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## Effect of enhanced N, P, K and Zn fertilizer on growth, yield and economics of wet seeded rice under Tamirabarani command area

**M Madhan Kumar, M Hemalatha, M Joseph, R Nandhini and M Arun Raj**

#### Abstract

A field experiment was conducted at Agricultural College and Research Institute, Killikulam, Tamilnadu, during 2016-2017, to study the effect of enhanced N, P, K and Zn fertilizer on growth, 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<sub>9</sub>) resulted in higher growth, yield 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<sub>8</sub>). Highest benefit : cost ratio was recorded with the treatment T<sub>8</sub>.

**Keywords:** Wet seeded rice, enhanced fertilizer, growth, yield, benefit: cost ratio

#### Introduction

Rice (*Oryza sativa* L.) is one of the most important staple food crop in many Asian countries. 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<sup>-1</sup> (India stat, 2015) [7]. Although transplanting has been a major traditional method of rice establishment in Asia, economic factors and recent changes in rice production technology have improved the desirability of direct-seeding methods. 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. Simultaneously, the availability of high-yielding, short-duration varieties, and chemical weed control methods made such a switch technically and economically viable. (Pandey *et al.*, 1995a) [11].

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 (Anitha and Jose Mathew, 2010) [2]. General recommendations of N, P, K and Zn fertilizers for direct seeded rice are similar to those in puddled transplanted rice, except that a slightly higher dose of N (22.5 - 30 kg ha<sup>-1</sup>) is suggested in direct seeded rice (Gathala *et al.*, 2011) [4] 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) [8]. Keeping these points in view, a field experiment was conducted to find out the effect of enhanced N, P, K and Zn fertilizer on growth, 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), from 2016 to 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<sub>1</sub>), Wet seeding with drum seeder + 100% Rec. dose of N,P,K& Zn (T<sub>2</sub>), Wet seeding with drum seeder + 125% Rec. dose of N, P, K & Zn (T<sub>3</sub>), Wet seeding with drum seeder + 150% Rec. dose of N, P, K & Zn (T<sub>4</sub>), Wet seeding with drum seeder without Rec. dose of N, P, K & Zn (T<sub>5</sub>), Wet seeding with paddy cum dhaincha seeder + 75% Rec. dose of N, P, K & Zn (T<sub>6</sub>), Wet seeding with paddy cum dhaincha seeder + 100% Rec. dose of N, P, K & Zn (T<sub>7</sub>), Wet

seeding with paddy cum dhaincha seeder + 125% Rec. dose of N, P, K & Zn (T<sub>8</sub>), Wet seeding with paddy cum dhaincha seeder + 150% Rec. dose of N, P, K & Zn (T<sub>9</sub>), Wet seeding with paddy cum dhaincha seeder without Rec. dose of N, P, K & Zn (T<sub>10</sub>).

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<sub>1</sub> to T<sub>5</sub> sowing was done through drum seeder and for treatments T<sub>6</sub> to T<sub>10</sub> 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<sub>4</sub> ha<sup>-1</sup> 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<sub>4</sub> is applied at 12.5 kg ha<sup>-1</sup>. 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 (GoTN, 2012)<sup>[6]</sup>. Weeds were controlled by application of Pretilachlor @ 0.75 kg ha<sup>-1</sup> 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 growth, yield and economics were recorded.

## Results and Discussion

### Growth

The growth parameters of wet seeded rice varied significantly among the various treatments. The growth parameters like plant height, number of tillers, dry matter production, leaf area index and crop growth rate were higher with 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<sub>9</sub>), it was comparable with the application of 125% recommended dose of N, P, K and Zn coupled with co-cultivation of green manure and its *in-situ* incorporation at 30 DAS (T<sub>8</sub>).

Yosef Tabar (2013)<sup>[13]</sup> reported that Increase in plant height of wet seeded rice might be due to higher dose of application of Nitrogen fertilizer. Incorporation of green manure increases and maintain the availability of nutrients at later stages, which results in greater production of tillers (Parasuraman and Chandrasekaran, 2005)<sup>[12]</sup>. The higher dry matter production

was due to application of enhanced dose of N, P, K and Zn (Meshram *et al.*, 2015)<sup>[10]</sup>. Gharib *et al.* (2011)<sup>[5]</sup> reported that greater availability of nutrients, vigorous root activity, greater expansion of the leaf blades and better soil fertility by application of enhanced dose of N, P, K and Zn with green manuring leads to more number of tillers which in turn increased the LAI. Matiwade and Sheelavantar (1994)<sup>[9]</sup> observed that integration of green manure + enhanced nitrogen leads to more crop growth rate in rice (Table 1).

### Yield

Among the different treatments, the higher grain yield (6025 kg ha<sup>-1</sup>) and straw yield (7049 kg ha<sup>-1</sup>) were registered with the 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<sub>9</sub>), it was on par with 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<sub>8</sub>) with comparable grain yield (5890 kg ha<sup>-1</sup>) and straw yield (6701 kg ha<sup>-1</sup>) (Table 2).

The yield increase in these two treatments 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 assimilates to sink resulting in higher yield. Similar results are reported by Bridgit *et al.* (1996)<sup>[3]</sup>.

### Economics

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<sub>9</sub>). The highest B:C ratio (2.77) was recorded with the application of 125% recommended dose of N, P, K and Zn in wet seeded rice intercropped with green manure (T<sub>8</sub>) (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)<sup>[11]</sup>.

