DOI: 10.15740/HAS/AU/12.TECHSEAR(6)2017/1520-1525 *Agriculture Update*
Volume **12** | TECHSEAR-6 | 2017 | 1520-1525
Visit us : *www.researchjournal.co.in*

RESEARCH ARTICLE :

Physical and cooking parameters of organic rice under non-chemical weed management

BAVAJI GUDI SHOBHA RATHOD AND E. SOMASUNDARAM

ARTICLE CHRONICLE :
Received :
17.07.2017;
Accepted :
01.08.2017

KEY WORDS :
Organic rice, Physical characters, Cooking characters, Yield

SUMMARY : A field investigation was carried out at Tamil Nadu Agricultural University, Coimbatore to evaluate the effect of different non-chemical weed management practices on physical and cooking parameters of organic rice (CO (R) 50). The experiment was laid out in Randomized Block Design with three replication and ten treatments. The physical parameters like kernel length values varied from 5.86 to 6.10 mm, kernel breadth varied from 2.03 to 2.11 mm, L/B ratio varied from 2.77 to 2.94 and cooking parameters like kernel length after cooking (KLAC) values ranging from 9.60 to 10.80 mm, kernel breadth after cooking (KBAC) ranging from 2.80 to 3.42 mm, linear elongation ratio (LER) ranging from 1.64 to 1.78, breadth wise elongation ratio (BER) ranging from 1.00 to 1.19, water absorption ratio ranging from 3.05 to 3.81 and volume expansion ratio ranging from 2.50 to 3.40. From this experiment mulching with biodegradable polythene sheet recorded the highest grain yield (5557 kg ha^{-1}) and quality parameters like kernel length, kernel length after cooking, kernel breadth after cooking, water absorption ratio and volume expansion ratio. But among different non-chemical weed management practices benefit cost ratio was found to be highest in Hand weeding on 15 DAT followed by *Azolla* inoculation.

How to cite this article : Rathod, Bavaji Gudi Shobha and Somasundaram, E. (2017). Physical and cooking parameters of organic rice under non-chemical weed management. *Agric. Update*, **12**(TECHSEAR-6) : 1520-1525; **DOI: 10.15740/HAS/AU/12.TECHSEAR(6)2017/1520-1525.**

Author for correspondence :
BAVAJI GUDI SHOBHA RATHOD
Department of Agronomy, Agricultural College and Research Institute (T.N.A.U.), COIMBATORE (T.N.) INDIA
Email: rathodshoba@gmail.com

See end of the article for authors' affiliations

BACKGROUND AND OBJECTIVES

Rice (*Oryza sativa* L.) is the staple food for more than half of world population and is one of the leading cereal crop being grown in many regions of world. Currently, a keen awareness has sprung on the adoption of organic farming as a remedy to cure the negative impact of modern agriculture. There is an emerging awareness among public on the use of high quality food materials which are free from chemical toxicants. In India, the total area under certified organic cultivation is 4.72 million hectares (2013-14) including 3.99 million hectares under forest cover (*www.apeda.gov.in*). The area under organic rice is 11,292 ha and production is 22,674 million tonnes. In Tamil Nadu, organically rice cultivated in 5.8 ha and production is 14.77 million tonnes (NPOP, 2012).

Weeds are responsible for heavy rice yield lossesvaried from 28 to 93 per cent depending on the type of weed flora and intensity, stage, nature and duration of crop-weed competition (Pandey *et al*., 2001). The

continuous use of the herbicides over a period of time on a same piece of land, leads to ecological imbalances in terms of weed shift and environmental pollution.Hence, emphasis is given for the use of organic resources and non-chemical management practices to maintain the soil quality and environmental health in order to produce food of high quality.Therefore, the present study was aimed at finding out the effect of different non-chemical weed management practices on physical and cooking parameters of organic rice.

