Int.J.Curr.Microbiol.App.Sci (2017) *6*(9): 1510-1520

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 6 Number 9 (2017) pp. 1510-1520**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2017.609.184

Effect of Different Harvesting and Threshing Methods on harvest Losses and Seed Quality of Rice Varieties

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Keywords

Rice, Harvesting, Threshing, Shattering loss, Germination, Seedling vigour.

Article Info

Accepted:
19 July 2017
Available Online:
10 September 2017

A B S T R A C T

Present investigation is an attempt to study the effect of different harvesting and threshing methods on harvesting and threshing losses and physiological seed quality of rice varieties *viz.*, CR1009 Sub1, Improved white ponni and CO51. The treatments are manual harvesting and manual threshing, manual harvesting and mechanical threshing (axial flow thresher) and combine harvesting (with pneumatic wheel). The harvested and threshed seeds were evaluated in terms of moisture content (%), 1000 seed weight (g) threshing efficiency (%), visible broken seed (%), visible dehusked seed (%), shattering loss (kg/ha), germination and seedling vigour. The results revealed that rice seed harvested and threshed through manual method or by combine with higher threshing efficiency and did not affect the germination and seedling vigour irrespective of the varieties studied.

Introduction

Rice is one of the most important food grains of the world and staple food of most of the people in Asia. Globally rice is cultivated in 154 M ha with an annual production of around 426 million tonnes at an average productivity of 2.76 t ha^{-1}. In India, rice is cultivated round the year in one or the other part of the country, in diverse ecologies spread over 43.8 M ha (Jagtap *et al.,* 2012) with a production of 85.3 million tonnes of rice and the average productivity being 1.94 t ha^{-1}.Postharvest loss includes the food loss across the food supply chain from harvesting of crop until its consumption (Aulakh *et al.*, 2013). Postharvest loss accounts for direct physical losses and quality losses that reduce the economic value of crop, or may make it unsuitable for human consumption. In severe cases, these losses can be up to 80% of the total production. These losses play a critical role in influencing the life of millions of smallholding farmers by impacting the available food volumes and trade-in values of the commodities. Harvesting of rice includes cutting, stacking, handling, threshing, cleaning and hauling of paddy. The goal of good harvesting method is to maximize seed yield, and to minimize seed damage and quality deterioration. Harvesting can be done manually using sickles and knives, or

mechanically with the use of threshers or combine harvesters. Regardless of the method, a number of guidelines should be followed that will ensure that harvest losses are kept to a minimum and seed quality is preserved during harvest operations.

Guidelines for proper harvesting include harvest at the right time and moisture content, avoid delays in threshing after harvesting, use the proper machine settings when using a threshing machine, clean the seed properly after threshing and avoid delay in drying after threshing. However, there is insufficient information on post-harvest losses of different varieties of rice seed produced locally.

The unavailability of sufficient information on precise harvest and threshing losses and the nature of the losses make it difficult to estimate and determine where most of the losses occur along the seed production chain and ways to address them, Against the stalemate, the study was initiated to find out the effect of different harvesting and threshing methods on harvest losses and seed quality of rice varieties.

Materials and Methods

An experiment was conducted at the Department of Applied Sciences and Engineering, Agricultural Engineering College and Research Institute, Tamil Nadu Agricultural University, Kumulur, Tiruchirappalli, Tamil Nadu during *kharif*, 2016 to find out the influence of harvesting and threshing methods on seed quality of rice varieties *viz.*, CR1009 Sub1, IW Ponni and CO51. The treatments are manual harvesting and manual threshing (T_1), manual harvesting and mechanical threshing (axial flow thresher) (T_2) and combine harvesting (with pneumatic wheel) (T_3). The rice crops were harvested at physiological maturity stage. The seed moisture content (%) and 1000 seed weight (g) was estimated at the time of harvest. The following observations were made during the harvesting and threshing *viz.*, threshing efficiency (%), visible broken seed (%), visible dehusked seeds (%) and shattering loss (%).

