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Nutrient uptake by weeds and rice under different organic weed management practices

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Abstract
Field study was conducted during the rabi, 2014 at wetlands farm of Tamil Nadu Agricultural University, Coimbatore to assess the nutrient uptake by weeds and crops under different organic weed management practices. The experiment was laid out in randomized block design with three replication and ten treatments. The study revealed that the unweeded check recorded the highest (10.1, 0.81 and 8.15 kg ha-1 at 20 DAT and 17.18, 1. 62 and 15.16 kg ha-1 at 30 DAT) nutrient removal of weeds. The weed control treatments showed a effective weed control and a gradual variation due to impose of different treatments at different stages. Nutrient uptake of rice crop with maximum uptake of nutrient and grain yield was recorded in mulching using biodegradable polyethelene sheets (78.2, 26.7, 100.29 and 5557 kg ha-1). Minimum depletion of N, P and K was observed in unweeded check. The highest benefit: cost ratio were recorded in hand weeding on 15 DAT followed by azolla inoculation on the same day.

Keywords: Nutrient uptake, Removal, Rice, Weed management practices

Introduction
India is the world's second largest producer of Rice. India has tremendous potential to grow crops organically and export organic products to the international market. Domestic demand for organically rice grown is also gaining momentum. 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) [9].

Organic producers rank weeds as their number one problem (Walz, 1999) [14]. Weeds are dynamic and the composition and competition by weeds is dependent on soil, climate, cropping and management factors. Weeds have higher content of nutrients than the crop plants and they grow faster and absorb nutrients earlier than the crops. The uptake of nutrients in unweeded plot was nearly nine times more than the chemical or manual weed control treatments (Sankaran and Mani, 1974) [10]. Weed competition for 30-50 days reduced yield by 62 to 65 per cent in rice crop. Weed control after the critical period could prove wasteful (Hosmani, 1995) [4]. Keeping these points in view, the present study was under taken to evaluate the nutrient uptake by weeds and crops under different organic weed management practices.

Materials and methods
Field investigation was carried out during *rabi* 2014-2015 (October to February) at wetland farm, Tamil Nadu Agricultural University, Coimbatore. 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^{-1} 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 ha^{-1} on 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}). The soil of the experimental field was clay loam with pH of 8.3, low in available nitrogen (216 kg ha^{-1}), medium in available phosphorus (16.9 kg ha^{-1}),

high in available potassium (410 kg ha^{-1}) and medium in organic carbon content (0.60%). CO (R) 50 medium duration (130-135 days) rice variety was chosen for the study.

Rice seedlings were raised separately in nursery and the 21 days old seedlings were transplanted with a spacing of 22.5 X 22.5 cm. All other package of practices for the treatments were carried out as per recommendation of CPG (2012) [2]. Crop and weed samples collected to assess dry matter production were dried in hot air oven at 70°C and ground into a fine powder in a Wiley mill and subjected to assess the uptake of N, P and K. In the case of weeds N, P and K uptake at 20 and 50 DAT were estimated with respect to N, P and K uptake at 30, 60 and 90 DAT were estimated. N, P and K uptake of weed and crop was estimated as per standard procedures given below. Nutrient content of the samples were multiplied with their respective dry matter production to arrive the nutrient uptake and expressed in kg ha^{-1}.

Plant analysis (Nutrient uptake by crop and removal by weeds)		
Nitrogen	**Micro kjeldahl method**	**Humphries (1956)**
Phosphorous	Triacid digestion with colorimetric estimation	Jackson (1973)
Potassium	Triacid digestion with flame photometric method	Jackson (1973)

Statistical Analysis

The data recorded on various parameters recorded during the course of investigation was statistically analyzed as per the procedures suggested by Gomez and Gomez (1984) [3] for randomized block design. Wherever the treatmental difference were found significant ('F' test), critical difference was worked out at 0.05 probability level. Treatmental differences that were non-significant were denoted by 'NS'.

Results and discussion

Significant difference was observed due to the application of different organic weed management practices. The data related to nutrient uptake by weeds and rice are displayed in Tables 1, 2 and 3.

Nutrient removal by weeds

All the weed control treatments significantly influenced the nitrogen removal by weeds at all the stages of observation presented in Table 1.

