

Effect of plant population and nitrogen on yield attributes and yield of hybrid rice (*Oryza sativa*)

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Received: July 1998

ABSTRACT

A field experiment was conducted during 1996–97 and 1997–98 at Madurai, Tamil Nadu, to study the response of hybrid ('CORH 2') rice (*Oryza sativa* L.) to different plant populations (50, 33 and 25 hills/m²), seedling/hill (single or double) and N levels (150, 200 and 250 kg/ha) under lowland condition. The yield parameters were more with the population of 50 hills/m². Planting of single seedling/hill performed equal to that of 2 seedlings/hill. Yield parameters and yield were higher with 200 and 150 kg N/ha. However, the treatment combination of 50 hills/m² with single seedling/hill and application of 150 kg N/ha was found economically feasible agronomic practice for rice hybrid 'CORH.2'.

Key words : Plant population, Hybrid rice, B:C ratio

Cultivation of hybrid rice is different from that of inbred rice varieties because of its genetic variability. Hybrid rice shows yield advantage of about 15% under tropical conditions owing to increase in total biomass production, higher spikelet number and to some extent higher test grain weight (Ponnuthurai *et al.*, 1984). New and front-line agronomic packages such as optimum plant population, seedling number/hill and optimum dose of N levels are required to tap the yield potential of hybrid rice. A medium-duration (120–125 days) rice hybrid culture, 'TNRH 16' has been released as 'CORH 2' by Tamil Nadu Agricultural University, Coimbatore, in

1998. With the objective of evaluating agronomic management practices such as plant population, number of seedlings and N levels to the newly released hybrid rice, the present study was undertaken.

MATERIALS AND METHODS

A field experiment was conducted during *samba* (Oct.–Nov. to Jan.–Feb.) 1996–97 and 1997–98 at Agricultural College and Research Institute, Madurai, Tamil Nadu. The soil was sandy clay loam classified as Typic udic Hapludalf, with pH 7.6. It was low in available N (260 kg/ha), medium in P (13 kg/ha) and medium in available K (284 kg/ha). The rice hybrid,

Table 1. Yield attributes and yield of hybrid 'CORH 2' rice (1996-97)

Treatment	Panicles/ m ²	Panicle weight (g)	Panicle length (cm)	Grains/ panicle	Filled grains/ panicle	Sterility (%)	1,000- grain weight (g)	Harvest index (%)	Grain yield (q/ha)	Straw yield (q/ha)	Benefit : cost ratio
<i>Population (hills/m²)</i>											
50	529	3.2	24.2	129.9	119.8	11.7	24.13	46.7	70.04	79.98	2.73
33	461	3.0	23.1	126.3	114.0	13.8	23.79	46.6	67.60	77.35	2.62
25	368	2.8	22.2	122.7	107.4	16.7	23.36	46.5	65.10	74.72	2.49
CD (P = 0.05)	38	0.08	0.8	3.8	4.0	0.4	NS	NS	2.13	2.25	
<i>Seedlings/hill</i>											
Single	465	3.1	23.4	126.7	115.4	13.0	23.92	47.1	68.48	76.65	2.67
Double	440	3.0	22.9	125.9	112.1	15.0	23.61	46.0	66.68	78.06	2.57
CD (P = 0.05)	NS	NS	NS	NS	NS	0.4	NS	NS	NS	NS	
<i>N (kg/ha)</i>											
150	458	3.1	23.8	127.6	114.5	11.6	24.0	47.3	67.76	75.45	2.77
200	495	3.2	23.9	129.6	117.2	13.9	23.8	47.4	69.55	77.17	2.72
250	405	2.8	21.8	121.8	109.6	16.8	23.5	45.2	65.44	79.45	2.37
CD (P = 0.05)	42	0.06	0.7	3.5	3.7	0.3	NS	NS	2.01	2.04	

'CORH 2' was the test cultivar. The experiment was laid out in split-plot design with 3 replications. The main plots consisted of plant population (hills/m²): 50 (20 cm × 10 cm), 33 (20 cm × 15 cm), 25 (20 cm × 20 cm) and seedling number/hill: single or double. The subplots included N levels, i.e. 150, 200 and 250 kg/ha. Phosphorus and potash each at 50 kg/ha was commonly adopted. Nitrogen in the form of urea along with K as muriate of potash was split applied equally at basal, tillering, panicle initiation and heading stages. Phosphorus as superphosphate was applied basal. Seedlings of 25 days were planted single or double with varied population as per the treatments. The yield attributes were recorded at harvest, grain yield was assessed at 14% moisture and the straw yield after sun-drying. The benefit : cost ratio (B : C) (net income/cost of cultivation) for each treatment combination was calculated, based on the prevailing market rates (Tables 1 and 2).