Threshing efficiency

Final seeds obtained after threshing in all the outlets constituted threshed seeds while unthreshed left over's in the straw along with threshed seeds constitute the total seed input. Threshing efficiency was calculated using the following formula (RNAM. 1983).

$$\text{Threshing efficient (\%)} = \frac{\text{Sample collected in all outlets (g)}}{\text{Total seed input (g)}} \times 100$$

Visible broken seed percentage

In all the harvest and threshing methods, damaged seed coat and split husk that are visible to naked eyes were separated from the total final seeds obtained after threshing. Percent of visible broken seed was calculated based on the following formula (RNAM. 1983).

$$\text{Visible broken seed (\%)} = \frac{\text{Broken seed (g)}}{\text{Total seed input (g)}} \times 100$$

Visible dehusked seeds

In all the harvest and threshing methods, completely dehusked seeds that are visible to naked eyes were separated from the total final seeds obtained after threshing. Per cent of visible dehusked seed was calculated based on the following formula (RNAM. 1983).

$$\text{Visible dehusked seed (\%)} = \frac{\text{Visible dehusked seed (g)}}{\text{Total seed input (g)}} \times 100$$

Shattering loss

In the field, eight number of random quadrants are chosen of 1 square meters surface area of treatment T_1 (Manual harvesting) and T_3 (Combine harvesting).

After the harvesting procedure, all seeds that are lying on the ground within the quadrants are collected. The collected seeds were weighed. The loss can be expressed as kg/ha (IRRI, www.knowledgebank.irri.org).

Germination test

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 was recorded.

Ten random seedlings were dried in a hot air oven at 85^0C for 24 h. and the dry weight was recorded and expressed as g/10 seedling. The vigour index was calculated using the following formula (Abdul – Baki and Anderson, 1973)

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

Statistical analysis

The experiment was conducted in a factorial completely randomized block design. The results were subjected to statistical analysis for significant difference (p=0.05) as per Panse and Sukhatme (1995). Percentage values were transformed using arc sine values prior to statistical analysis.

Results and Discussion

The results on effect of harvesting and threshing methods on harvest losses and physiological seed quality of rice varieties revealed that the moisture content of the seed at the time of harvesting were 22.50%, 19.72% and 19.51% in CO51, CR1009 Sub 1 and improved white ponni, respectively. The 1000 seed weight were highest in CR1009 Sub 1 (22.8 g) followed by CO51 (17.2 g), the lowest 1000 seed weight recorded in improved white ponni (16.8 g) (Table 1). Significant difference in the percentage of threshing efficiency was observed among the varieties and its different harvesting methods.

Among the varieties, the highest threshing efficiency shows in improved white ponni (99.83 %) and CR1009 Sub 1 (99.79 %), which was on par with each other and the lowest threshing efficiency was observed in CO51 (99.67 %). Among the different harvesting and threshing methods, the highest threshing efficiency in combine harvesting (99.99 %) followed by manual harvesting and mechanical threshing (99.76 %) which was on par with each other. While manual harvesting and threshing registered the lowest threshing efficiency of 99.54 % (Table 2, Fig. 1). The maximum broken seed was recorded in seeds harvested and threshed by combine harvester (3.53 per cent) followed by manual harvesting and mechanical threshing (0.69 per cent) while the minimum was observed in seeds obtained through manual harvesting and threshing (0.02 per cent) (Table 3, Fig. 2). Results on dehusked seeds obtained in three varieties with different harvesting and threshing methods revealed that all the three varieties were not significantly influenced (Table 4). Among the treatments maximum dehusked seed was recorded in combine harvesting (0.27 per cent) followed by manual harvesting and mechanical threshing (0.15 per cent) while the minimum in manual

harvesting and threshing (0.01 per cent). Threshing is a very important operation in rice postharvest handling, which if not handled properly results in broken or damage seeds and mixing with other foreign matter including sand, stones and other rice varieties which present more challenges for processing (Staple Crop Programme, 2011).

Alizadeh and Allameh (2013) revealed that if moisture decreases too low, then broken rice percentage increase. Feliz *et al.*, (2005) reported that increasing combine harvester cylinder speed increasing the percentage of damaged rice. Somchai and Winit (2011); Askari Asli-Ardeh and Abbaspour-Gilandeh (2008) in rice; Thomison (2010) in maize; and Muhammad Shafi *et al.*, (2005) in wheat minimum grain damage was observed at higher moisture content, 30 mm concave clearance and 5.64 t h^{-1} of feed rate. Miah *et al.*, (1994) in their result revealed that percentage of grain damage and unthreshed grains are significantly affected by the threshing method. Their results also showed that germination rate and storage life depend on the method of threshing in rice.