The application of rice bran 2 t ha^{-1}fb hand weeding (T_8) registered distinctly lowest (1.31 and 1.27 kg ha^{-1}) nitrogen and potassium removal by weeds. Phosphorus removal was lowest (0.14 kg ha^{-1}) in hand weeding on 15 DAT fb azolla inoculation (T_9) at 20 DAT. Whereas, at 50 DAT, the least (1.27 kg ha^{-1}) nitrogen uptake was recorded by the application of rice bran 2 t ha^{-1}fb hand weeding (T_8) and conoweeding thrice (T_4) resulted in lowest (2.65 kg ha^{-1}) uptake of potassium. Phosphorus uptake by weeds was least (0.26 kg ha^{-1}) in hand weeding twice (T_3) which was statistically at par with application of rice bran 2 t ha^{-1}fb hand weeding (T_8) at 5% level of significance. The pattern of nutrient removal by weeds showed that the nutrient losses due to weeds were minimum wherever effective weed control was possible. Similar results were also reported by Singh *et al.* (2005) [12].

Significantly, higher nitrogen, phosphorus and potassium removal by weeds (10.1 and 17.18 kg ha^{-1}), (0.81 and 1.62 kg ha^{-1}) and (8.15 and 15.16 kg ha^{-1}) was registered with unweeded check (T_{10}) at 20 and 50 DAT. In general all the weed control treatments recorded lower nutrients (N, P and K) removal by weeds than unweeded control. This might be due to control of weeds at early stages and reduced weed density, dry weight of weeds at critical crop growth stages. Weeds being more vigorous competitors remove a greater portion of the fertilizer applied to the rice crop. Usually nitrogen is the first nutrient to become limiting factor as a result of crop-weed competition.

The effective control of weeds by application of rice bran at 2 t ha^{-1} 3 DAT followed by hand weeding on 35 DAT, hand weeding on 15 DAT followed by azolla inoculation, hand weeding on 15 DAT and 35 DAT led to the least removal of N, P and K by weeds (Table 1). Higher nutrient removal by weeds in unweeded control might be due to fast growing nature of weeds which made them to absorb the available nutrients earlier than crop plants, resulting an inadequate supply of nutrients to the crop. These results were coinciding with the findings of Thirumuragan *et al*. (1998) [13] who reported that slow growth of rice at the early stages allowed the weeds to compete efficiently for nutrients. At maturity stage the high removal of nutrients by weeds reflected on the yield attributing characters.

Nutrient uptake by plants

Nitrogen uptake of transplanted organic rice as influenced by different weed control treatments as presented in Table 2.

The nitrogen uptake by plants was distinctly higher in mulching with biodegradable polyethelene sheet (T_5) (38.7, 64.2 and 78.2 kg ha^{-1} at 30, 60 and 90 DAT, respectively) and was followed by application of rice bran at 2 t ha^{-1} fb hand weeding (T_8) which recorded uptake of 36.7, 59.5 and 77.8 kg ha^{-1} at 30, 60 and 90 DAT, respectively. Hand weeding on 15 DAT fb azolla inoculation (T_9) (35.1, 52.6 and 75.7 kg ha^{-1} at 30, 60 and 90 DAT, respectively) registered as next best treatment of nitrogen uptake.

Weed management practices exerted positive influence on phosphorous uptake. With regard to phosphorous uptake, mulching with biodegradable polyethelene sheet (T_5) registered significantly higher phosphorus uptake of 9.5, 17.3 and 26.7 kg ha^{-1} at 30, 60 and 90 DAT, respectively and was comparable with application of rice bran at 2 t ha^{-1}fb hand weeding (T_8) (9.1, 16.0 and 26.6 kg ha^{-1} at 30, 60 and 90 DAT, respectively). These treatments were comparable with hand weeding twice (T_3) (8.6, 17.3 and 24.6 kg ha^{-1} at 30, 60 and 90 DAT, respectively) and hand weeding on 15 DAT fb azolla inoculation (T_9) which registered phosphorous uptake of 8.1, 14.7 and 24.1 kg ha^{-1} at 30, 60 and 90 DAT, respectively.

