Journal of Agricultural Engineering and Food Technology
p-ISSN: 2350-0085; e-ISSN: 2350-0263; Volume 4, Issue 1; January-March, 2017 pp. 66-70

http://www.krishisanskriti.org/Publication.html

Nutrient Content, Uptake and Yield of Direct Seeded Upland Autumn Rice (*Oryza sativa*) Varieties as Influenced by Integrated Weed and Nutrient Management Practices

Gayatree Goswami[1], P. K.Gogoi[2] and Debashish Baruah[3]

[1,2]Department of Agronomy, Assam Agricultural University, Jorhat-785013
[3]Farm Manager, Krishi Vigyan Kendra, Assam Agricultural University, Sivasagar-785640
E-mail: [1]tridishat@gmail.com, [3]debashishbaruah9@gmail.com

Abstract—*A field experiment was conducted during autumn 2014 at Assam Agricultural University, ICR Farm, Jorhat, Assam to compare three different direct seeded upland rice varieties under five different integrated weed and nutrient management practices. The experiment was carried out in factorial randomized block design replicated thrice with 15 treatments involving 3 varieties; Inglongkiri, Maizubiron and Rasi adopting 5 treatments of weed and nutrient management, i.e. 20-10-10 kg/ha N-P_2O_5-K_2O + pretilachlor @ 750 g/ha followed by grubber 30 DAS (W_1), 30-15-15 kg/ha N-P_2O_5-K_2O + pretilachlor @ 750 g/ha followed by grubber 30 DAS (W_2), 10-5-5 kg/ha N-P_2O_5-K_2O + pretilachlor @ 750 g/ha followed by grubber 30 DAS + Vermicompost @ 1 t/ha (at sowing & 30 DAS) + Sesbania (Sesbania aculeata) green mulch (up to 30 days) (W_3), 10-5-5 kg/ha N-P_2O_5-K_2O + pretilachlor @ 750 g/ha followed by grubber 30 DAS with intra-row spacing 15cm (W_4), and 20-10-10 kg/ha N-P_2O_5-K_2O + Weedy check (W_5). The results revealed that N and P content in grain and straw of all the three varieties was significantly higher in W_2 while Rasi showed significantly higher P content in combination with W_2. The N, P and K uptake was significantly higher in grains of Rasi and W_2 showed highest in grain, straw and total uptake. An increase in yield as evident by higher grain and straw yield for all the three varieties was observed in W_2. The variety Rasi showed significantly higher grain yield when combined with W_2 while Maizubiron showed significantly higher straw yield when combined with W_2.*

1. INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops of the world, grown in wide range of climatic zones. Rice is the staple food for nearly half of the world‘s population, most of whom live in developing countries. The crop occupies one-third of the world’s total area planted to cereals and provides 35 to 60% of the calories consumed by 2.7 billion people. The two principal methods of rice crop establishment are direct seeding and transplanting. Direct seeding of rice is gaining momentum in India due to high demand of labour during peak season of transplanting and availability of water for short periods thus making paddy cultivation cost effective. It matures earlier

(7-10 days) than the transplanted crop due to the absence of transplanting shock (Dhyani *et al*., 2005) and allows timely planting of succeeding crop. It also ensures the timely sowing in a stipulated time frame. Direct seeded rice accounts for 35 per cent of the total rice cultivated area in India (Nageshwari and Subhramaniyan, 2004). It is now fast replacing traditional transplanted rice in areas with good drainage and weed control (Balasubramanian and Hill, 2000).

Direct seeded rice crop has a higher nutrient requirement as compared to a transplanted crop because of the higher plant density and greater production of biomass in the vegetative phase (Dingkuhn *et al*., 1990). Proper weed management practices along with integrated nutrient management (Sarkar and Gangwar, 2001), more particularly with major nutrients, significantly influence the crop productivity in upland situations. Fertilizer management can definitely alter the competitive balance between crops and weeds, but methods to incorporate it into integrated weed management are yet to be developed (Buhler, 2002).Integrated use of chemical fertilizers with manures, compost and green manure crops is very important for sustainable rice production especially under rainfed upland conditions (Meelu, 1996). Also, the advent of high yielding short duration upland rice varieties, which respond well to weed management and nutrient application has shown some promise in this direction under upland condition as well. Therefore, to study the efficacy of integrated weed and nutrient management practices and varieties on direct seeded rice, the present investigation was undertaken.