Significant difference in shattering loss was observed among the varieties and its treatments. Among the varieties, the lowest shattering loss shows in CO51 (85.02 kg/ha) followed by improved white ponni (93.39 kg/ha), which was on par with each other and the highest shattering loss was observed in CR1009 Sub 1 (147.15 kg/ha), among the treatment, shattering loss was highest in combine harvesting (158.84 kg/ha).

Table.1 Moisture content (%) and 1000 seed weight (g) of different rice Varieties during harvesting

Rice varieties	Moisture content (%)	1000 seed weight (g)
CO51 (V_1)	22.50 (28.32)	17.2
CR1009 Sub 1 (V_2)	19.72 (26.36)	22.8
Improved white ponni (V_3)	19.51 (26.21)	16.8
Mean	20.58 (26.96)	18.9
SEd	0.263	0.132
CD (P=0.05)	0.547	0.275

(Figures in parenthesis indicate arcsine value)

Table.2 Effect of manual harvesting and mechanical threshing and combine harvester in threshing efficiency (%) of rice varieties

Treatments (T) Varieties (V)	Threshing efficiency (%)			
	Manual harvesting and threshing	Manual harvesting and mechanical threshing	Combine harvesting	Mean
CO51	99.323 (85.30)	99.709 (86.94)	99.985 (89.26)	99.67 (87.17)
CR1009 Sub 1	99.638 (86.59)	99.750 (87.21)	99.995 (89.40)	99.79 (87.73)
Improved white ponni	99.663 (86.72)	99.827 (87.67)	99.989 (89.32)	99.83 (87.90)
Mean	99.54 (86.20)	99.76 (87.27)	99.99 (89.33)	99.76 (87.60)
	V	T		VxT
SEd	0.268	0.268		0.464
CD (P=0.05)	0.567	0.567		NS

Table.3 Effect of manual harvesting and mechanical threshing and combine harvesting on broken seed (%) of rice varieties

Treatments (T) / Varieties (V)	Broken seed (%)			
	Manual harvesting and threshing	Manual harvesting and mechanical threshing	Combine harvesting	Mean
CO51(V_1)	0.016 (0.723)	0.841 (5.252)	4.428 (12.131)	1.762 (6.035)
CR1009 Sub 1	0.012 (0.630)	0.536 (4.180)	2.668 (9.358)	1.072 (4.723)
Improved white ponni	0.019 (0.789)	0.692 (4.678)	3.483 (10.569)	1.398 (5.345)
Mean	0.016 (0.714)	0.690 (4.703)	3.526 (10.685)	1.411 (5.368)
	V	T		VxT
SEd	0.498	0.498		0.863
CD (P=0.05)	NS	1.047		NS

