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Growth and Yield of Aerobic Rice as Influenced by Drip Fertigation in Southern Transition Zone of Karnataka

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ABSTRACT

A field experiment was conducted on sandy loam soils, at College of Agriculture, Shivamogga, Karnataka to find out the effect of levels and methods of fertilizer application on growth and yield of aerobic rice during Summer 2016. The experiment was laid out in a Randomized Complete Block Design comprising of 3 replications and 12 treatments. Results showed that aerobic rice yields differed significantly among the treatments. Application of 25% RDF - soil application + 100% RDF - fertigation recorded higher plant height (67 cm), number of tillers plant^{-1} (39.7), leaf area (2659 cm^2 plant^{-1}), leaf area index (4.25), total dry matter accumulation (116 g plant^{-1}), grain yield (71.43 q ha^{-1}) and straw yield (81.72 q ha^{-1}), thereby achieved yield increment of 59 per cent over surface irrigation with soil application of 100 per cent RDF. However, it was found statically on par with 125 or 100 % RDF through fertigation and 25% RDF - soil application + 75% RDF - fertigation treatments.

Key words: *Aerobic rice, Fertilizers, summer, Fertigation.*

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important staple food for more than half the planet's population and is a water intensive enterprise. It is cultivated in different ecosystems in many ways. India being the second largest producer of world (106.57 m t), covers an area of 43.97 m ha with the productivity level of 2424 kg ha^{-1} [1]. As the water use efficiency of rice is very low and loss of applied fertilizers in the field is more, it creates challenges for rice cultivation. So, adoption of aerobic rice system holds well in the present condition.

Aerobic rice production is a revolutionary way of growing rice in well-drained, non-puddled, and non-saturated soils without ponded water[2]. This system uses input-responsive specialized rice cultivars and complementary management practices to achieve at least 4-6 t/ha using only 50-70% of the water required for irrigated rice production.

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This is recommended in areas where water is too scarce or expensive to allow traditional irrigated rice cultivation. Yield of aerobic rice is low due to faulty practice of fertilizer use. In the light of water saving, it is imperative to match fertilizer application for exploring growth potentialities of any crop. Chemical fertilizers are a real asset if they are applied whenever needed by the crop (time of application) in the appropriate method and amount.

Fertigation gives advantages such as higher use efficiency of water and fertilizer, minimum losses of N due to leaching, supplying nutrients directly to root zone, control of nutrient concentration in soil solution and saving in application cost. Thus, fertigation becomes prerogative for increasing the yield of most of the crops under drip irrigation[3]. As water soluble fertilizers are costly inputs, efforts should be made to reduce the quantity by conjunctive mode with normal fertilizers[4]. Keeping the above facts in mind, the present study was conducted with the objective to determine the fertilizer rates with appropriate mode of application for getting highest growth and yield in aerobic rice through adoption of drip during summer 2016.

MATERIAL AND METHODS

A field experiment was conducted during summer season of 2016 at College of Agriculture, UAHS, Shivamogga. The experimental site was situated at 13° 58' to 14° 1' North latitude and 75° 34' to 75° 42' East longitude with an altitude of 650 m above the mean sea level comes under Southern Transition Zone of Karnataka. The experiment was laid out in a Randomized Complete Block Design (RCBD) comprising 3 replications and 12 treatments *viz.,* T_1: 75% RDF through fertigation; T_2: 100% RDF through fertigation; T_3: 125% RDF through fertigation; T_4: 50% RDF- soil application + 25% RDF - fertigation; T_5: 50% RDF- soil application + 50% RDF - fertigation; T_6: 50% RDF- soil application + 75% RDF - fertigation; T_7: 25% RDF- soil application + 50% RDF - fertigation; T_8: 25% RDF - soil application + 75% RDF - fertigation; T_9: 25% RDF - soil application + 100% RDF - fertigation; T_{10}: 75% RDF through soil application; T_{11}: 100% RDF through soil application and T_{12}: 125% RDF through soil application. Based on 1.0 PE, fertigation is scheduled for 8 equal splits at 10, 20, 30, 40, 50, 60, 70 and 80 DAS. The aerobic rice cultivar used for the study was MAS 946-1 (Sharada).