Mulching with biodegradable polyethelene sheet (T_5) recorded distinctly higher potassium uptake of 77.4, 90.3 and 100.29 kg ha^{-1} at 30, 60 and 90 DAT, respectively. This treatment was at par with the application of rice bran at 2 t ha^{-1}fb hand weeding (T_8) with uptake of 73.5, 91.7 and 96.5 kg ha^{-1} at 30, 60 and 90 DAT, respectively, and hand weeding on 15 DAT fb azolla inoculation (T_9) (70.1, 77.9 and 99.8 kg ha^{-1} at 30, 60 and 90 DAT, respectively).

Unweeded check (T_{10}) registered significantly lower nitrogen uptake (18.0, 35.8 and 43.9 kg ha^{-1}), phosphorous uptake (2.4, 6.8 and 11.1 kg ha^{-1}) and lower potassium uptake of (20.3, 50.7 and 64.6 kg ha^{-1}) at 30, 60 and 90 DAT.

Adoption of different weed management practices significantly influenced on the weed density and weed dry weight resulting in more nutrient available to the crop for better growth and production. Mulching by using biodegradable polyethelene sheet recorded significantly higher N, P and K nutrients by plants and higher grain yield (Table 2, 3 and 4). This might be due to the higher mineral

nitrogen concentration in top soil at all growth stage of rice, due to mulching with biodegradable polyethelene sheet for weed suppression, and utilization of available nutrients to the maximum extent by better root activity of absorption brought about higher grain yield of rice. Control recorded lower uptake of nutrients by rice due to severe infestation. Similar result was also reported by Borah *et al*., (2008) [1] stating that the highest uptake of nutrients by weeds in weedy plot at 30 DAT.

Use of rice bran in organic farming has shown beneficial effect on microbial growth, weed control in organic farming system. Rice bran increased the bacterial population in paddy soil and the increased bacterial population accelerated the decomposition of organic matter. The higher inorganic nitrogen content in soil at early growth stage of rice might be partly due to more nitrogen application from rice bran, but is mostly due to the accelerated decomposition of organic matter. Azolla inoculation in rice fields increased the grain yields (5020 kg ha^{-1}) and its growth in rice field suppressed weeds. The pattern of N release from azolla differs in such a way that the release rate is relatively slower just after submergence and faster at a later period, probably because of the higher content of lignin was reported by Shi *et al*., (1978) [11].

Grain yield

The perusal of data revealed that grain yield of transplanted organic rice was very much influenced by weed control treatments over unweeded control (Table 4).

Among the weed management practices, Mulching with biodegradable polyethelene sheet (T_5) recorded significantly higher grain yield of 5557 kg ha^{-1} and it was at par with application of rice bran at 2 t ha^{-1}fb hand weeding (T_8), hand weeding on 15 DAT fb azolla inoculation (T_9) and hand weeding twice (T_3). Drastically lower grain yield of 2774 kg ha^{-1} was obtained from the unweeded check (T_{10}). All other treatments recorded significantly higher yield than unweeded check (T_{10}).

The effective suppression and control of weeds starting from the early crop growth stage might have resulted in better growth and yield of rice. The variation in grain yield under different treatments was the result of variation in weed density and weed biomass. This result could be supported by the findings of Mubshar *et al.,* (2012) [8] who reported that continuously flooded transplanted rice with plastic mulching resulted in higher paddy yield (4.04 t ha^{-1}); while performance of no mulch direct seeding remained poor.

On the basis of above findings, it may be concluded that nutrient uptake of rice crop with maximum uptake of nutrient was recorded in mulching with biodegradable polyethelene sheet it was on par with the application of rice bran at 2 t ha^{-1}fb hand weeding and hand weeding on 15 DAT fb azolla inoculation. Nutrient removal by weeds showed a gradual variation due to effective weed control at different stages of crop. Unweeded check (T_{10}) registered significantly lower nutrient uptake and higher nutrient removal compared with other treatments.

Taking in to consideration of economics, it is suggested to go for economically viable weed management practices in organic rice. Among all the treatments, the net return and B:C ratio was highest from hand weeding on 15 DAT followed by azolla inoculation on the same day.