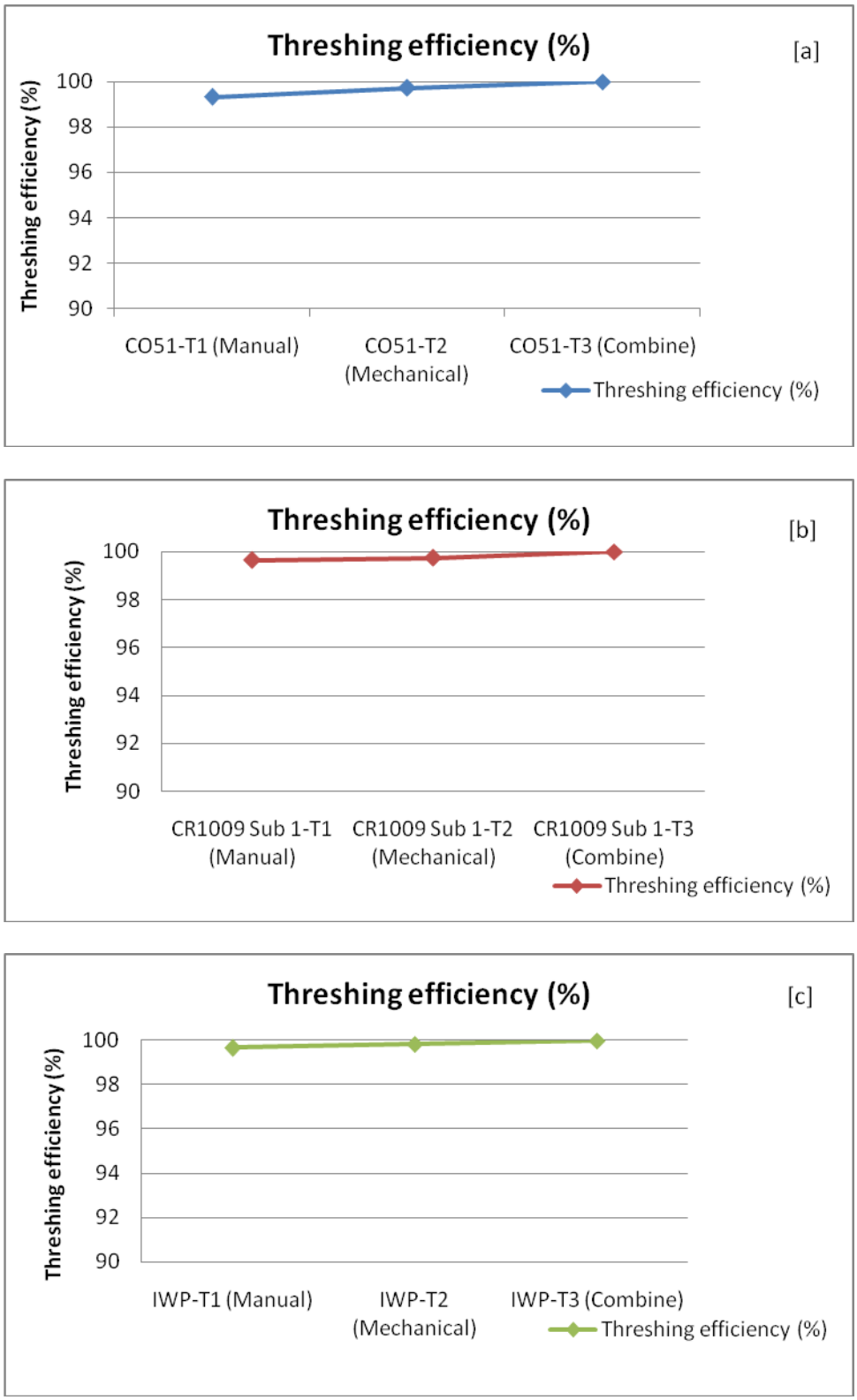
Table.4 Effect of manual harvesting and mechanical threshing and combine harvesting on dehusked seed (%) of rice varieties

Treatments (T) / Varieties (V)	Dehusked seed (%)			
	Manual harvesting and threshing	Manual harvesting and mechanical threshing	Combine harvesting	Mean
CO51	0.013 (0.645)	0.095 (1.75)	0.226 (2.72)	0.111 (1.704)
CR1009 Sub 1	0.008 (0.522)	0.210 (2.59)	0.227 (2.72)	0.148 (2.141)
Improved white ponni	0.015 (0.700)	0.133 (2.08)	0.343 (3.33)	0.164 (2.923)
Mean	0.012 (0.622)	0.146 (2.14)	0.266 (3.33)	0.141 (1.895)
	V		T	VxT
SEd	0.148		0.148	0.0.257
CD (P=0.05)	NS		311	NS

Table.5 Effect of manual harvesting and mechanical threshing and combine harvesting on shattering loss (Kg/ha) of rice varieties

