

at panicle initiation. The WS crop received 17 kg P and 33 kg K/ha.

All the treatments received 50-22-42 kg NPK/ha during the DS to study residual effects of N.

All N levels were superior to the control during both seasons (see table).

N at 56 kg/ha equaled 84 kg N/ha; 112 kg N/ha was best during the WS. USG gave the highest yields, 3.3 t/ha in the WS and 2.9 t/ha in the DS. DS yield was low because of a hailstorm at harvest. Residual effect was pronounced

with N levels as well as sources during DS.

Bacterial blight (BB) intensity increased with increasing N, and was higher in the WS than in the DS with respect to levels as well as sources. □

Constraints to rice yields in Punjab, Pakistan

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We analyzed the contribution of various factors to the gap between potential and actual yields in farmers' field trials. The recommended inputs were land preparation by 2 plowings in dry soil and 4 plowings and 2 plankings in standing water, transplanting with 30-d-old seedlings, fertilizer at 110-26 kg NP/ha, plant density of 250,000 hills/ha, 2 kg Zn/ha, insect control using carbofuran (3G) at 16 and

20 kg/ha, and hand weeding at 20 and 30 d after transplanting.

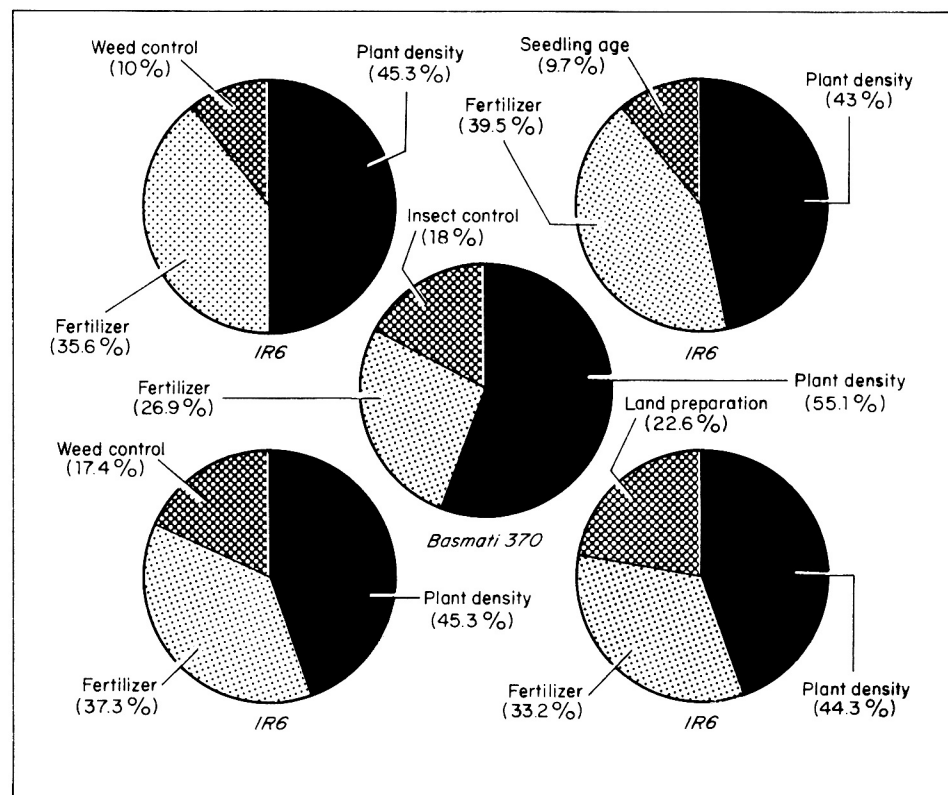
Farmer's inputs were land preparation with 2 plowings and 1 planking in standing water, transplanting with 50-d-old seedlings, plant population of 125,000 hills/ha, fertilizer at 50-13 kg NP/ha, no Zn, no insect and weed control.

The contribution of plant density to the yield gap was 43-45% for IR6 and 55% for Basmati 370 (see figure). The contribution of fertilizer was 33-39.5% for IR6 and 27% for Basmati 370. Other test factors' contributions follow: land preparation for IR6, 22.6%; insect control (for Basmati 370), 18%; weed control, 10-17%; and seedling age (IR6), 9.7%. □

Effect of soil N on rice yield in Punjab

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We conducted 15 experiments in farmers' fields using 0, 50, 100, and 150 kg N/ha as urea, replicated twice. Surface soil samples of Typic Ustochrepts (0-15 cm) collected before transplanting were loamy sand to loam in texture, alkaline (pH 7.4 to 8.8), nonsaline (EC 0.06 to 0.48 dS/m), and low to medium in organic C (0.14 to 0.68%). The mean and range of soil test



Contribution of test factors to yield gap. Punjab, Pakistan.

Table 1. Status of nitrogen in rice growing soils. Punjab, India.

Soil N fraction	N content (µg/g soil)	
	Range	Mean
Total N	392-952	643
Hydrolyzable N	233-699	468
Hydrolyzable amino acid N	60-168	106
Hydrolyzable hexosamine N	14-56	28
Hydrolyzable NH ₄ -N	42-140	94
Nonhydrolyzable N	112-309	220

Table 2. Relationships of soil N fractions with yield and N uptake by rice. Punjab, India.

Soil N fraction	Relative yield	Relative N uptake
Total N	0.54*	0.68**
Hydrolyzable N	0.52*	0.66**
Hydrolyzable amino acid N	0.43	0.60*
Hydrolyzable hexosamine N	0.61*	0.60*
Hydrolyzable NH ₄ -N	0.64**	0.72**
Nonhydrolyzable N	0.55*	0.67**

^a Significance at the 5% (*) and 1% (**) levels.

$$\text{Relative yield/relative uptake} = \frac{\text{Yield or uptake without N}}{\text{Maximum yield or uptake with N}} \times 100.$$