RESOURCES AND METHODS

A field experiment was conducted during *Rabi* 2014-15 (October-February) at Tamil Nadu Agricultural University, Coimbatorein O_4 block wetland. The farm is situated in the Western Agroclimatic Zone of Tamil Nadu at 11°N latitude and 77°E longitudes at an altitude of 426.72 M above Mean Sea Level.The soil of the experimental field was having a pH of 8.3 and EC of 0.45 dSm^{-1} taxonomically classified as clay loam. The soil was characterized aslow in available nitrogen (216 kg/ha), medium in available phosphorus (16.9 kg/ha), high in available potassium (410 kg/ha) and medium in organic carbon content (0.60%).

Meteorological parameters:

During the experimental period, a total rainfall of 20.4 mm was received in 8 rainy days. The mean maximum and minimum temperatures were 30.2°C and 20.8°C, respectively and the mean relative humidity was 87.9 to 54.1 per cent at 0722 hrs and 1422 hrs. The average bright sunshine hour of 6.0 hrs day^{-1} and with an average wind velocity of 4.8 km hr^{-1}. Weather conditions prevailed during the cropping period are illustrated in Fig. A.

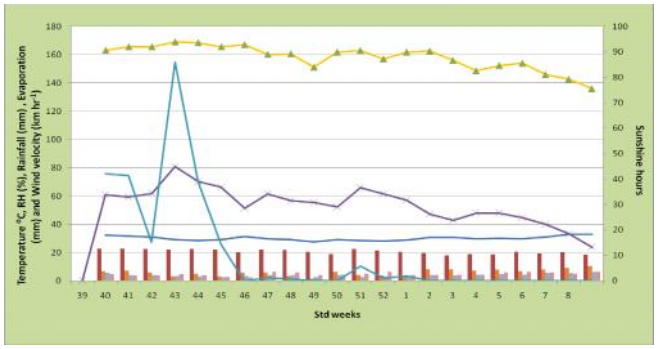

Fig. A: Weather parameters prevailed during the cropping period (*Rabi* 2014-2015)

The experiment was laid out in a Randomized Block Design (RBD) with three replications. The treatments comprised of ten different weed management practices *viz.*, Application of paddy straw @ 3 t/ha on 3 DAT + Hand weeding on 35 DAT (T_1), *Azolla* as dual crop with rice and incorporation on 35 DAT using power weeder (T_2), Hand weeding on 15 DAT and 35 DAT (T_3), Conoweeder 3 times on 20, 30, 40 DAT (T_4), Mulching with biodegradable polyethelene sheet (T_5), Intercropping mesta (*Hibiscus cannabinus*) with rice as paired row and harvested greens (T_6), Intercropping daincha (*Sesbania aculeata*) with rice as paired row cropping and incorporation on 35 DAT (T_7), Application of rice bran @ 2 t/haon 3 DAT + Hand weeding on 35 DAT (T_8), Hand weeding on 15 DAT followed by *Azolla* inoculation (T_9) and Unweeded check (T_{10}).Medium duration (130 -135 days) rice variety CO (R) 50 was chosen for the study.All the package of practices for the treatments were carried out as per recommendation of CPG (2012). Observations were recorded for various yield and quality parameters. Grain from each net plot was cleaned, sun dried and weighed at 14 per cent moisture content and the grain yield was expressed in kg ha^{-1}.

Physical characters :

Kernel length and breadth:

The length and breadth of brown rice (de-hulled) was measured using vernier calipers and expressed in mm (Kaul, 1970).