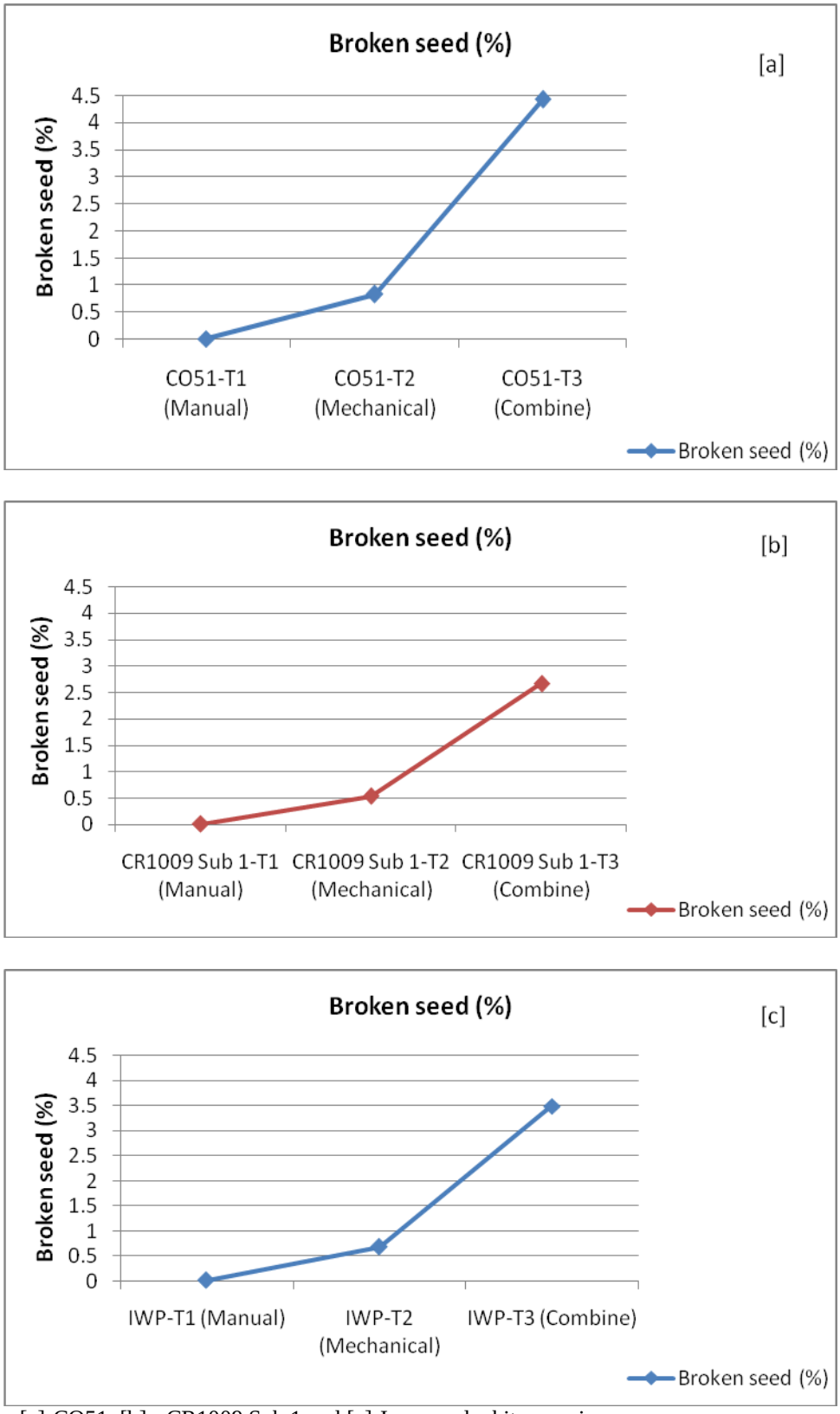
Treatments (T) / Varieties (V)	Shattering loss (Kg/ha)		
	Treatments (T)		
	Manual harvesting and threshing	Combine harvesting	Mean
CO51	22.46	147.58	85.02
CR1009 Sub 1	123.88	170.43	147.15
Improved white ponni	28.28	158.50	93.39
Mean	58.20	158.84	108.52
	V	T	VxT
SEd	0.761	0.622	1.077
CD (P=0.05)	1.546	1.262	2.186

Fig.1 Effect of different harvesting and threshing methods on Threshing efficiency (%) of rice varieties



