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EFFECT OF ENHANCED N, P, K AND Zn FERTILIZER LEVELS ON YIELD ATTRIBUTES, YIELD AND ECONOMICS OF WET SEEDED RICE UNDER TAMIRABARANI COMMAND AREA

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ABSTRACT

A field experiment was conducted at Agricultural College and Research Institute, Killikulam, Tamilnadu, during *Late Pishanam* (December - March) of 2016-2017, to study the effect of enhanced N, P, K and Zn fertilizer levels on yield attributes, yield and economics of wet seeded rice under Tamirabarani command area. Among different treatments, application of 150 % recommended dose of N, P, K and Zn coupled with concurrent growing of green manure and its incorporation at 30 DAS (T_9) resulted in higher yield attributes viz., number of productive tillers m^{-2}, panicle length (cm), panicle weight (g), number of filled grains $panicle^{-1}$, number of ill filled grains $panicle^{-1}$, test grain weight (g), grain yield (kg ha^{-1}), straw yield (kg ha^{-1}) and net return, it was comparable with the application of 125% recommended dose of N, P, K and Zn coupled with concurrent growing of green manure and its *in-situ* incorporation at 30 DAS (T_8). Highest B:C ratio was recorded with the treatment T_8 (Wet seeding with paddy cum dhaincha seeder + 125 % Recommended dose of N, P, K and Zn).

(Key words: Wet seeded rice, enhanced N, P, K and Zn fertilizer, yield attributes, yield, B:C ratio)

INTRODUCTION

More than 90% of the world's rice is grown and consumed in Asia, where 60% of the world's population lives. In India, rice is cultivated in 44.1 million hectares with an annual production of about 105.5 million tonnes. In Tamil Nadu rice is grown in an area of 16.42 lakh hectares with the production of 57.28 lakh million tonnes with an average productivity of 3,191 kg ha^{-1} (Anonymous, 2015). Transplanting is the most dominant and traditional method of crop establishment in irrigated lowland rice. Huge water inputs, high labour costs and labour requirements for TPR have reduced the profit margins (Pandey and Velasco, 1999). About 10 to 15 labour $acre^{-1}$ are required for rice transplanting, weeding (20 $acre^{-1}$) and harvesting (10 $acre^{-1}$) (Anonymous, 2011).The rising labour cost, the need to intensify rice production through double and triple cropping, late onset of monsoon and delayed release of canal water provided the economic incentives for a switch to direct seeding. Much of the recent spread of direct seeding in Southeast Asian countries has been in response to the rising wage rate (Pandey *et al*., 1995). In addition to higher economic returns, direct seeded rice crops are faster and easier to sowing, less labour intensive and consume less water (Bhushan *et al*., 2007) are conducive to mechanisation (Khade *et al*., 1993).

Intercropping green manure and incorporation in wet seeded rice provides nutrients to rice plant, reduces fertilizer requirement, improves soil fertility and reduces the cost of cultivation. *In-situ* green manuring offers not only an effective method of providing organic manures but also has considerable potential for weed suppression (Musthafa and Potty, 2001). Rice tolerates intensive shading during its vegetative phase with least detrimental effect on yield (Yoshida and Parao, 1976). This fact could be advantageously used for intercropping green manure during the early stages and incorporating it before rice becomes more sensitive to shading. So far we are following the fertilizer recommendation of transplanted rice to direct seeded rice, but the nutrient requirement for direct seeded rice was higher than the transplanted rice to compensate for the higher losses and lower availability of N from soil mineralization at the early stage as well as the longer duration of the crop in the main field in dry-direct seeded rice (Kumar and Ladha, 2011). Keeping these points in view, a field experiment was conducted during *Late Pishanam* season

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2016-2017 at Agricultural College and Research Institute, Killikulam, to find out the effect of enhanced N, P, K and Zn fertilizer levels on yield attributes, yield and economics of wet seeded rice under Tamirabarani command area.