Length		Breadth	
Grain size	Length (mm)	Scale	Length (mm)
Extra long	>7.5	1	>2.40
Long	6.61-7.50	2	2.21-2.40
Medium	5.51-6.60	3	2.01-2.20
Short	<5.50	4	1.80-2.00

Length/Breadth (*L/B*) *ratio:*

It is the ratio between the kernel length and kernel breadth, calculated to determine the grain shape as suggested by Kaul (1970) using the formulae:

$$\text{L/B ratio Z } \frac{\text{Kernel length (mm)}}{\text{Kernel breadth (mm)}}$$

Grain shape	L/B ratio
Slender	>3.00
Medium	2.10-3.00
Bold	1.10-2.00
Round	< 1.00

Cooking characteristics :

Kernel length and breadth after cooking (*KLAC*):

Ten normal milled grains were pre-soaked to 10-30 minutes and were placed directly into boiling water. The length and breadth of 10 grains were measured. The average was worked out and expressed in mm (Azeez and Shafi, 1966).

Scale	KLAC (mm)
1	< 9.00
2	9.01-10.00
3	10.01-11.00
4	11.01-12.00

Length elongation ratio (*LER*):

LER is calculated by the following formulae:

$$\text{Length elongation ratio} = \frac{\text{Length of cooked rice (mm)}}{\text{Length of raw rice (mm)}}$$

Breadth wise elongation ratio (*BER*):

BER is calculated by the following formulae:

$$\text{Breadth elongation ratio} = \frac{\text{Breadth of cooked rice (mm)}}{\text{Breadth of raw rice (mm)}}$$

Volume expansion and water absorption:

The volume of the initial milled rice was measured by water displacement method in a graduated measuring cylinder. Then the same quantity of milled rice was cooked in hot water in glass tube till its optimum cooking time. The cooked rice volume was measured again, by water displacement method. It is expressed in cubic centimetre.

$$\text{Volume expansion} = \frac{\text{Volume of cooked rice (cc)}}{\text{Volume of milled rice (cc)}}$$

Statistical analysis :

The data on various parameters studied during the investigation was statistically analyzed as per the procedures suggested by Gomez and Gomez (1984) for Randomized Block Design. Wherever statistical significance was observed, critical difference (CD) at 0.05 per cent level of probability was worked out for comparison.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Grain yield :

The perusal of data revealed that grain yield of transplanted organic rice was very much influenced by

Table 1: Effect of different non-chemical weed management practices on physical parameters in organic rice production

		Treatments	Kernel length (mm)	Grain size	Kernel breadth (mm)	Scale	L/B ratio	Grain shape
T_1	-	Application of paddy straw @ 3t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	6.01	Medium	2.05	3	2.85	Medium
T_2	-	Azolla as dual crop with rice and incorporation on 35 DAT using power weeder	5.92	Medium	2.05	3	2.77	Medium
T_3	-	Hand weeding twice on 15 DAT and 35 DAT	5.99	Medium	2.10	3	2.85	Medium
T_4	-	Conoweeder 3 times on 20, 30, 40 DAT	5.97	Medium	2.10	3	2.84	Medium
T_5	-	Mulching with biodegradable polyethelene sheet	6.10	Medium	2.09	3	2.93	Medium
T_6	-	Intercropping mesta (Hibiscus cannabinus) with rice as paired row and harvesting as green	5.90	Medium	2.08	3	2.79	Medium
T_7	-	Intercropping daincha (*Sesbania aculeata*) with rice as paired row cropping and incorporation on 35 DAT	5.91	Medium	2.04	3	2.83	Medium
T_8	-	Application of rice bran @ 2t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	6.09	Medium	2.06	3	2.94	Medium
T_9	-	Hand weeding on 15 DAT followed by azolla inoculation	6.05	Medium	2.11	3	2.93	Medium
T_{10}	-	Unweeded check	5.86	Medium	2.03	3	2.80	Medium
		S.E.±	NA	NA	NA	NA	NA	NA
		C.D. (P=0.05)						

NA - Data statistically not analysed

weed control treatments over unweeded control. Higher grain yield (5557 kg ha^{-1}) was observed in mulching with biodegradable polyethelene sheet which was in conformity with the findings of Ali Mohtisham *et al.* (2013) who reported that the plastic sheet mulching resulted in maximum paddy yield due to improvement in plant height, number of panicle and 1000-grain weight. Drastically lower grain yield of 2774 kg ha^{-1} was obtained from the unweeded check.

