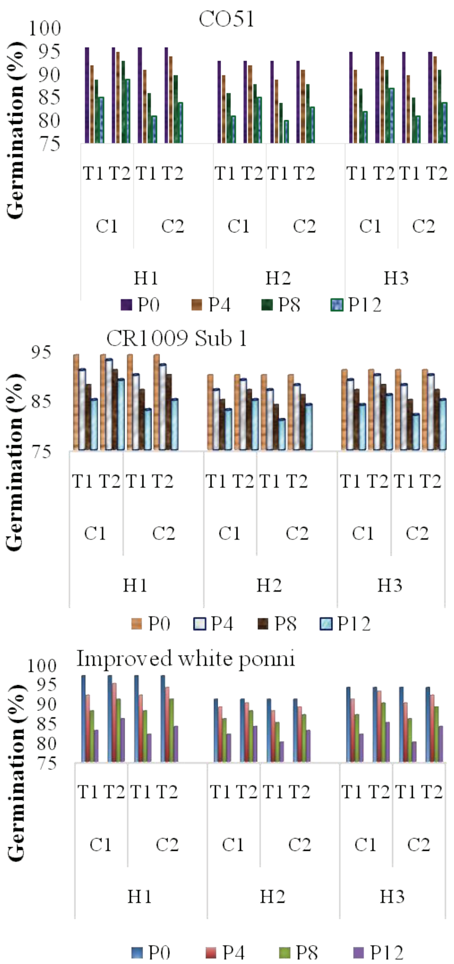
An experiment was conducted at Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Kumulur, Tiruchirappalli, Tamil Nadu during 2016-2017 to find out the influence of harvesting and threshing methods on seed storability of rice varieties *viz.,* CR1009 Sub1, IW Ponni and CO51. The treatments are manual harvesting and manual threshing (H_1), manual harvesting and mechanical threshing (axial flow thresher) (H_2) and combine harvesting (with pneumatic wheel) (H_3). The seeds collected from different harvesting and threshing methods were cleaned and graded. The graded seeds were stored in both super grain bag (C_1) and gunny bag (C_2) containers with 12.4 to 12.5 per cent of moisture content as per the following treatment of control (T_1) and water soluble polymer 4 g +12 ml water.kg^{-1} (T_2) and reduced to 8 per cent of moisture content. The treated seeds were stored under ambient conditions. The experiment was designed adopting FCRD with three replications. The following quality parameters were recorded initially and at monthly intervals for a period of 12 months to assess the storability of seeds. Treatment wise, the seeds were placed for germination in roll towel method. Under each treatment, 400 seeds were sown with eight replications of 50 seeds each. Seed germination was expressed as the percentage of seeds producing normal seedlings. Fourteen days after sowing (ISTA, 2011) ten seedlings from each replication were randomly selected and the root and shoot lengths were measured and the mean value was recorded. Ten random seedlings were dried in a hot air oven at 85^{0}C for 24 h. and the dry weight was recorded and expressed as g.seedling^{-10}. The vigour index was calculated using the following formula (Abdul – Baki and Anderson, 1973)

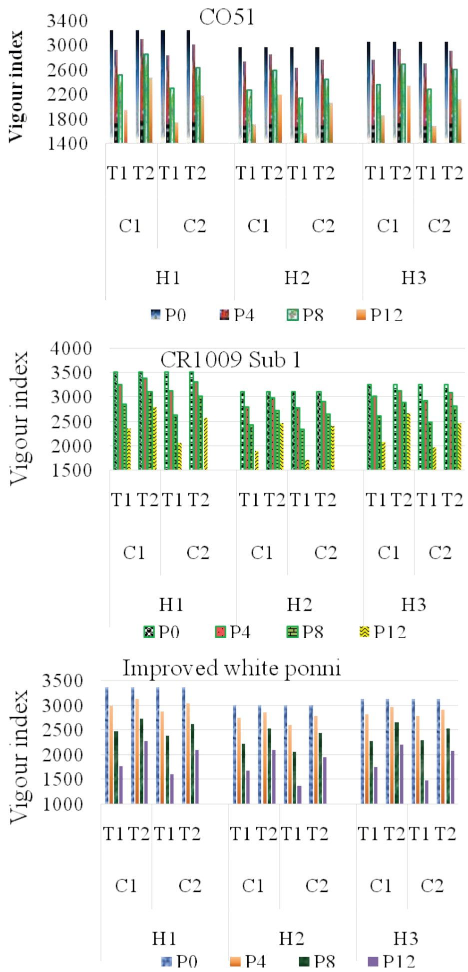
Vigour Index = Percentage germination x Total seedling length (cm).

