

Partial factor productivity of major nutrients on grain and straw of rice hybrids in SRI strategy

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ABSTRACT

Rice is an important cereal crop of India. Field experiments were conducted at the wetlands of Agricultural College and Research Institute, Coimbatore to bring out the impact of modified planting / direct seeding, limited irrigation, conoweeding and green manuring verses conventional planting, conventional irrigation, hand weeding and no green manuring on the partial factor productivity (PFP) of rice hybrids CORH 2 and ADTRH 1. Partial factor productivity of grain and straw yields were higher under modified planting / direct seeding, conoweeding and no green manuring practices.

Key words : Conoweeding, Green manuring, Limited irrigation, Partial factor productivity

INTRODUCTION

In India, rice is cultivated over an area of 41.9 m.ha with a total production of 83.1 m.tonnes and productivity of 1984 kg/ha (Anon, 2006). Rice ecology is endowed with several yield depressing factors viz., weed menace, nutritional disorders, labour scarcity, pest-disease complex and water scarcity. These limitations are not without opportunities.

Exploitation of the inherent potential of rice soils with suitable crop management options may insulate the existing constraints and step up rice production and productivity. Hence, the present study was undertaken with modified crop management options such as differential crop establishment, water efficient rice cultivation, weed control effected by *in situ* weed incorporation using conoweeder and soil fertility enhancement through green manuring, the principles of System of Rice Intensification (SRI). Partial factor productivity reflects the ability of the major nutrients to produce incremental grain and straw yields. The present paper highlights the partial factor productivity of major nutrients on grain and straw yields of CORH 2 and ADTRH 1 rice hybrids as influenced by SRI strategy.

MATERIALS AND METHODS

Field experiments were conducted during 2001 – 02 in the wetlands of Agricultural College and Research Institute, Coimbatore to bring out the influence of the principles of SRI on grain and straw yields of CORH 2 (125 days duration) and ADTRH 1 (115 days duration) rice hybrids.

The soil of the experimental site was deep, clay loam (Vertic Ustochrept) belonging to Noyyal series. The pH was 8.3, electrical conductivity, 0.54 dSm⁻¹, cation

exchange capacity, 18.0 cmol (p+) kg⁻¹, organic carbon, 5.1 g kg⁻¹, available NPK were 232, 32 and 740 kg ha⁻¹, respectively. The available silica content was 380 ppm. The treatments adopted were:

Main plot treatments (Irrigation and establishment techniques):

- P₁ : Transplanting conventional nursery seedlings at 20 x 20 cm spacing
- P₂ : Transplanting 10 – 12 days old dapog nursery seedlings at 20 x 20 cm spacing verses
- I₁ : Irrigating the field to 5 cm one day after the disappearance of ponded water
- I₂ : Irrigating the field to 2 cm after the development of hairline cracks

Subplot treatments (Weeding and nutrient management):

- W₁ : Manual hand weeding twice as per the farmers' practice (weeds removed)
- W₂ : Weeding by conoweeder at 10 days interval upto maximum vegetative period verses
- N₁ : Recommended level of N, P, K and Zn without the addition of green manures
- N₂ : Recommended level of N, P, K and Zn with the addition of green manures @ 6.25 t ha⁻¹.

The experiment was laid out in strip plot design with each treatment replicated four times. The fertilizer (NPK) was applied at the rate of 150: 60: 60 kg ha⁻¹ for P₁ and 175: 60 : 60 kg ha⁻¹ for P₂ during wet season for CORH 2 and 150 : 60 : 90 kg ha⁻¹ during dry season for ADTRH 1.

Grain yield was obtained at 14 % moisture content. Straw was sundried to a constant weight and oven dried

and the yield was recorded.

Partial factor productivity of grain and straw yields were calculated as follows,

$$PF_{gy} \text{ (kg /kg)} = GY / Nt$$

GY – Grain yield (kg ha⁻¹)

Nt – Total amount of the major nutrients (NPK) applied (kg ha⁻¹) in a treatment

$$PF_{sy} \text{ (kg /kg)} = SY / Nt$$

SY – Straw yield (kg ha⁻¹)

Nt – Total amount of the major nutrients (NPK) applied (kg ha⁻¹) in a treatment

RESULTS AND DISCUSSION

The results of analysis of variance for different characters and parameters are given in Table 1.

Grain:

The partial factor productivity of applied major nutrients on grain at harvest ranged from 12.4 (P₂I₂W₁N₂) to 23.2 kg kg⁻¹ (P₂I₁W₂N₁) and 14.1 (P₁I₂W₁N₂) to 23.0 (P₂I₁W₂N₂) kg kg⁻¹ during wet and dry seasons, respectively. PFP did not vary much among the plant establishment methods during wet season while during dry season, direct seeding registered relatively higher PFP of 19.0 as against 17.4 kg kg⁻¹ recorded under conventional planting.