The experimental area was laid out as per the plan and the land within each individual plot was levelled to maintain uniform irrigation water application and seeds were dibbled at 25 cm X 25 cm apart. Recommended Farm Yard Manure was applied at the rate of 10 t ha^{-1} two weeks before sowing for all the treatments. The recommended dose of fertilizers (100: 50: 50 of NPK kg ha^{-1} and zinc sulphate @ 20 kg ha^{-1}) were applied as per the treatments. The sources of nutrients for water soluble fertilizers used were 19:19:19 and calcium ammonium nitrate (15.5 % N and 17 % Ca). In standard soil application, the sources of nutrients applied were in the form of urea (46 % N), single super phosphate (16 % P_2O_5) and muriate of potash (60 % K_2O). At different fertigation intervals, fertilizer solution was freshly prepared by taking the required quantity of fertilizer and was filled in plastic bucket which was connected with suction device of ventury system. As per the treatment details, NPK was applied through drip-fertigation method by using ventury system to each plot up to 80 days after sowing at ten days interval. For standard soil application treatments, out of the recommended dose of fertilizers, 50 per cent of recommended nitrogen & potassium and entire dose of phosphorous were applied as basal dose. Remaining 50 per cent of recommended nitrogen was applied in two splits once at 30 days after sowing and another at 55-60 days just before panicle emergence along with 50 per cent of recommended potassium. Healthy crop stand was ensured by adopting need based plant protection and recommended package of practices. Growth and yield parameters were recorded as per the standard methodology suggested. The data pertaining to the experiment were subjected to statistical analysis as suggested by Gomez and Gomez[5] and results were compared.

RESULTS AND DISCUSSION

Effect of levels and methods of fertilizer application on growth parameters of aerobic rice

The results (Table 1) revealed that the higher plant height, number of tillers per plant, leaf area per plant, leaf area index and total dry matter accumulation per plant were recorded under 25% RDF - soil application + 100% RDF - fertigation treated plots (67 cm, 39.7, 2659 cm^2 $plant^{-1}$, 4.25 and 116 g $plant^{-1}$, respectively) which found to be superior over surface irrigation with soil application of 100 per cent RDF (54.69 cm, 27.97, 2189 cm^2 $plant^{-1}$, 3.65 and 91.1 g $plant^{-1}$, respectively). This was found on par with treatments such as 125 or 100 % RDF through fertigation and 25% RDF - soil application + 75% RDF - fertigation (61-65.16 cm, 35.63-38.35, 2374-2505 cm^2 $plant^{-1}$, 3.80-4.01 and 105.41-113.78 g $plant^{-1}$, respectively for plant height, number of tillers, leaf area, leaf area index and total dry matter accumulation). This may be attributed to availability of nutrients with time phase in root zone of plants, wherein plants are able to utilize the nutrients in a better way. In turn, helped to record higher growth attributes. These findings are in agreement with Govindan & Grace[6] and Rekha[7]. Maintenance of adequate soil moisture by frequent irrigation and nutrient supply match with crop growth demand along with good soil aeration throughout crop growth period might have favoured faster cell division and elongation focussed ultimately in increased plant height, higher tiller production, more number of leaves and leaf area development leading to maintain total dry matter accumulation. Similar results were obtained by Vijaykumar[8]; Abdelraouf *et al.*[9] and Anita Fanish & Muthukrishnan[10]. But in surface irrigation treatments with soil application of fertilizers, nutrients were applied in two splits, utilization was found lower due to intermittence of partial dry and wet period as soil moisture reduced with time between two applications[11].

Effect of levels and methods of fertilizer application on yield of aerobic rice

Application of 25% RDF - soil application + 100% RDF - fertigation recorded significantly higher grain (71.43 q ha^{-1}) and straw (81.72 q ha^{-1}) yield as compared to surface irrigation with soil application of 100 per cent RDF (44.86 q ha^{-1} and 52.26 q ha^{-1}, respectively) (Table 2). Further, this treatment was on par with 125 or 100 % RDF through fertigation and 25% RDF - soil application + 75% RDF - fertigation (62.13-68.90 and 71.55-80.20 q ha^{-1}, respectively for grain and straw yield). Higher yield was attributed to higher growth and yield attributes which can be linked to higher uptake of water and nutrients due to frequent split application of fertilizers in drip irrigation coinciding with actual needs of crop and favoured good vegetative growth, which resulted in maximum yield. Similar results were obtained by Vijaykumar[8]; Pritee Aswathy *et al.*[12] and Anusha[13]. The findings are further strengthened by the fact that use of water soluble fertilizer resulted in higher concentration of available plant nutrient in the top layer[14]. Singandhupe *et al.*[11] and Sampathkumar & Pandian[15] also reported that piece meal application of fertilizers in drip irrigation coincided with the actual needs of crop up to eighty days and favoured good growth and produce maximum yield. However, no significant difference was noticed in harvest index among the treatments, whereas 25% RDF - soil application + 75% RDF - fertigation recorded relatively higher harvest index (0.48).