Physical characters :

Physical quality parameter such as kernel length, kernel breadth and length breadth ratio were estimated at post harvest stage andpresented in Table 1.

Kernel length :

Among the weed management practices the kernel length was higher (6.10 mm) in mulching with biodegradable polyethelene sheet (T_5) and followed by application of rice bran at 2t ha^{-1} on 3 DAT + HW on 35 DAT (T_8), hand weeding on 15 DAT followed by *Azolla* inoculation (T_9) and application of paddy straw at 3t ha^{-1}fb hand weeding (T_1). The kernel length ranging from 5.86 to 6.10 mm were classified as medium size category.

Kernel breadth:

Hand weeding on 15 DAT followed by *Azolla* inoculation (T_9) recorded numerically higher kernel breadth of 2.11 mm and followed by hand weeding twice (T_3), conoweeder thrice (T_4) and mulching with biodegradable polyethelene sheet (T_5). All other treatments evaluated and registered kernel breadth ranging from 2.03 to 2.11 mm were grouped under Scale 3 were classified as medium size category.

Length breadth ratio :

The weed management practices significantly increased the L/B ratio (2.94) in application of rice bran at 2t ha^{-1} on 3 DAT + HW on 35 DAT (T_8) and followed by mulching with biodegradable polyethelene sheet (T_5), hand weeding on 15 DAT followed by *Azolla* inoculation (T_9) and application of paddy straw at 3t ha^{-1}fb hand weeding (T_1). All the treatments were classified as medium in grain shape andthe L/B ratio ranged from 2.80-2.94.

Cooking characters :

Cooking parameter such as Kernel Length after Cooking, Kernel Breadth after Cooking, Linear Elongation Ratio, Breadth wise Elongation Ratio, Water uptake and volume expansion ratio were estimated and data's are presented in Table 2 and 3.

Kernel length after cooking (KLAC):

Data pertaining to kernel length after cooking (mm) under different weed management practices are given in Table 2.

Table 2 : Effect of different non-chemical weed management practices on Cooking parameters in organic rice production

		Treatments	KLAC (mm)	Scale	KBAC (mm)	Scale	LER	BER
T_1	-	Application of paddy straw @ 3t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	10.70	3	3.40	2	1.78	1.19
T_2	-	*Azolla* as dual crop with rice and incorporation on 35 DAT using power weeder	9.60	2	3.09	2	1.62	1.12
T_3	-	Hand weeding twice on 15 DAT and 35 DAT	10.40	3	3.32	2	1.74	1.16
T_4	-	Conoweeder 3 times on 20, 30, 40 DAT	10.50	3	3.21	2	1.76	1.13
T_5	-	Mulching with biodegradable polyethelene sheet	10.80	3	3.42	2	1.77	1.17
T_6	-	Intercropping mesta (Hibiscus cannabinus) with rice as paired row and harvesting as green	9.80	2	2.98	2	1.66	1.07
T_7	-	Intercropping daincha (*Sesbania aculeata*) with rice as paired row cropping and incorporation on 35 DAT	10.40	3	3.16	2	1.76	1.12
T_8	-	Application of rice bran @ 2t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	10.50	3	3.38	2	1.72	1.15
T_9	-	Hand weeding on 15 DAT followed by *Azolla* inoculation	10.20	3	3.10	2	1.69	1.06
T_{10}	-	Unweeded check	9.60	2	2.80	2	1.64	1.00
		S.E.±	NA	NA	NA	NA	NA	NA
		C.D. (P=0.05)						

NA - Data statistically not analysed

Kernel length after cooking was influenced by the weed management practices. Significant variation was observed among the different weed management practices. Kernel length after cooking was significantly higher in (10.80 mm) in mulching with biodegradable polyethelene sheet (T_5) and it was followed by application of paddy straw at 3 t ha^{-1} on 3 DAT and hand weeding on 35 DAT (T_1), conoweeder thrice (T_4) and application of rice bran at 2t ha^{-1} on 3 DAT + HW on 35 DAT (T_8).