MATERIALS AND METHODS

A field experiment was conducted at Agricultural College and Research Institute, Killikulam, Tamilnadu (8°46' N and 77°42' E), during *Late Pishanam* (December - March) of 2016-2017. The experimental site is situated in semi-arid tropical region**.** The soil of the experimental field is sandy clay loam in texture. The treatments consists of Wet seeding with drum seeder + 75% Rec. dose of N, P, K & Zn (T_1), Wet seeding with drum seeder + 100% Rec. dose of N,P,K& Zn (T_2), Wet seeding with drum seeder + 125% Rec. dose of N, P, K & Zn (T_3), Wet seeding with drum seeder + 150% Rec. dose of N, P, K & Zn (T_4), Wet seeding with drum seeder without Rec. dose of N, P, K & Zn (T_5), Wet seeding with paddy cum dhaincha seeder + 75% Rec. dose of N, P, K & Zn (T_6), Wet seeding with paddy cum dhaincha seeder + 100% Rec. dose of N, P, K & Zn (T_7), Wet seeding with paddy cum dhaincha seeder + 125% Rec. dose of N, P, K & Zn (T_8), Wet seeding with paddy cum dhaincha seeder + 150% Rec. dose of N, P, K & Zn (T_9), Wet seeding with paddy cum dhaincha seeder without Rec. dose of N, P, K & Zn (T_{10}).

The experiment was laid out in Randomized Block Design and replicated thrice. The rice variety ASD 16 was used in this experiment. For treatments T_1 to T_5 sowing was done through drum seeder and for treatments T_6 to T_{10} sowing was done through paddy cum dhaincha seeder through which the dhaincha was sown in inter-row spacings of rice. The recommended dose of fertilizer *viz.*, 120:40:40:25 kg NPK and $ZnSO_4$ ha^{-1} was applied at 75 %, 100 %, 125 % and 150 % levels to the respective treatment plots. The entire P and Zn fertilizer were applied as basal in the form of single super phosphate and Zinc sulphate. The N and K fertilizer were applied in four equal splits *viz.*, at 21 days after sowing, active tillering, panicle initiation and heading stages. For, dhaincha intercropped plots, 50% of the recommended dose of $ZnSO_4$ was applied at 12.5 kg ha^{-1}.Crops were irrigated as and when required. Appropriate need based plant protection measures were taken up to control the pest and diseases following the recommended package of practices as per the Crop Production Guide (Anonymous, 2012). Weeds were controlled by application of Pretilachlor @ 0.75 kg ha^{-1} and hand weeding. The intercropped green manure was *in-situ* incorporated in the interspace of rice rows by cono weeder on 30 DAS. Crop was harvested at its full maturity and threshed in respective plots. Data on yield attributes viz., number of productive tillers m^{-2}, panicle length (cm), panicle weight (g), number of filled grains $panicle^{-1}$, number of ill filled grains $panicle^{-1}$, test grain weight (g), grain yield (kg ha^{-1}), straw yield (kg ha^{-1}) were recorded following standard procedures from 10 randomly marked hills. Economic parameters like gross returns, net returns and rupee returned $rupee^{-1}$ invested were worked out treatment wise taking prevailing market rates for different inputs and out puts.

RESULTS AND DISCUSSION

The findings of this study revealed that the yield attributes, yield and economics were significantly influenced by different levels of N, P, K & Zn fertilizer.