During both the seasons, PFP of conventional irrigation was found to be relatively higher (19.6 and 18.7 kg kg⁻¹) compared to limited irrigation. Conoweeding registered a higher PFP of 20.0 kg kg⁻¹ and 18.5 kg kg⁻¹ during both the seasons as against 18.6 kg kg⁻¹ and 17.9 kg kg⁻¹ observed under conventional weeding. PFP of no green manuring was noticed to be relatively higher compared to green manuring during both the seasons. PFP during wet season was found to be relatively higher (19.3 kg kg⁻¹) than that recorded at dry season (Table 1).

Straw:

The PFP of applied nutrients on straw was 52.8 kg kg⁻¹ during wet season and 38.9 kg kg⁻¹ during dry season. PFP observed during wet season ranged from 41.7 to 64.5 kg kg⁻¹ and during dry season it was 27.9 to 47.1 kg kg⁻¹. PFP of applied nutrients on straw was found to be higher under modified planting during both the seasons (53.1 and 41 kg kg⁻¹, respectively).

During wet season, PFP of applied nutrients on straw

Table 1 : Partial factor productivity (PFP) (kg kg⁻¹) of applied major nutrients on grain and straw yields of rice hybrids CORH 2 and ADTRH 1

Treatments	Grain yield		Straw yield	
	CORH 2	ADTRH 1	CORH 2	ADTRH 1
P ₁ I ₁ W ₁ N ₁	22.8	60.1	20.0	36.5
P ₁ I ₁ W ₁ N ₂	15.7	44.4	15.2	29.1
P ₁ I ₁ W ₂ N ₁	22.3	60.8	20.8	48.1
P ₁ I ₁ W ₂ N ₂	16.6	44.4	15.3	38.3
P ₁ I ₂ W ₁ N ₁	23.0	59.6	19.0	34.3
P ₁ I ₂ W ₁ N ₂	16.2	41.7	14.1	27.9
P ₁ I ₂ W ₂ N ₁	22.6	64.5	20.0	41.1
P ₁ I ₂ W ₂ N ₂	16.6	45.1	14.7	33.6
P ₂ I ₁ W ₁ N ₁	23.2	60.6	22.3	44.9
P ₂ I ₁ W ₁ N ₂	14.4	41.9	16.0	43.9
P ₂ I ₁ W ₂ N ₁	23.2	59.2	23.0	47.1
P ₂ I ₁ W ₂ N ₂	18.7	43.4	16.8	44.9
P ₂ I ₂ W ₁ N ₁	21.2	64.5	21.2	48.2
P ₂ I ₂ W ₁ N ₂	12.4	46.6	15.5	25.6
P ₂ I ₂ W ₂ N ₁	22.7	62.5	21.3	47.1
P ₂ I ₂ W ₂ N ₂	17.5	45.8	16.0	31.1
Mean	19.3	52.8	18.2	38.9
P ₁	19.5	52.6	17.4	36.1
P ₂	19.2	53.1	19.0	41.6
I ₁	19.6	51.9	18.7	41.6
I ₂	19.0	53.8	17.7	36.1
W ₁	18.6	52.4	17.9	36.3
W ₂	20.0	53.2	18.5	41.4
N ₁	22.6	61.5	21.0	43.4
N ₂	16.0	44.2	15.5	34.3

was higher under limited irrigation (53.8 kg kg⁻¹) while at dry season, the trend was reversed, wherein limited irrigation recorded relatively lower value of 36.1 kg kg⁻¹ as against 41.6 kg kg⁻¹ observed under conventional irrigation. During both the seasons, conoweeding practice was found to record a higher PFP than conventional weeding. The PFP of applied nutrients on straw yield was lower under green manuring during both the seasons compared to no green manuring.

During dry season, direct seeding significantly increased the grain and straw yields than the conventional seedlings. The better foraging ability of the root system in direct seeding owing to the reduced transplanting shock would have favoured better utilization of applied nutrients resulting in higher uptake and increased yields. Wet seeded rice producing similar of higher grain yields than transplanted rice was well documented by several workers (Khan, 1990; Ramasamy *et al.*, 1994).

Due to the occurrence of internal water stress due to reduced water potential, the PFP for grain yield is less under limited irrigation than the conventional irrigation. But for straw yield, the PFP difference was not noticed during wet season. Mechanical weed control significantly increased the grain and straw yields during both the seasons. Soil aeration and root pruning (Shad, 1986) as effected by the conoweeder would have provided conducive environment for the uptake of nutrients contributing for the increased yields and increased PFP. Chandra and Manna (1990) reported increased grain yields under mechanical control due to increased nutrient uptake due to root pruning and aeration. This might have favoured better utilization of nutrients and increased partial factor productivity.

Application of green manure @ 6.25 t/ha in addition to the recommended dose of fertilizers did not have significant effect on yield. Rather it has resulted in decreased grain and straw yields during wet season. Some of the organic acids produced with the addition of green manures could retard root elongation, restrict nutrient uptake and reduce shoot weight (Watanabe, 1984). Thus the utilization of applied nutrients was hampered under green manuring practice resulting in decreased PFP of grain and straw yields (Table 1).

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