All treatments evaluated and registered KLAC values ranging from 9.60 to 10.80 mm and comes under Scale 3 category expect unweeded check (T_{10}), intercropping mesta with rice as paired row and harvesting as greens (T_6) and *Azolla* as dual crop with rice and power weeder incorporation on 35 DAT (T_2) were classified under Scale 2. Sood and Sadiq (1979) stated that length-wise expansion without a corresponding increase in girth is considered a highly desirable rice grain quality trait.

Kernel breadth after cooking (KBAC):

All the weed management practices were evaluated and registered KBAC values ranging from 2.80 to 3.42 mm and obtained Scale 2. The higher KBAC value (3.42 mm) registered under mulching with biodegradable polyethelene sheet (T_5) followed by application of paddy straw at 3 t ha^{-1} on 3 DAT and hand weeding on 35 DAT (T_1) and the lowest value KBAC (2.80 mm) was recorded with unweeded check (T_{10}).

Linear elongation ratio (LER) and breadth wise elongation ratio (BER):

Adoption of different weed management practices had significant influence on linear elongation ratio and breadth wise elongation ratio are presented in Table 3.

Maximum LER (1.78) and BER (1.19) was recorded in the application of paddy straw at 3 t ha^{-1} on 3 DAT and hand weeding on 35 DAT (T_1) and followed by mulching with biodegradable polyethelene sheet (T_5).The lowest LER and BER of 1.64 and 1.00 was noticed in the unweeded check (T_{10}).Linear elongation of rice on cooking is one of the major characteristics of good rice (Sood and Sadiq, 1979).

Water absorption ratio:

The water absorbed by rice during cooking is considered an important quality parameter as it gives some estimate of the volume increase during cooking. Water uptake shows a positive influence on grain elongation. Mulching with biodegradable polyethelene sheet (T_5) registered higher water absorption ratio (3.81) and it was comparable with application of rice bran at 2t ha^{-1} on 3 DAT + HW on 35 DAT (T_8), hand weeding twice (T_3) and hand weeding on 15 DAT fb *Azolla* inoculation (T_9), which were comparable with each other.

Volume expansion ratio:

The lesser volume expansion ratio (2.5) was registered by mulching with biodegradable polyethelene

Table 3 : Effect of different non-chemical weed management practices on cooking parameter and grain yield (kg ha^{-1}) in organic rice production

		Treatments	LER	BER	Water absorption ratio	Volume expansion ratio	Grain yield
T_1	-	Application of paddy straw @ 3t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	1.78	1.19	3.25	2.6	4610
T_2	-	*Azolla* as dual crop with rice and incorporation on 35 DAT using power weeder	1.62	1.12	3.18	2.7	3898
T_3	-	Hand weeding twice on 15 DAT and 35 DAT	1.74	1.16	3.38	3.0	5020
T_4	-	Conoweeder 3 times on 20, 30, 40 DAT	1.76	1.13	3.13	2.8	4557
T_5	-	Mulching with biodegradable polyethelene sheet	1.77	1.17	3.81	2.5	5557
T_6	-	Intercropping mesta (Hibiscus cannabinus) with rice as paired row and harvesting as green	1.66	1.07	3.10	2.8	3642
T_7	-	Intercropping daincha (*Sesbania aculeata*) with rice as paired row cropping and incorporation on 35 DAT	1.76	1.12	3.23	3.0	4241
T_8	-	Application of rice bran @ 2t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	1.72	1.15	3.52	2.5	5377
T_9	-	Hand weeding on 15 DAT followed by azolla inoculation	1.69	1.06	3.36	2.6	5020
T_{10}	-	Unweeded check	1.64	1.00	3.05	3.4	2774
		S.E.±	NA	NA	NA	NA	371.2
		C.D. (P=0.05)					779.9

NA - Data statistically not analysed

sheet (T_5) and it was comparable with application of rice bran at 2t ha^{-1} on 3 DAT + HW on 35 DAT (T_8), application of paddy straw at 3t ha^{-1}fb hand weeding (T_1) and hand weeding on 15 DAT fb *Azolla* inoculation (T_9). The highest volume expansion ratio (3.4) was recorded with unweeded check (T_{10}) which is superior thanall other treatments.