All the yield components such as number of productive tillers, panicle length, panicle weight, number of filled grains $panicle^{-1}$, number of ill filled grains $panicle^{-1}$ and test weight with values of 438 m^{-2}, 24.8 cm, 3.2 g, 169 $panicle^{-1}$, 9 $panicle^{-1}$ and 24.53 g were higher with the application of 150 % recommended dose of N, P, K and Zn with green manure intercropping and its *in-situ* incorporation at 30 DAS (T_9). However, it was comparable with the application of 125% recommended dose of N, P, K and Zn with green manure intercropping and its *in-situ* incorporation at 30 DAS (T_8) with equivalent number of productive tillers (431 m^{-2}), panicle length (23.3 cm), panicle weight (3.1 g), number of filled grains $panicle^{-1}$ (164 $panicle^{-1}$), number of ill filled grains $panicle^{-1}$ (10 $panicle^{-1}$) and test weight (24.46 g) (Table 1). Mahajan *et al.* (2012) reported favourable increase in yield attributes of rice with increased levels of N, P, K and Zn fertilizer application coupled with concurrent growing of green manure and its incorporation might have influence on higher N, P, K and Zn uptake, resulting in higher photosynthates accumulation and translocation to reproductive parts. Moreover, addition of green manure sustain the soil pH, increased the soil aeration and enhance the availability of nutrients that influenced higher yield attributes.

Application of 150% recommended dose of N, P, K and Zn coupled with concurrent growing of green manure and its incorporation at 30 DAS (T_9) recorded higher grain yield (6025 kg ha^{-1}) and straw yield (7049 kg ha^{-1}) which was comparable with the application of 125% recommended dose of N, P, K and Zn coupled with co-cultivation of green manure and its incorporation at 30 DAS (T_8) gave equivalent grain yield (5890 kg ha^{-1}) and straw yield (6701 kg ha^{-1}) (Table 2). The increase in yield might be the fact that steady and adequate supply of nutrients by the enhanced biochemical activities of micro-organisms coupled with large photosynthesizing surface would have helped in the production of more tillers and dry matter with enhanced supply of assimilate to sink resulting in higher yield. Similar results were reported by Bridgit *et al.* (1996), who reported that planting at 25 cm x 25 cm with dhaincha intercropping and its incorporation by conoweeder at 30 DAS recorded higher grain (6110 and 6324 kg ha^{-1}) and straw yield (6973 and 7358 kg ha^{-1}).

The highest gross return and net return were recorded with the application of 150% recommended dose of N, P, K and Zn in wet seeded rice coupled with green manure intercropping (T_9). The highest B:C ratio (2.77) was recorded with the application of 125% recommended dose

Table 1. Effect of enhanced N, P, K and Zn fertilizer on number of productive tillers m^{-2}, panicle length (cm) and panicle weight (g) of wet seeded rice

	Treatments	No. of productive tillers m^{-2}	Panicle length (cm)	Panicle weight (g)	No. of filled grains $panicle^{-1}$	No. of ill filled grains $panicle^{-1}$	Test grain weight (g)
T_1	Wet seeding with drum seeder + 75% Recommended dose of N, P, K & Zn	400	17.9	1.9	127	24	24.08
T_2	Wet seeding with drum seeder + 100% Recommended dose of N, P, K & Zn	404	20.5	2.5	145	14	24.26
T_3	Wet seeding with drum seeder + 125% Recommended dose of N, P, K & Zn	409	21.7	2.7	151	13	24.32
T_4	Wet seeding with drum seeder + 150% Recommended dose of N, P, K & Zn	420	23.0	2.9	158	11	24.43
T_5	Wet seeding with drum seeder without recommended dose of N, P, K & Zn	393	14.1	1.6	111	33	23.97
T_6	Wet seeding with paddy cum dhaincha seeder + 75% Recommended dose of N, P, K & Zn	402	18.8	2.1	132	21	24.15
T_7	Wet seeding with paddy cum dhaincha seeder + 100% Recommended dose of N, P, K & Zn	416	22.2	2.8	154	13	24.38
T_8	Wet seeding with paddy cum dhaincha seeder + 125% Recommended dose of N, P, K & Zn	431	23.3	3.1	164	10	24.46
T_9	Wet seeding with paddy cum dhaincha seeder + 150% Recommended dose of N, P, K & Zn	438	24.8	3.2	169	9	24.53
T_{10}	Wet seeding with paddy cum dhaincha seeder without recommended dose of N, P, K & Zn	397	14.8	1.7	117	28	24.02
SE (d)		5.4	0.8	0.11	3.7	1.1	0.28
CD (P=0.05)		11.3	1.6	0.24	7.8	2.3	–