2. MATERIALS AND METHODS

A field experiment was conducted at ICR farm of Assam Agricultural University, Jorhat, Assam during autumn season of 2014. The soil of experimental plot was sandy loam in texture with pH 4.95, organic carbon of 0.53% and 263.87, 22.10 and 134.71 kg/ha N, P and K, respectively. The experiment was carried out in factorial randomized block design replicated thrice with 15 treatments involving 3 varieties; Inglongkiri, Maizubiron and Rasi adopting 5 treatments of weed and nutrient management, *i.e.* 20-10-10 kg/ha N-P_2O_5-K_2O + pretilachlor @ 750 g/ha followed by grubber 30 DAS (W_1), 30-15-15 kg/ha N-P_2O_5-K_2O + pretilachlor @ 750 g/ha followed by grubber 30 DAS (W_2), 10-5-5 kg/ha N-P_2O_5-K_2O + pretilachlor @ 750 g/ha followed by grubber 30 DAS + Vermicompost @ 1 t/ha (at sowing & 30 DAS) + Sesbania (*Sesbania aculeata*) green mulch (up to 30 days) (W_3), 10-5-5 kg/ha N-P_2O_5-K_2O + pretilachlor @ 750 g/ha followed by grubber 30 DAS with intra-row spacing 15cm (W_4), and 20-10-10 kg/ha N-P_2O_5-K_2O + Weedy check (W_5).

The nutrients N, P_2O_5, K_2O were applied in the form of urea, single super phosphate (SSP) and muriate of potash (MOP), respectively. The required amounts of P_2O_5 fertilizers, as per treatment, were applied as basal in the lines one day prior to sowing and thoroughly mixed with the soil. The required amounts of N and K_2O fertilizers, as per treatment, were applied in two splits. Half of nitrogenous and potassic fertilizers was applied 20 days after sowing. The second top dressing with the remaining quantities of nitrogenous and potassic fertilizers was done in 40 days after sowing. The vermicompost @ 1 t/ha was applied in rows in two equal splits *i.e.* at basal and 30 DAS. *Sesbania aculeata* as green mulch was grown and incorporated in soil at 30 days DAS. The pre-emergence application of pretilachlor (Craze 50 EC) was made by spraying the herbicide spray solution on the soil surface uniformly, one day after sowing of rice seed. The spray solution, on the basis of spray volume of 500 litre ha^{-1}, was sprayed as per the treatments by using knapsack sprayer. While applying the pre-emergence herbicide, care was taken to ensure that the herbicide drift dose not reaches to adjacent experimental plots. Mechanical weeding, as per treatment, was done on 30 DAS by using manually operated grubber.

Nitrogen content (%) in grain and straw was estimated by modified Kjeldahl method as described by Jackson (1973). Phosphorus was determined colorimetrically by tri-acid digestion and yellow colour method as outlined by Jackson (1973). The colour intensity was measured in Spectronic 20 colorimeter at 470 nm wavelength. Potassium was determined by tri-acid flame photometer method as described by Jackson (1973).

3. RESULTS AND DISCUSSION

Nutrient content and uptake

The content of nutrients, particularly major nutrients, in plant is one of the key indicators of proper nutrition of crop. Nutrient uptake is determined by the concentration of the particular nutrient in plant tissue and the dry matter production. Either dry matter production or high level of nutrient accumulation may lead to high nutrient uptake (Pandey, 2009). In this investigation, different varieties could bring about significant variation in N and P content in grain. Nitrogen and phosphorous content in grain was significantly higher in variety Rasi followed by that in *Inglongkiri*. However, N and P content in straw and K content in grain and straw were non-significant amongst the three varieties. Regarding the factor, weed and nutrient management practices, application of 30-15-15 kg/ha N-P_2O_5-K_2O along with pretilachlor @ 750g a.i./ha and grubber 30 DAS showed significantly higher N, P content in grain and straw as well as K content in straw. The combined effect of variety Rasi and W_2 *i.e.* application of 30-15-15 kg/ha N-P_2O_5-K_2O along with pretilachlor @ 750 g a.i./ha and use of grubber 30 DAS showed significantly higher P content (0.216) in grain followed by that (0.214) observed in interaction of *Inglonkiri* with W_2.

Regarding uptake of major nutrients, N and P uptake in grain was significantly higher with variety Rasi followed by that in *Inglongkiri*. However, P uptake in straw was significantly high in *Maizubiron* followed by that in *Inglongkiri*. In the treatment weed and nutrient management, application of 30-15-15 kg/ha N-P_2O_5-K_2O along with pretilachlor @ 750 g a.i. ha^{-1} and grubber 30 DAS showed significantly higher N, P and K uptake in grain and straw as well as total N (65.68), P (9.37) and K (76.88) uptake followed by that in addition of 20-10-10 kg/ha of N-P_2O_5-K_2O along with pretilachlor @ 750 g a.i./ha and grubber 30 DAS.

Rasi along with weed and nutrient management practices of application of 30-15-15 kg/ha of N-P_2O_5-K_2O, pre-emergence application of pretilachlor @ 750g a.i./ha and working with grubber at 30 DAS (W_2) resulted significantly higher uptake of P in grain (4.70) followed by that (4.39) in combination of variety Inglongkiri (V_1) with W_2. This was due to significantly higher content of P in grain and straw as well as grain yield under this treatment combination (V_3W_2).