### Conclusion

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 is found to be the best for getting higher yield and higher returns per rupee invested in wet seeded rice under Tamirabarani command area.

**Table 1:** Effect of enhanced N, P, K and Zn fertilizer on growth of wet seeded rice

Treatments	HA			PI	PI-HA
	Plant height (cm)	Tillers (No. m <sup>-2</sup> )	DMP (kg ha <sup>-1</sup> )	LAI	CGR (kg ha <sup>-1</sup> day <sup>-1</sup> )
T <sub>1</sub> Wet seeding with drum seeder + 75% Recommended dose of N, P, K & Zn	89.97	419	6809	3.51	75
T <sub>2</sub> Wet seeding with drum seeder + 100% Recommended dose of N, P, K & Zn	95.21	428	10845	4.02	116
T <sub>3</sub> Wet seeding with drum seeder + 125% Recommended dose of N, P, K & Zn	98.78	435	11592	4.12	126
T <sub>4</sub> Wet seeding with drum seeder + 150% Recommended dose of N, P, K & Zn	102.47	441	12235	4.30	132
T <sub>5</sub> Wet seeding with drum seeder without recommended dose of N, P, K & Zn	82.67	411	4573	2.89	48
T <sub>6</sub> Wet seeding with paddy cum dhaincha seeder + 75% Recommended dose of N, P, K & Zn	93.65	424	7732	3.78	81
T <sub>7</sub> Wet seeding with paddy cum dhaincha seeder + 100% Recommended dose of N, P, K & Zn	100.12	437	12104	4.20	130
T <sub>8</sub> Wet seeding with paddy cum dhaincha seeder + 125% Recommended dose of N, P, K & Zn	107.05	445	12813	4.60	138
T <sub>9</sub> Wet seeding with paddy cum dhaincha seeder + 150% Recommended dose of N, P, K & Zn	110.31	450	13240	4.69	140
T <sub>10</sub> Wet seeding with paddy cum dhaincha seeder without recommended dose of N, P, K & Zn	86.13	415	5335	3.01	56
SE d	3.48	3.00	307	0.18	3
CD (P=0.05)	7.31	6.29	646	0.38	7

AT – Active tillering stage

PI – Panicle initiation stage

HA – At harvest stage

**Table 2:** Effect of enhanced N, P, K and Zn fertilizer on grain yield and straw yield (kg ha<sup>-1</sup>) of wet seeded rice

Treatments		Grain yield (kg ha <sup>-1</sup> )	Straw yield (kg ha <sup>-1</sup> )
T <sub>1</sub>	Wet seeding with drum seeder + 75% Recommended dose of N, P, K & Zn	3070	3662
T <sub>2</sub>	Wet seeding with drum seeder + 100% Recommended dose of N, P, K & Zn	4950	5802
T <sub>3</sub>	Wet seeding with drum seeder + 125% Recommended dose of N, P, K & Zn	5220	6110
T <sub>4</sub>	Wet seeding with drum seeder + 150% Recommended dose of N, P, K & Zn	5545	6420
T <sub>5</sub>	Wet seeding with drum seeder without recommended dose of N, P, K & Zn	2060	2421
T <sub>6</sub>	Wet seeding with paddy cum dhaincha seeder + 75% Recommended dose of N, P, K & Zn	3480	4141
T <sub>7</sub>	Wet seeding with paddy cum dhaincha seeder + 100% Recommended dose of N, P, K & Zn	5480	6390
T <sub>8</sub>	Wet seeding with paddy cum dhaincha seeder + 125% Recommended dose of N, P, K & Zn	5890	6701
T <sub>9</sub>	Wet seeding with paddy cum dhaincha seeder + 150% Recommended dose of N, P, K & Zn	6025	7049
T <sub>10</sub>	Wet seeding with paddy cum dhaincha seeder without recommended dose 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 (₹ ha <sup>-1</sup> )	Net Return (₹ ha <sup>-1</sup> )	B:C ratio
T <sub>1</sub>	Wet seeding with drum seeder + 75% Recommended dose of N, P, K & Zn	41686	14365	1.53
T <sub>2</sub>	Wet seeding with drum seeder + 100% Recommended dose of N, P, K & Zn	66906	38322	2.34
T <sub>3</sub>	Wet seeding with drum seeder + 125% Recommended dose of N, P, K & Zn	70530	40681	2.36
T <sub>4</sub>	Wet seeding with drum seeder + 150% Recommended dose of N, P, K & Zn	74710	43595	2.40
T <sub>5</sub>	Wet seeding with drum seeder without recommended dose of N, P, K & Zn	27863	5458	1.24
T <sub>6</sub>	Wet seeding with paddy cum dhaincha seeder + 75% Recommended dose of N, P, K & Zn	47223	21202	1.81
T <sub>7</sub>	Wet seeding with paddy cum dhaincha seeder + 100% Recommended dose of N, P, K & Zn	73970	46686	2.71
T <sub>8</sub>	Wet seeding with paddy cum dhaincha seeder + 125% Recommended dose of N, P, K & Zn	79003	50454	2.77
T <sub>9</sub>	Wet seeding with paddy cum dhaincha seeder + 150% Recommended dose of N, P, K & Zn	81397	51582	2.73
T <sub>10</sub>	Wet seeding with paddy cum dhaincha seeder without recommended dose of N, P, K & Zn	32665	11560	1.55

Data statistically not analysed

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