Table 2. Effect of enhanced N, P, K and Zn fertilizer on grain yield and straw yield (kg ha^{-1}) of wet seeded rice

	Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
T	Wet seeding with drum seeder + 75% Recommended dose of N, P, K & Zn	3070	3662
T^1	Wet seeding with drum seeder + 100% Recommended dose of N, P, K & Zn	4950	5802
T^2	Wet seeding with drum seeder + 125% Recommended dose of N, P, K & Zn	5220	6110
T^3	Wet seeding with drum seeder + 150% Recommended dose of N, P, K & Zn	5545	6420
T^4	Wet seeding with drum seeder without recommended dose of N, P, K & Zn	2060	2421
T^5	Wet seeding with paddy cum dhaincha seeder + 75% Recommended dose of		
^{6}	N, P, K & Zn	3480	4141
T	Wet seeding with paddy cum dhaincha seeder + 100% Recommended dose		
^{7}	of N, P, K & Zn	5480	6390
T	Wet seeding with paddy cum dhaincha seeder + 125% Recommended dose		
^{8}	of N, P, K & Zn	5890	6701
T	Wet seeding with paddy cum dhaincha seeder + 150% Recommended dose		
^{9}	of N, P, K & Zn	6025	7049
T	Wet seeding with paddy cum dhaincha seeder without recommended dose		
^{10}	of N, P, K & Zn	2410	2855
SE (d)		166	197
CD (P=0.05)		348	414

Table 3. Effect of enhanced N, P, K and Zn fertilizer on economics of wet seeded rice

Treatments		Gross Return (Rs. ha^{-1})	Net Return (Rs. ha^{-1})	B: Cratio (Rs. ha^{-1})
T	Wet seeding with drum seeder + 75%			
^{1}	Recommended dose of N, P, K & Zn	41686	14365	1.53
T	Wet seeding with drum seeder + 100%			
^{2}	Recommended dose of N, P, K & Zn	66906	38322	2.34
T	Wet seeding with drum seeder + 125%			
^{3}	Recommended dose of N, P, K & Zn	70530	40681	2.36
T	Wet seeding with drum seeder + 150%			
^{4}	Recommended dose of N, P, K & Zn	74710	43595	2.40
T	Wet seeding with drum seeder without			
^{5}	recommended dose of N, P, K & Zn	27863	5458	1.24
T	Wet seeding with paddy cum dhaincha seeder +			
^{6}	75% Recommended dose of N, P, K & Zn	47223	21202	1.81
T	Wet seeding with paddy cum dhaincha seeder +			
^{7}	100% Recommended dose of N, P, K & Zn	73970	46686	2.71
T	Wet seeding with paddy cum dhaincha seeder +			
^{8}	125% Recommended dose of N, P, K & Zn	79003	50454	2.77
T	Wet seeding with paddy cum dhaincha seeder +			
^{9}	150% Recommended dose of N, P, K & Zn	81397	51582	2.73
T	Wet seeding with paddy cum dhaincha seeder			
^{10}	without recommended dose of N, P, K & Zn	32665	11560	1.55

Data statistically not analysed

of N, P, K and Zn in wet seeded rice intercropped with green manure (T_8) (Table 3). The higher economic return was realized due to application of enhanced levels of N, P and K fertilizer and green manure documented in earlier studies by Alagappan (2014).

Based on the results of the above study it is concluded that, in wet seeded rice application of 125% recommended dose of N, P, K and Zn coupled with green manure intercropping and its incorporation at 30 DAS was found to be the best for getting higher yield and higher returns rupee^{-1} invested in wet seeded rice under Tamirabarani command area.

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