Table 1: Effect of different weed management practices on nitrogen, phosphorous and potassium removal by weeds (Kg ha^{-1}) in organic rice production

Treatments			Nitrogen (Kg ha^{-1})		Phosphorous (Kg ha^{-1})		Potassium (Kg ha^{-1})	
			20 DAT	50 DAT	20 DAT	50 DAT	20 DAT	50 DAT
T_1	-	Application of paddy straw @ 3t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	4.65	4.91	0.35	0.32	3.93	4.50
T_2	-	*Azolla* as dual crop with rice and incorporation on 35 DAT using power weeder	5.39	8.33	0.38	0.68	3.96	8.43
T_3	-	Hand weeding twice on 15 DAT and 35 DAT	4.08	4.38	0.17	0.26	3.45	3.71
T_4	-	Conoweeder 3 times on 20, 30, 40 DAT	7.99	5.18	0.44	0.48	6.08	2.65
T_5	-	Mulching with biodegradable polyethelene sheet	4.83	5.92	0.30	0.34	3.51	4.77
T_6	-	Intercropping mesta (*Hibiscus cannabinus*) with rice as paired row and harvested as greens	6.71	13.26	0.40	0.80	5.57	9.46
T_7	-	Intercropping daincha (*Sesbania aculeata*) with rice as paired row cropping and incorporation on 35 DAT	6.80	5.82	0.41	0.52	5.34	5.39
T_8	-	Application of rice bran @ 2t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	1.31	1.27	0.20	0.28	1.38	3.21
T_9	-	Hand weeding on 15 DAT followed byazolla inoculation	3.81	6.98	0.14	0.54	3.19	6.03
T_{10}	-	Unweeded check	10.1	17.18	0.81	1.62	8.15	15.16
SEd			0.65	0.13	0.03	0.10	0.50	0.82
CD (P=0.05)			1.36	0.27	0.06	0.20	1.04	1.72

Table 2: Effect of different weed management practices on nitrogen uptake by plant (Kg ha^{-1}) in organic rice production

Treatments			Nitrogen uptake by plant (Kg ha^{-1})		
			30 DAT	60 DAT	90 DAT
T_1	-	Application of paddy straw @ 3t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	27.9	52.2	74.5
T_2	-	*Azolla* as dual crop with rice and incorporation on 35 DAT using power weeder	31.1	64.2	65.5
T_3	-	Hand weeding twice on 15 DAT and 35 DAT	32.8	61.6	70.9
T_4	-	Conoweeder 3 times on 20, 30, 40 DAT	30.9	56.2	68.7
T_5	-	Mulching with biodegradable polyethelene sheet	38.7	63.2	78.2
T_6	-	Intercropping mesta (*Hibiscus cannabinus*) with rice as paired row and harvested as greens	24.7	47.1	61.1
T_7	-	Intercropping daincha (*Sesbania aculeata*) with rice as paired row cropping and incorporation on 35 DAT	26.4	54.5	67.6
T_8	-	Application of rice bran @ 2t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	36.7	59.5	77.8

T_9	-	Hand weeding on 15 DAT followed by azolla inoculation	35.1	52.6	75.7
T_{10}	-	Unweeded check	18.0	35.8	43.9
SEd			2.8	5.1	6.3
CD (P=0.05)			5.9	10.8	13.3

Table 3: Effect of different weed management practices on phosphorous uptake by plant (Kg ha^{-1}) in organic rice production

Treatments			Phosphorous uptake by plant (Kg ha^{-1})		
			30 DAT	**60 DAT**	**90 DAT**
T_1	-	Application of paddy straw @ 3t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	7.6	14.1	25.2
T_2	-	*Azolla* as dual crop with rice and incorporation on 35 DAT using power weeder	6.9	16.6	20.1
T_3	-	Hand weeding twice on 15 DAT and 35 DAT	8.6	17.3	24.6
T_4	-	Conoweeder 3 times on 20, 30, 40 DAT	7.7	15.1	22.8
T_5	-	Mulching with biodegradable polyethelene sheet	9.5	17.0	26.7
T_6	-	Intercropping mesta (*Hibiscus cannabinus*) with rice as paired row and harvested as greens	6.1	12.7	18.9
T_7	-	Intercropping daincha (*Sesbania aculeata*) with rice as paired row cropping and incorporation on 35 DAT	6.5	14.0	21.5
T_8	-	Application of rice bran @ 2t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	9.1	16.0	26.6
T_9	-	Hand weeding on 15 DAT followed by azolla inoculation	8.1	14.7	24.1
T_{10}	-	Unweeded check	2.4	6.8	11.1
SEd			0.7	1.4	2.0
CD (P=0.05)			1.4	2.8	4.3