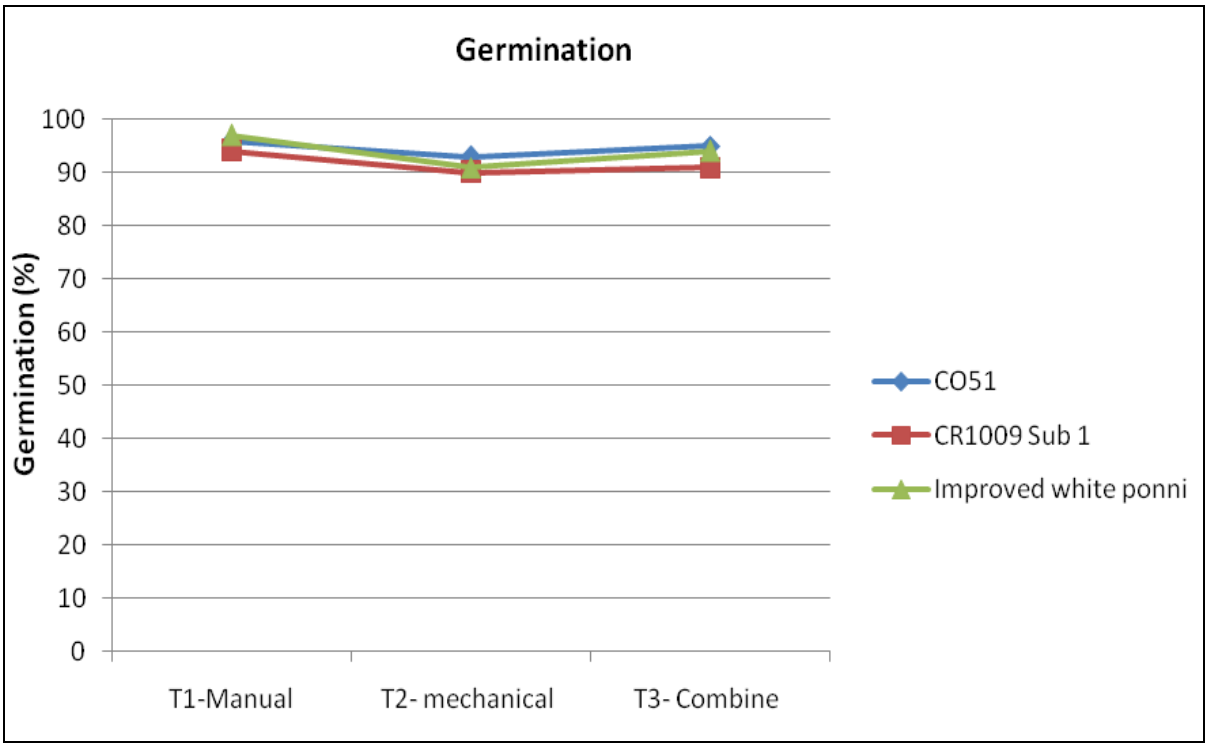
Note: [a]-CO51, [b] - CR1009 Sub 1 and [c]-Improved white ponni

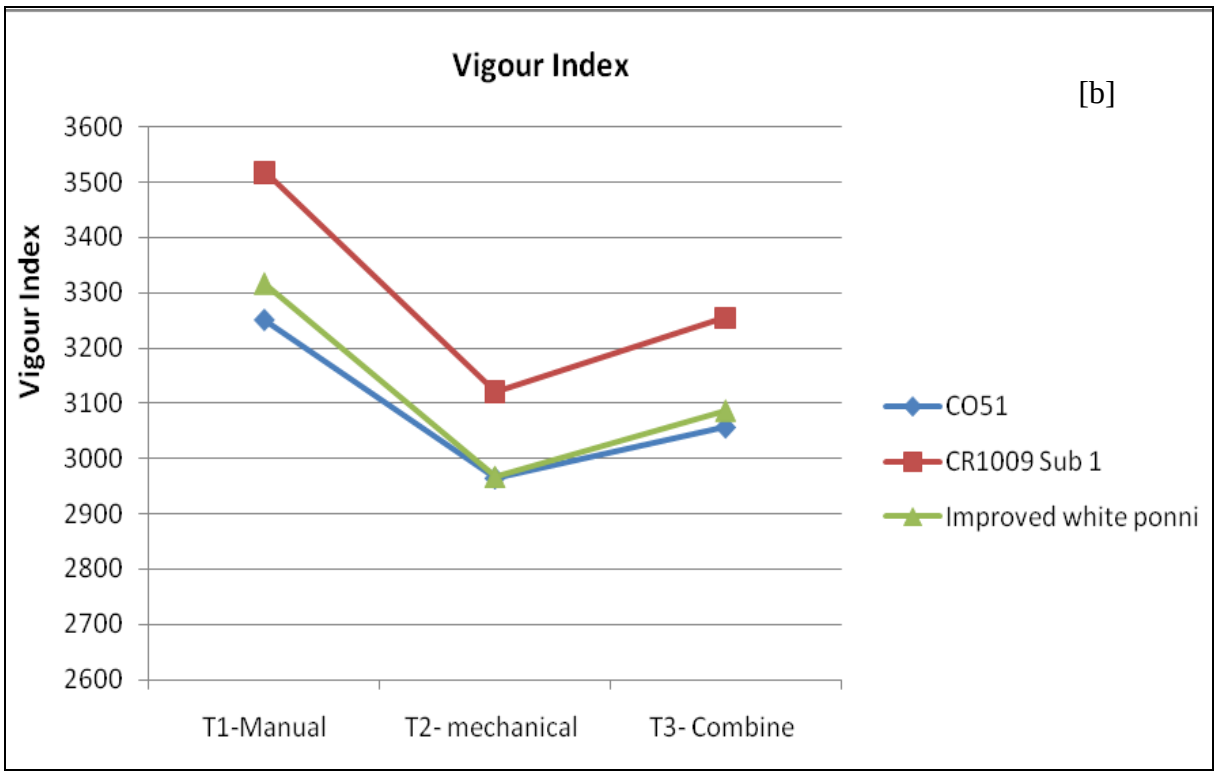
Fig.2 Effect of different harvesting and threshing methods on broken seed (%) of rice varieties