Table 1: Growth parameters of aerobic rice as influenced by method of fertilizer application through soil and fertigation during summer 2016

Treatments	**Plant height (cm)**	**No. of tillers**	**Leaf area (cm^2 $plant^{-1}$)**	**LAI**	**TDMA (g $plant^{-1}$)**
T_1 - 75% RDF through fertigation	59.12	32.32	2312.2	3.70	95.90
T_2 - 100% RDF through fertigation	61.22	35.63	2374.1	3.80	105.41
T_3 - 125% RDF through fertigation	65.16	38.35	2505.3	4.01	113.78
T_4 - 50% RDF - soil application + 25% RDF - fertigation	53.49	25.53	2167.9	3.47	79.93
T_5 - 50% RDF - soil application + 50% RDF - fertigation	56.60	28.37	2250.8	3.60	88.57
T_6 - 50% RDF - soil application + 75% RDF - fertigation	60.11	34.41	2340.4	3.74	100.11
T_7 - 25% RDF - soil application + 50% RDF - fertigation	56.29	28.26	2235.9	3.58	84.78
T_8 - 25% RDF - soil application + 75% RDF - fertigation	63.91	36.74	2397.6	3.84	109.50
T_9 - 25% RDF - soil application + 100% RDF - fertigation	67.05	39.72	2659.0	4.25	116.10
T_{10} - 75% RDF through soil application	53.18	25.42	2093.3	3.35	76.87
T_{11} - 100% RDF through soil application	54.69	27.97	2189.6	3.50	82.76
T_{12} - 125% RDF through soil application	57.60	30.31	2281.4	3.65	91.10
S.Em.±	2.27	1.79	90.0	0.14	3.34
CD (P=0.05)	6.67	5.25	264.1	0.42	9.80
CV (%)	6.6	9.7	6.7	6.7	6.1

***Based on 1.0 PE, fertigation is scheduled for 8 equal splits at 10, 20, 30, 40, 50, 60, 70 and 80 DAS**
DAS: Days after sowing; RDF: 100:50:50 kg NPK ha^{-1}

Table 2: Grain yield, straw yield and harvest index of aerobic rice as influenced by method of fertilizer application through soil and fertigation during summer 2016

Treatments	**Grain yield (q ha^{-1})**	**Straw yield (q ha^{-1})**	**Harvest index**
T_1 - 75% RDF through fertigation	53.95	65.59	0.45
T_2 - 100% RDF through fertigation	62.13	71.55	0.46
T_3 - 125% RDF through fertigation	68.90	80.20	0.46
T_4 - 50% RDF - soil application + 25% RDF - fertigation	40.42	50.85	0.44
T_5 - 50% RDF - soil application + 50% RDF - fertigation	50.16	59.96	0.46
T_6 - 50% RDF - soil application + 75% RDF - fertigation	60.96	70.57	0.46
T_7 - 25% RDF - soil application + 50% RDF - fertigation	49.91	60.43	0.45
T_8 - 25% RDF - soil application + 75% RDF - fertigation	68.56	73.30	0.48
T_9 - 25% RDF - soil application + 100% RDF - fertigation	71.43	81.72	0.47
T_{10} - 75% RDF through soil application	38.49	44.66	0.46
T_{11} - 100% RDF through soil application	44.86	52.26	0.46
T_{12} - 125% RDF through soil application	52.38	64.48	0.45
S.Em.±	3.18	3.68	0.02
CD (P=0.05)	9.34	10.8	NS
CV (%)	10.4	9.8	8.1

***Based on 1.0 PE, fertigation is scheduled for 8 equal splits at 10, 20, 30, 40, 50, 60, 70 and 80 DAS**
NS - Non-significant; DAS: Days after sowing; RDF: 100:50:50 kg NPK ha^{-1}

CONCLUSION

From the results it can be concluded that soil application of 25 per cent RDF with 75 or 100 per cent RDF through fertigation scheduled for 8 splits from 10 to 80 DAS with 1.0 PE in summer found ideal for achieving higher yield potentiality.

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