Treatment wise seeds were analyzed electrical conductivity (Presley, 1958), and pathogen infection percentage (ISTA, 1999). The results were subjected to statistical analysis for significant difference (p=0.05) as per Panse and Sukhatme (1999). Percentage values were transformed using arc sine values prior to statistical analysis.

Results and Discussion

The results of the different harvesting and threshing methods on storability of rice varieties revealed that the moisture content was significantly





H1- Manual harvesting and manual threshing
H2- Manual harvesting and mechanical threshing
H3- Combine harvesting
T1- Control
T2- Water soluble polymer 4g+12 ml water.kg^{-1}

C1- Super grain bag
C2- Gunny bag

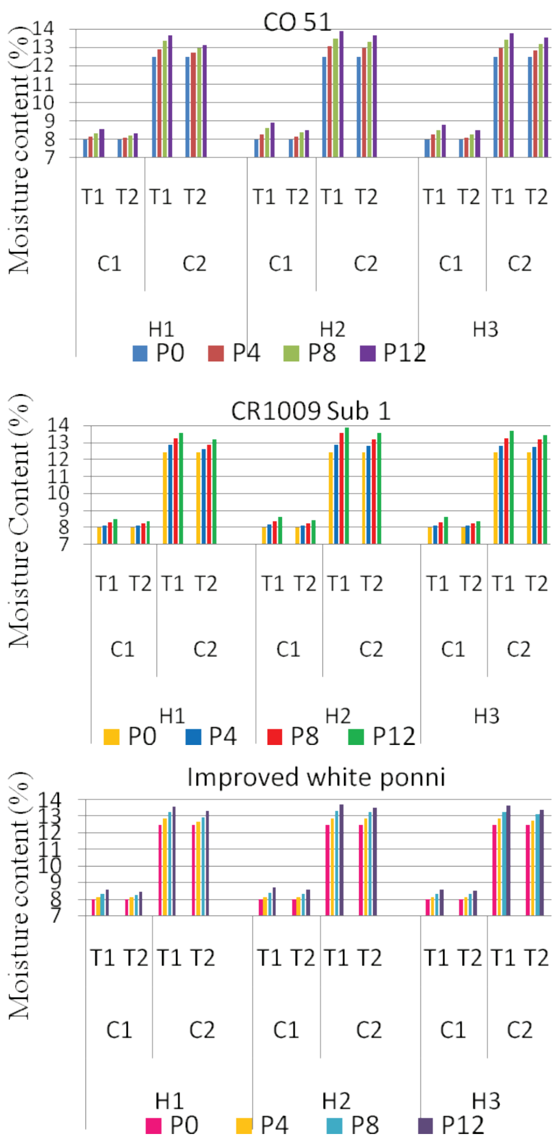
P- Periods

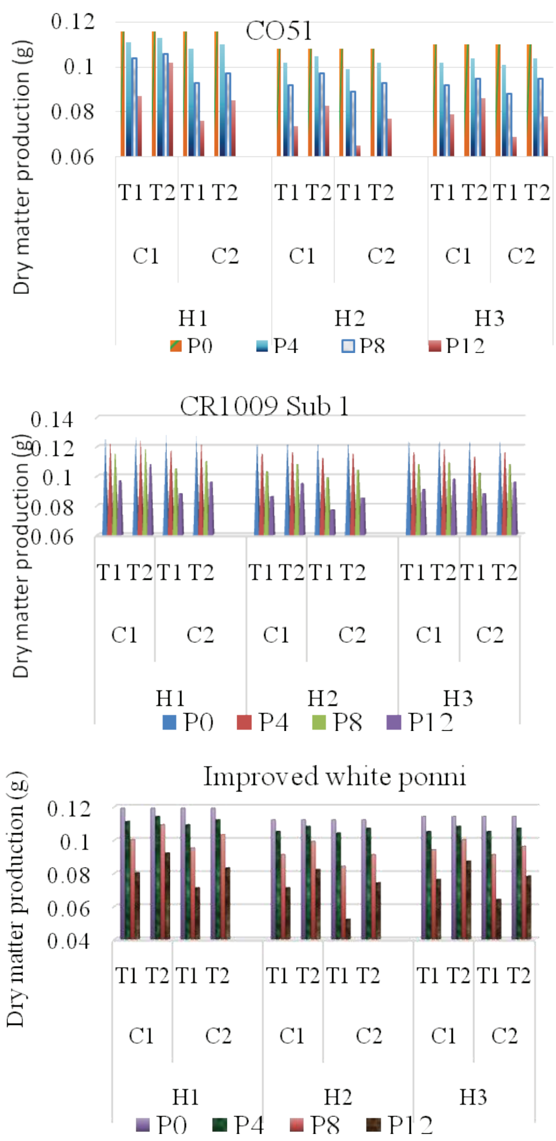
Fig.1. Germination (%)