Table 4: Effect of different weed management practices potassium uptake by plant (Kg ha^{-1}) and grain yield (Kg ha^{-1}) in organic rice production

Treatments			Potassium uptake by plant (Kg ha^{-1})			Grain yield (Kg ha^{-1})
			30 DAT	**60 DAT**	**90 DAT**	
T_1	-	Application of paddy straw @ 3t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	62.3	75.1	90.2	4610
T_2	-	*Azolla* as dual crop with rice and incorporation on 35 DAT using power weeder	61.7	84.9	84.7	3898
T_3	-	Hand weeding twice on 15 DAT and 35 DAT	65.6	88.0	95.3	5020
T_4	-	Conoweeder 3 times on 20, 30, 40 DAT	55.9	80.2	88.4	4557
T_5	-	Mulching with biodegradable polyethelene sheet	77.4	90.3	100.3	5557
T_6	-	Intercropping mesta (*Hibiscus cannabinus*) with rice as paired row and harvested as greens	49.4	67.3	78.3	3642
T_7	-	Intercropping daincha (*Sesbania aculeata*) with rice as paired row cropping and incorporation on 35 DAT	52.7	74.5	86.0	4241
T_8	-	Application of rice bran @ 2t ha^{-1} on 3 DAT + Hand weeding on 35 DAT	73.5	91.7	96.5	5377
T_9	-	Hand weeding on 15 DAT followed by azolla inoculation	70.1	77.9	99.8	5020
T_{10}	-	Unweeded check	20.3	50.7	64.6	2774
SEd			5.5	7.3	8.2	371.2
CD (P=0.05)			11.6	15.4	17.2	779.9

References

1. Borah N, Deka NC, Deka J, Barua IC, Rajkhowa DJ. Effect of herbicides with or without paddy weeders on weeds in transplanted. Indian Journal of Agronomy. 2008; 52(2):107-110.
2. CPG. Crop production guide. Published by Directorate of Agriculture, Chennai and TNAU, Coimbatore, India. 2012.
3. Gomez KA, Gomez AA. Statistical procedure for agricultural research. John Wiley and Sons, New York. 1984, 680.
4. Hosmani MM. Integrated weed management in field crops. Venkatadri Printers, Bangalore, 1995, 113-145.
5. http://apeda.gov.in/apedawebsite/organic/Organic_Products.htm
6. Humphries EC. Mineral component and ash analysis. In: Modern methods of plant analysis, Springer Verlag, Berlin. 1956, 468-502.
7. Jackson ML. Soil Chemical Analysis. Prentice Hall India Pvt. Ltd., New Delhi. 1973, 498.
8. Mubshar H, Farooq S, Ali S. Plastic mulching improves the water use efficiency and productivity of direct seeded and transplanted fine rice. Proceedings of 3rd International Conference 'Frontiers in Agriculture' held at Dankook International Cooperation on Agriculture, Dankook University, Cheonansi, Republic of Korea during October 3-5, 2012.
9. NPOP (National Programme for Organic Production). Organic Certification Area and Production Statistics. 2012. hptt://www.npop.com.
10. Sankaran S, Mani VS. Comparative efficiency of physical, chemical and combination methods of weed control in grain sorghum. Madras Agricultural Journal. 1974; 61(4):244-252.
11. Shi SL, Cheng LL, Lin HH, Shu CL, Wen CH. Effect of azolla on the fertility of paddy soils. Acta Pedologica Sinica. 1978; 15:54-60.
12. Singh S, Singh G, Singh VP, Singh AP. Effect of establishment methods and weed management practices on weeds and rice in rice-wheat cropping system. Indian Journal of Weed Science. 2005; 37:51-57.
13. Thirumuragan V, Balasubramainian R, Thanasekaran T. Influence of field preparation, planting methods and weed management on rice. Pestology. 1998; 22:11-16.
14. Walz E. Final Results of the Third Biennial National Organic Farmers' Survey. Santa Cruz, CA: Organic Farming Research Foundation. 1999.