Note: [a]-CO51, [b] - CR1009 Sub 1 and [c]-Improved white ponni

Fig.3 Effect of different harvesting and threshing methods on germination (%) and vigour index of rice varieties





Note: [a]-Germination (%) [b]-Vigour Index

While manual harvesting and threshing, minimum shattering loss of 58.20 kg/ha was recorded (Table 5). Among the varieties studied, 1000 seed weight were more in CR1009 Sub 1 this may be the reason for more shattering loss in CR1009 Sub 1. Mejia (2003) reported that rice should be harvested one week before maturity for minimum losses, which increased to more than 60% at 4 weeks after maturity. During manual harvesting and manual threshing and manual harvesting and mechanical threshing, collection of harvested crop making into bundles and transport to threshing yard is a laborious process. Apart from tedious field work in dusty conditions and possible exposure to mold spores, this operation of preparing and carrying bundles is fraught with huge seed losses. When bundles are prepared and carried, seeds fall out of the bundles on to the ground creating substantial losses which continue to increase as the plant material dries. Whereas combines provide an enclosed system which greatly reduces the chances of losses and provide a sophisticated cleaning system. Even though threshing and cleaning operations are complex, it is completed in single operation by combine which operate on proven physical principles using impact, acceleration and gravity to thresh, separate and clean seeds. The threshing, separation and cleaning sections of the combine have extremely low losses. If the operator drives slow enough to not slug feed the cylinder/rotor losses will be low (Paulsen *et.al,* 2015). When thresher or combine is used, care must be taken to thoroughly check the machinery for previous crop remnants to avoid seed admixture.

Results on physiological quality of seeds obtained by different harvesting and threshing methods in three varieties revealed that seed germination of all the three varieties were not significantly influenced by the different harvesting and threshing methods. However, vigour index values were significantly influenced. The maximum vigour index was recorded in seeds harvested and threshed manually (3362) followed by combine harvester (3133) while the minimum was observed in seeds obtained through manual harvesting and mechanical threshing (3017) (Fig. 3). Yadav and Sharma (1998) observed that the cracked seed coats reflect poor quality of seeds as they may be prone to imbibitional and pathogenic injury during storage. Dubbern *et al.,* (2001) remarked that damaged seed coat usually have less vigor and viability. Rahman *et al.,* (2004) observed that the mechanical damage cause seed vigor reduction. Broken seed impair their germination ability (Spokas *et al.,* 2008). Masilamani *et al.,* (2017) revealed that sunn hemp seed crop harvested and threshed by manual were higher germination and seedling vigour than mechanically harvested and threshed. Masilamani and Tajuddin (2012) studied that the effect of combine harvesting and harvesting and threshing with manually of two rice varieties. Which revealed that the seeds harvested by combine maintained 83 per cent and 82 per cent germination in respect of ADT36 and BPT 5204 rice varieties respectively up to 12 months of storage. The increase in kernel breakage and a decrease in seed germination due to decrease in forward speed, increase in cylinder rotational speed and decrease in clearance between cylinder and concave in wheat (Ramadhan, 2013). From this study it could be concluded that manual/combine harvester is recommended for harvesting of rice varieties *viz.,* CR1009 Sub1, IW Ponni and CO51 without impairing the germination and seedling vigour.

References

Abdul-Baki, A.A., and Anderson, J.D. 1973. Vigour determination of soybean seeds by multiple criteria. *Crop Sci.,* 13: 630-

633.

Alizadeh, M.R., and Allameh, A. 2013. Evaluating rice losses in various harvesting practices. *Int. Res. J. Appl. & Bas. Sci.,* 4: 894.901.

Askari Asli-Ardeh, E.A., and Abbaspour-Gilandeh, Y. 2008. Investigation of the effective factors on threshing loss, damaged grains percent and material other than grain to grain ratio on an auto head feed threshing unit. *Am. J. Agrl. & Biol. Sci.,* 3: 699-705.