Fig.2. Vigour Index

Fig. 1 and 2. Influence of harvesting and threshing methods, storage containers and seed treatments on germination and vigour index of rice varieties

influenced by harvesting and threshing methods, container used for storage, treatment applied and period of storage in all the three varieties tested (Fig. 3). In the present study, there was a slight increase in the seed moisture content over the storage period, irrespective of container and treatment. It did not fluctuate much over storage particularly in polymer coated seed stored either in super grain bag or gunny bag, mainly due to the protection offered by the polymer, which prevented the absorption of moisture from storage environment (West *et al.,* 1985). Higher the moisture content and temperature, lesser the shelf life of paddy seed reported by Kaliyan *et al.,* 2006. Ramanadane and Ponnusamy (2004) reported that the moisture content is associated with decline of seed quality. Harringtons thumb rule says that storability increases as the moisture content decreases. For every one percent reduction in moisture content, the shelf life is doubled within a range of 5 to 15%. It was reported that, there was a negative logarithmic relation between moisture content and longevity (Ellis *et al.,* 1990).





H_1- Manual harvesting and manual threshing

H_2- Manual harvesting and mechanical threshing

H_3- Combine harvesting

T_1- Control

T_2- Water soluble polymer 4g+12 ml water.kg^{-1}

C_1- Super grain bag

C_2- Gunny bag

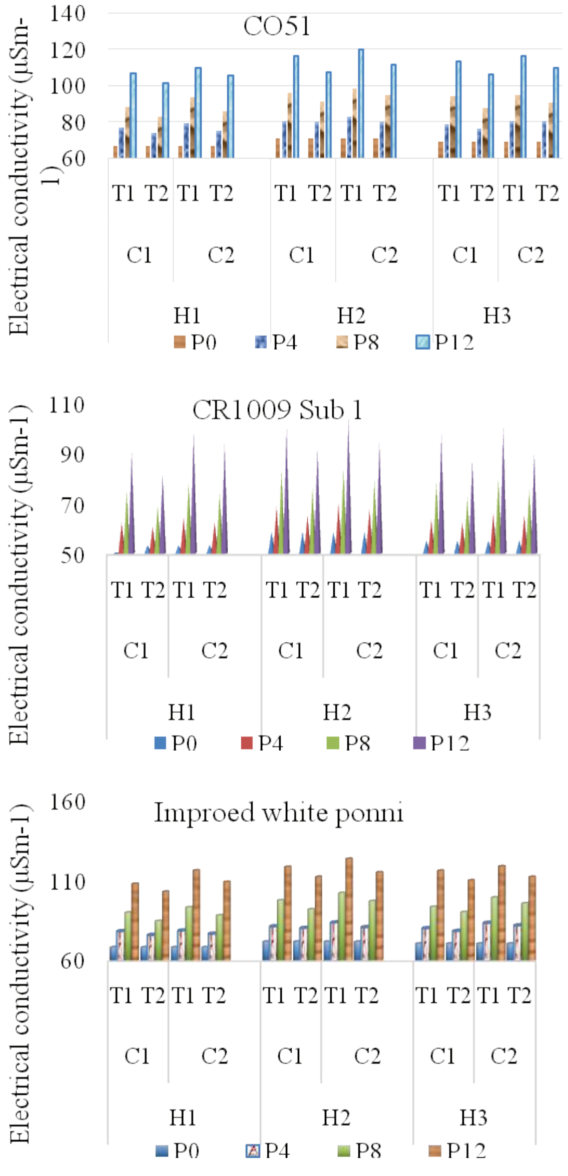
P- Periods

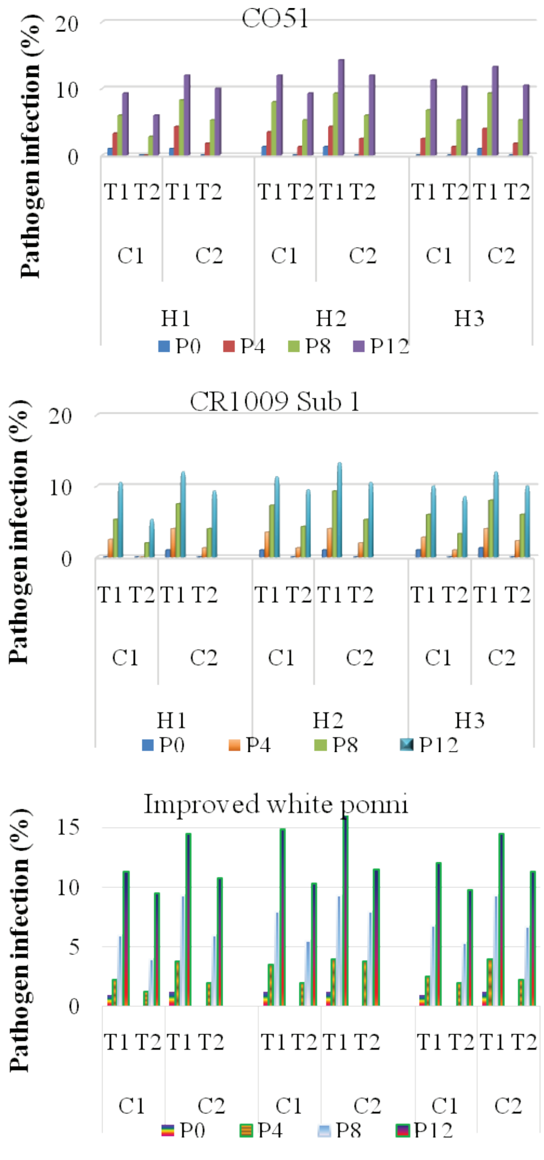
Fig.3. Moisture content (%)

Fig.4. Dry Matter Production (g)

Fig. 3 and 4. Influence of harvesting and threshing methods, storage containers and seed treatments on moisture content (%) and dry matter production (g) of rice varieties

Seed physiological parameters were significantly influenced by harvesting and threshing methods, container used for storage, treatment applied and period of storage in all the three varieties tested. Irrespective of the rice varieties studied, seeds obtained by manual harvesting and manual threshing registered maximum germination, dry matter production