Likewise, the combined effect of variety along with weed and nutrient management practices revealed that the treatment V_3W_2 showed significantly higher total N uptake (69.57) followed by that (64.32) in treatment combination V_1W_2 and also significantly higher total P uptake (12.13) followed by that in treatment V_3W_2.

The variation in N, P and K uptake might be due to variation of nutrient concentration in the plant tissue as well as yield of grain and straw.

Grain yield and straw yield (q/ha)

A perusal of the findings revealed that there was no significant difference in grain yield amongst the three varieties tested while Inglonkiri showed significantly higher straw yield. It might be due to significantly higher plant height at harvest in Inglongkiri. Regarding the factor, weed and nutrient management, application of 30-15-15 kg/ha N-P_2O_5-K_2O along with pretilachlor @ 750 g a.i./ha and use of grubber 30 DAS (W_2) showed significantly higher grain yield and straw yield. The higher grain yield might be due to better nutrition of rice crop owing to application of higher dose of major nutrients as well as reduction in crop weed competition due to combined methods of weed control *i.e.* chemical and mechanical, that resulted in statistically superior growth characters (LAI, number of tillers and dry matter accumulation) and yield attributing characters (number of panicles, panicle length and number of filled grains). Kavitha *et al.*, (2010) reported that application of pretilachlor suppressed the weed in the early growth stages of *autumn* rice leading to higher yield. The higher straw yield might be due to higher amount of dry matter production at 30 and 60 DAS in W_2. The improved cultivars produced higher yields than traditional cultivars in both high and low fertility conditions (Saito *et al.*, 2006).

The grain and straw yield were affected significantly by the interaction effect of varieties and weed and nutrient management practices. The results revealed that higher grain yield was given by Rasi, when combined with application of 30-15-15 kg/ha N-P_2O_5-K_2O along with pretilachlor @ 750 g a.i./ha and use of grubber 30 DAS (W_2) while Inglongkiri showed significantly higher straw yield when combined with W_2.

4. ACKNOWLEDGEMENTS

The authors thank the Professor and Head of Department of Agronomy, Assam Agricultural University for providing necessary facilities. Financial assistance provided by Directorate of Post-Graduate Studies, Assam Agricultural University is duly acknowledged.

Table 1: Effect of variety, weed and nutrient management practices on N, P and K content in grain and straw

Treatment	N content (%)		P content (%)		K content (%)	
	Grain	Straw	Grain	Straw	Grain	Straw
Variety						
V_1: Inglongkiri	1.614	1.055	0.198	0.174	1.421	1.731
V_2: Maizubiron	1.485	1.054	0.196	0.174	1.410	1.715
V_3: Rasi	1.617	1.042	0.199	0.172	1.409	1.730
S.Em ±	0.036	0.026	0.001	0.004	0.022	0.052
CD (P = 0.05)	0.104	NS	0.002	NS	NS	NS
Weed and nutrient management						
W_1: 20-10-10 kg/haN-P_2O_5-K_2O + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	1.669	1.103	0.207	0.181	1.412	1.714
W_2: 30-15-15 kg/haN-P_2O_5-K_2O + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	1.694	1.147	0.212	0.188	1.448	1.763
W_3: 10-5-5 kg/haN-P_2O_5-K_2O + vermicompost @ 1t/ha + sesbania green mulch + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	1.643	1.121	0.198	0.184	1.408	1.712
W_4: 10-5-5 kg/haN-P_2O_5-K_2O + intra-row spacing 15 cm + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	1.582	1.057	0.196	0.160	1.414	1.734
W_5: 20-10-10 kg/haN-P_2O_5-K_2O + weedy check	1.274	0.822	0.176	0.154	1.385	1.703
S.Em ±	0.046	0.033	0.001	0.005	0.028	0.067
CD (P = 0.05)	0.134	0.096	0.002	0.013	NS	NS

Table 2: Effect of variety, weed and nutrient management practices on N, P and K uptake by grain, straw and total uptake

Treatment	N uptake (kg/ha)			P uptake (kg/ha)			K uptake (kg/ha)		
	Grain	Straw	Total	Grain	Straw	Total	Grain	Straw	Total
Variety									
V_1: Inglongkiri	26.20	22.89	49.09	3.20	3.74	6.96	22.75	36.53	59.28
V_2: Maizubiron	23.97	22.62	46.59	3.08	3.69	6.78	21.89	36.09	57.98