Hemalatha *et al*. (2000) reported that application of FYM @ 12.5 t ha^{-1} , incorporated at the start of first puddling, improved the yield and quality of rice and soil fertility. Grain size and shape largely determine the market value and consumer acceptance of rice, while cooking quality is influenced by the properties of starch. Some varieties expand more in size than others upon cooking. Cooking parameters were kernels absorb water and increase in volume through increase in length or breadth (Hogan and Plank, 1958). Hossain *et al*. (2002) revealed that breadth wise increase is not desirable, whereas, length wise increase without increase in girth is desirable characteristics in high quality premium rice. The length of cooked rice (Table 2) ranged from 9.60-10.80 mm and the highest length of 10.80 mm was recorded with Mulching with biodegradable polyethelene sheet. From this experiment results mulching with biodegradable polythene sheet recorded the highest grain yield and quality parameters like kernel length, kernel length after cooking, kernel breadth after cooking, water absorption ratio and volume expansion ratio. But among different non-chemical weed management practices benefit cost ratio was found to be highest in Hand weeding on 15 DAT followed by *Azolla* inoculation.

Authors' affiliations :

E. SOMASUNDARAM, Department of Agronomy, Agricultural College and Research Institute (T.N.A.U.), COIMBATORE (T.N.) INDIA

REFERENCES

Azeez, M. A. and Shafi, M. (1966). Quality in rice. Department of Agriculture West Pakistan *Technical Bull.,* **3**: 13-50.

Banu, B.K., Kabir,A.,Begum F.and Choudary, N. H. (1992). Physico-chemical properties of modern and local rice varieties of Bangladesh. *J. Rice. Bangladesh,* **3**: 128-131.

CPG (2012). *Crop production guide.* Published by Directorate of Agri., Chennai and TNAU, Coimbatore, T.N. (INDIA).

Gomez, K.A. and Gomez, A.A. (1984). *Statistical procedure for agricultural research*. John Wiley and Sons, New York. pp. 680.

Hemalatha, M., Thirumurugan, V. and Balasubramanian (2000). Effect of organic sources nitrogen on productivity, quality of rice (*Oryza sativa*) and soil fertility in single crop wetlands. *Indian J. Agron.,* **45** (3): 564-567.

Hogan, J.T. and Plank, R.W. (1958). Hydration characteristics of rice as influenced by variety and drying method. *Cereal Chemistry,* **35** : 469-482.

Hossain, S.T., Ahmed, G.J.U., Islam, M.R. and Mahabub, A.A. (2002). Role of ducks in controlling weeds and insects in integrated rice-duck farming. *Bangladesh J. Environ. Sci.,* **6** (2) : 424-427.

Kaul, A.K. (1970). Early generation testing for quality characteristics, II. Rice. *Indian J.Genet. Plant Breed.,* **30** : 237-243.

Pandey, A.K., Prakash, V., Singh, R.D. and Mani, V. P. (2001). Integrated weed management in maize (*Zea mays*). *Indian J. Agron.,* **46** (2) : 260-265.

Sood, G. B. and Sadiq, E. A.(1979). Geographical distribution of kernel elongation gene(s) in rice. *Indian J. Genet. Plant Breed.,***40** : 439 - 342.

WEBLIOGRAPHY

http://apeda.gov.in/apedawebsite/organic/Organic_Products.htm.

NPOP (National Programme for Organic Production). (2012). Organic Certification Area and Production Statistics. *hptt://www.npop.com.*