and seedling vigour followed by seeds obtained by combine harvesting (Fig.1, 2 and 4). The minimum germination, dry matter production and seedling vigour was recorded in the seeds obtained by manual harvesting and mechanical threshing. The maximum germination, dry matter production and seedling vigour was observed during the initial period of storage and reached the minimum at 12 months of storage. Between the containers, super grain bag maintained the highest germination, dry matter production and seedling vigour, while the lowest germination, dry matter production and seedling vigour was observed in the seeds stored in gunny bag. Between the treatments applied, seeds coated with water soluble polymer @ 4 ml + 12 ml water.kg^{-1}





H_1- Manual harvesting and manual threshing
H_2- Manual harvesting and mechanical threshing
H_3- Combine harvesting
T_1- Control
T_2- Water soluble polymer 4g+12 ml water.kg^{-1}

C_1- Super grain bag
C_2- Gunny bag

P- Periods

Fig.5. Electrical conductivity (µSm^{-1})

Fig.6. Pathogen infection (%)

Fig. 5 and 6. Influence of harvesting and threshing methods, storage containers and seed treatments on electrical conductivity (µSm^{-1}) and pathogen infection (%) of rice varieties

registered the maximum germination percentage, dry matter production and seedling vigour. While, the minimum germination percentage, dry matter production and seedling vigour was observed in control. These findings are in agreement with the results obtained by John *et al.* (2005) in maize, Giang and Rame Gowda, (2007) in rice. The decline in germination percentage may be attributed to ageing effect. Ageing has damaging effect on enzymes that are necessary to convert reserve food in the embryo to usable form and ultimately production of normal seedling (Iqbal *et al.,* 2002). Alternatively, the reduction in germination, dry matter production and seedling vigour might be due to degradation of mitochondrial membrane leading to reduction in energy supply necessary for germination (Gidrol *et al.,* 1998). Loss of germination and seedling vigour during storage were reported by Sharma *et al.* (1990); Ramanadane and Ponnuswamy (2004) and Lee and Kim (2000) in rice.