Aulakh, J., Regmi, A., Fulton, J.R., Alexander, C. 2013. Estimating post-harvest food losses: Developing a consistent global estimation framework. In Proceedings of the Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, USA, 4–6.

Dubbern De Souza, F.H., and Marcos-Filho, J. 2001. The Seed Coat as a Modulator of Seed-Environment Relationships in Fabaceae. *Rev. Bras. Bot.* 24 Sao Paulo Dec.

Feliz, D.J., Proctor, A., Monsoor, M.A. and Eason, R.L. 2005. The effects of damaged kernels caused by combine harvester settings on milled rice free fatty acid levels. *J. Food Sci.* 70: 376–379.

Jagtap, D.N., Mahadkar, U.V. and Chavan, L.S. 2012. Productivity and Economics of Rice Influenced by Different Crop Establishment Methods and Fertilizer Sources. *Agrl. J.,* 7: 32-36.

Masilamani, P., Alex Albert, V., Vallal kannan, S., And Govindaraj, M. 2017. Influence of Harvesting and Threshing Methods on Seed Quality of Sunn hemp (*Crotalaria juncea L.*). XIV ISST National Seed Seminar on "Food Security through Augmented Seed Supply under Climate Uncertainties". Souvenir & Abstracts Proceedings. 311 -312.

Masilamani, P., and Tajuddin, A. 2012. Can we use combine for seed purpose? Kissan World. December 2012. 39:38-39.

Mejia, D.J., 2003. An overview of rice post-harvest technology: use of small metallic silos for minimizing losses. Proceedings of the 20th Session of the International Rice Commission Bangkok, Thailand Jul 2002. Retrieved from http://www.fao.org/docrep/006/y4751e/y4751e00.htm#Contents.

Miah, A.K., Roy, A.K., Hafiz, M.A., Haroon, M. and Seddique, S.S. 1994. A comparative study on the effect of rice threshing methods on grain quality. Agrl. Mechanization in Asia, Africa and Latin America, 25: 63-66.

Muhammad Shafi Sabir, Muhammad Iqbal and Muhammad Yasin. 2005. Influence of selected combine and crop parameters on kernel damage and threshability of wheat. *Pak. J. Agri. Sci,* 212: 112-116.

Panse, V.G., and Sukhatme, P.V. 1995. Randomized design and square and factorial experiment in statistical methods of Agricultural workers (2 nd Edn.) ICAR, New Delhi.

Paulsen, M.R., Kalita, P.K. and Rausch, K.D. 2015. Postharvest Losses due to Harvesting Operations in Developing Countries: A Review. ASABE Annual International Meeting Paper. New Orleans, Louisiana. 34: 26 – 29.

Rahman, M.M., Hampton, J.G. and Hill, M.J. 2004. Effect of seed moisture content following hand harvest and machine threshing on seed quality of cool tolerant soybean. *Seed Sci. & Tech.,* 32: 149-158.

RNAM test code and procedures for farm machinery. 1983. *Technical series*. 12:227-246

Somchai Chuan-udom and Winit Chinsuwan.

2011. Effects of operating factors of an axial flow rice combine harvester on grain breakage. *Songklanakarin J. Sci. Technol.*, 33: 221-225.

Spokas, L., Steponavicius, D. and Petkevicius, S. 2008. Impact of Technological Parameters of Threshing Apparatus on Grain Damage. *Agronomy Res.*, 6: 367–376.

Staple Crop Programme, 2011. Global Food Security Response, Initial Training Manual for Improve Rice Post Harvest Technology in West Africa pp.21

Thomison, P., 2010. Corn harvest schedules and dry down rates. CORN Newsletter. The Ohio State University Extension. Columbus, OH. Retrieved from http://corn.osu.edu/newsletters/2010/2010-29/corn-harvest-schedules-and-dry-down-rates.

Yadav, S.P., and Sharma, S.P. 1998. Seed coat cracking in Kabuli Gram. *Seed Res.* 26: 120-124. http://www.knowledgebank.irri.org/images/docs/training-manual-harvesting.pdf

How to cite this article:

Govindaraj, M., P. Masilamani, D. Asokan, P. Rajkumar and Selvaraju, P. 2017. Effect of Different Harvesting and Threshing Methods on harvest Losses and Seed Quality of Rice Varieties. *Int.J.Curr.Microbiol.App.Sci.* 6(9): 1510-1520.
doi: https://doi.org/10.20546/ijcmas.2017.609.184