RESULTS AND DISCUSSION

Yield attributes

Panicles/m², panicle weight, panicle length, grains/panicle and filled grains/panicle were more owing to adoption of plant population at 50 hills/m². More plants/unit area contributed more panicles/m². In addition, higher photosynthetic area at this population might have enabled greater translocation of photosynthates to the sink and hence improvement in most of the yield attributes. Balasubramanian and Palaniappan (1991) and Shiyas (1992) reported increase in most of the yield attributes with the adoption of 50 hills/m².

The yield attributes did not vary between the number of seedlings/hill.

There was no appreciable change in the yield attributes due to application of higher dose of N above 150 kg/ha. The yield attributes, viz. panicles/m², panicle weight, panicle length and grains/panicle, were similar at 200 and 150 kg N/ha. An appreciable reduction was noticed in important yield attributes like panicles/m², filled grains/panicle at 250 kg N/ha. This might be due to production of higher vegetative parts at the higher dose of N application, resulting in declining trend in yield attributes.

Yield and economics

Among the plant population tested, higher population of 50 hills/m² gave significantly more grain and straw yields than 33 and 25 hills/m², might be owing to cumulative influence of higher plant population on the yield attributes resulting in yield enhancement at 50 hills/m². Influence of higher population on rice yield was reported by Reddy and Reddy (1991) and Valarmathi (1994). The benefit : cost ratio was also higher at 50 hills/m².

Planting of single seedling/hill gave more grain yield, being comparable that of 2 seedlings/hill. The results are in accordance with Shahi *et al.* (1976). Though 2 seedlings/hill gave higher straw yield, it was at par with single seedling/hill. Planting of single seedling enabled higher benefit : cost ratio.

Among the N levels, 200 kg N/ha registered higher grain yield and it was at par with 150 kg N/ha. Application of 250 kg N/ha, however, registered significantly

Table 2. Yield attributes and yield of hybrid 'CORH 2' rice (1997-98)

Treatment	Panicles/ m ²	Panicle weight (g)	Panicle length (cm)	Grains/ panicle	Filled grains/	Sterility (%)	1,000- grain weight (g)	Harvest index (%)	Grain yield (q/ha)	Straw yield (q/ha)	Benefit : cost ratio
<i>Population (hills/m²)</i>											
50	518	3.2	23.7	128.9	112.7	14.2	24.11	47.6	64.35	70.78	2.69
33	468	3.0	22.8	124.3	108.3	14.8	23.68	47.6	62.10	68.38	2.57
25	354	2.9	21.8	119.3	103.7	15.3	23.17	47.5	59.68	65.96	2.45
CD (P = 0.05)	37	0.08	0.8	3.6	3.6	0.4	NS	NS	2.40	2.04	
<i>Seedlings/hill</i>											
Single	457	3.0	22.9	124.7	109.3	14.1	23.84	48.11	62.90	67.68	2.62
Double	436	3.0	22.6	123.6	106.8	15.4	23.46	47.0	61.19	69.06	2.52
CD (P = 0.05)	NS	NS	NS	NS	NS	0.3	NS	NS	NS	NS	
<i>N (kg/ha)</i>											
150	449	3.3	22.8	124.7	109.4	14.1	23.84	48.4	62.18	66.26	2.72
200	487	3.4	23.4	127.5	112.0	14.6	23.65	48.4	63.99	68.12	2.67
250	404	2.5	22.0	120.3	103.3	15.6	23.46	46.0	59.96	70.75	2.32
CD (P = 0.05)	41	0.07	0.7	3.4	3.6	0.3	NS	NS	2.07	2.24	

low yield. The results are in accordance with Valarmathi (1994) and James Martin *et al.* (1996). The straw yield increased at 250 kg N/ha than 150 and 200 kg N/ha. Application of higher dose of N promoted more biomass, resulting in significant increase in straw yield. With respect to B : C ratio, application of 150 kg N/ha was found more remunerative.

The combination of 50 hills/m² with single seedling/hill and 150 kg N/ha gave maximum yield and net returns/ha of hybrid rice, 'CORH 2'.

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