The decline in the seedling dry matter production might be attributed to DNA degradation with ageing which leads to impaired transcription causing incomplete or faulty enzyme synthesis essential for earlier stages of germination (Kapoor *et al.,* 2002). All seeds undergo ageing process during long-term storage which leads to deterioration in seed quality, however, the rate of seed deterioration can vary among various plant species (Merritt *et al.,* 2003). These findings are in agreement with results obtained by Kaushik *et al.* (2014) in maize and Sabir-Ahamed, (2003) in rice.

The pathogen infection was significantly influenced by harvesting and threshing methods, container used for storage, treatment applied and period of storage in all the three varieties tested. In rice varieties of CO51, CR1009 Sub 1 and improved white ponni, the lowest pathogen infection was observed during the initial period of storage which reached the highest after 12 months of storage (Fig. 6). Among the harvesting methods, seeds obtained by manual harvesting and threshing recorded lowest pathogen infection, followed by seeds obtained by combine harvester. The highest pathogen infection was recorded in the seeds obtained by manual harvesting and mechanical threshing. Moisture content is known to be the primary contributing factor in determining the kinds of fungi that invade stored seed and the degree to which they invade it (Coleman and Fellow, 1925). West *et al*. (1985) reported that mycelia growth were significantly less for the polymer coated soybean seeds at every observation period and the polymer coat itself provides protection from fungal invasion since polymer film coating serves as an effective dust free delivery system for fungicides and insecticides used to control diseases and pests during seed germination and seedling emergence (Robani, 1994). Vegulla, (2008) revealed that the maize seeds film coated with red polykote @ 6 g + carbendazim @ 2 g + imidachloprid @ 1 ml + micronutrient mixture @ 4 ml.kg^{-1} of seeds can be stored up to 6 months with least pathogen and insect infestation. Ambika *et al.* (2014) reported that initially there was no pathogen infection which got increased to 2.4 per cent at nine months of storage in rice. The seeds coated with polymer of Quick roots recorded nil pathogen infection, whereas untreated control seed recorded 8.0 per cent at ninth month of storage.

In the rice varieties of CO51, CR1009 Sub 1 and improved white ponni, the lowest seed leachate was observed during the initial period of storage which reached the highest after 12 months of storage periods (Fig.5). Among the harvesting methods, seeds obtained by manual harvesting and threshing recorded the lowest seed leachate, followed by seeds obtained by combine harvester. The maximum seed leachate was recorded in the seeds obtained by manual harvesting and mechanical threshing. Decrease in enzymatic activity in stored seeds with increase in storage period resulted reduction in germination and vigour (Khan *et al.,* 2013). Chen and Zhou (1990) observed similar increase in electrical conductivity, soluble sugar and amino acids with ageing of rice hybrids. When the seed storage period prolonged seed leachate also increased and seed quality decreased. This might be due to faster deterioration of cell membrane and also oxidation of polyunsaturated fatty acids in the membrane lipid compounds involving free radical chain reaction (Srivastava, 1975). Between the treatments applied, seeds coated with water soluble polymer @ 4 ml + 12 ml water.kg^{-1} registered the lowest seed leachate while, the highest was observed in control. The polymer coating may act as physical barrier, which has been reported to reduce the leaching of inhibitors from seed covering and may restrict oxygen diffusion to the embryo (Vanangamudi *et al.,* 2003).

Conclusion

From this study it could be concluded that different varieties of rice seed *viz.,* CO51, CR1009 Sub 1 and improved white ponni harvested and threshed by different methods and coated with water soluble polymer @ 4 ml + 12 ml of water.kg^{-1} of seed and reduced to the moisture content of 8 percent and packed in super grain bag maintained seed quality above minimum seed certification standards up to twelve months.

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