V_3: Rasi	26.70	22.10	48.80	3.28	3.58	6.86	22.79	35.00	57.80
S.Em ±	0.53	0.47	0.86	0.02	0.06	0.07	0.49	1.16	1.25
CD (P = 0.05)	1.53	NS	NS	0.05	0.19	NS	NS	NS	NS
Weed and nutrient management									
W_1: 20-10-10 kg/haN-P_2O_5-K_2O + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	31.33	27.93	59.26	3.86	4.57	8.44	26.51	43.40	69.91
W_2: 30-15-15 kg/haN-P_2O_5-K_2O + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	35.37	30.30	65.68	4.42	4.95	9.37	30.24	46.64	76.88
W_3: 10-5-5 kg/haN-P_2O_5-K_2O + vermicompost @ 1t/ha + sesbania green mulch + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	27.64	25.29	52.93	3.32	4.15	7.48	23.63	38.53	62.17
W_4: 10-5-5 kg/haN-P_2O_5-K_2O + intra-row spacing 15 cm + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	24.88	22.03	46.91	3.09	3.34	6.44	22.25	36.13	58.38
W_5: 20-10-10 kg/haN-P_2O_5-K_2O + weedy check	8.89	7.14	16.04	1.24	1.33	2.58	9.75	14.67	24.42
S.Em ±	0.68	0.61	1.11	0.02	0.08	0.15	0.63	1.50	1.61
CD (P = 0.05)	1.98	1.78	3.22	0.07	0.24	0.45	1.82	4.33	4.67

Table 3: Effect of variety, weed and nutrient management practices on grain yield, straw yield and harvest index of autumn rice

Treatment	Grain yield (q/ha)	Straw yield (q/ha)
Variety		
V_1: Inglongkiri	15.96	21.05
V_2: Maizubiron	15.50	21.03
V_3: Rasi	16.05	20.17
S.Em ±	0.20	0.11
CD (P = 0.05)	NS	0.31
Weed and nutrient management		
W_1: 20-10-10 kg/haN-P_2O_5-K_2O + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	18.77	25.33
W_2: 30-15-15 kg/haN-P_2O_5-K_2O + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	20.87	26.31
W_3: 10-5-5 kg/haN-P_2O_5-K_2O + vermicompost @ 1t/ha + sesbania green mulch + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	16.79	22.56
W_4: 10-5-5 kg/haN-P_2O_5-K_2O + intra-row spacing 15 cm + pretilachlor @ 750g a.i./ha+ grubber 30 DAS	15.73	20.92
W_5: 20-10-10 kg/haN-P_2O_5-K_2O + weedy check	7.03	8.63
S.Em ±	0.26	0.14
CD (P = 0.05)	0.75	0.40

REFERENCES

[1] Balasubramanian, V. and Hill, J., "Direct wet seeding of rice in Asia: Emerging Issues and Strategic research needs for the 21st Century". Paper presented at the Annual Workshop of the directorate of rice research, Hyderabad, Andhra Pradesh, 2000.

[2] Buhler, D. D., "Challenges and opportunities for integrated weed management", *Weed Science*, 50, 2002, pp. 273-280.

[3] Dhyani, V. C., Singh, V. P. and Singh, G., "Response of rice to crop establishment and weed management", *Indian J. Weed Science*, 37, 2005, pp. 260-262.

[4] Dingkuhn, M., Schnier, H. F. and Dorffling, K., "Diurnal and development changes in canopy gas exchange in relation to growth in transplanted and direct seeded flooded rice", *Australian Journal of Plant Physiology*, 17, 1995, pp. 119-134.

[5] Kavitha, M. P., Ganesaraja, V., Paulpandi, V. K. and Subramanian, R. B., "Effect of age of seedlings, weed management practices and humic acid application on system of rice intensification", *Indian J. Agril. Research*, 44, 4, pp. 294-299.

[6] Meelu O. P., "Integrated nutrient management for ecologically sustainable agriculture" in *23rd Tamhane Memorial Lecture, National seminar on developments in soil science, Gujarat Agric. University*, Anand, 1996.

[7] Nageshwari, R. and Subhramaniayan, B., "Influence of delayed basal dressing and split application of nitrogen in wet-seeded rice (*Oryza sativa* L.)", *Indian J. Agron*., 49, 2004, pp. 40-42.

[8] Pandey, S., "Effect of weed control methods on rice cultivars under the system of rice intensification (SRI)", M. Sc thesis (Agronomy), Tribhuvan University Institute of Agriculture and Animal Science Rampur, Chitwan, Nepal, 2009.

[9] Saito, K., Linquist, B., Atlin, G. N., Phanthaboon, K., Shiraiwa , T. and Horie, T., "Response of traditional and improved upland rice cultivars to N and P fertilizer in northern Laos", *Field Crops Research* , 96, pp. 216-223.

[10] Sarkar, A. and Gangwar, B., "Integrated nutrient management in rice based cropping systems under different agro-ecosystems", *Oryza*. 38, pp. 35-37.