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AGRONOMY AND AGRICULTURAL ECONOMICS

High Yielding Varieties of Rice in Tamil Nadu — Their Response to Nitrogen and Spacing

by

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Introduction: The yields of rice in India have been proverbially low when compared to those obtained in other countries. This can be attributed to the lack of varieties which respond to high levels of nitrogenous fertilizers and resist lodging. Many of the popular varieties of paddy are weak-strawed and they either do not respond in terms of increased grain yield to added nitrogen or respond only to modest levels. One of the possible ways to increase the paddy yields is to grow high yielding and higher fertilizer responsive varieties, besides adopting better agronomical practices.

Review of Literature: Several workers have reported different responses for different varieties at varying levels of nitrogen. Ramiah (1954) reported that by giving 60–100 lb N/acre, rice production can be increased. Some of the dwarf *indica* and Taiwanese *japonica* varieties even under tropical conditions respond upto 130 kg N/ha and yield as high as 8000 kg/ha (Richaria *et al.*, 1965). The yield of rice in tropics can be increased substantially by growing early maturing, short-statured, moderate tillering varieties (Beachell and Jennings, 1964). At Hyderabad, HR 67 and ADT 27 have responded up to 200 kg N/ha (Anon, 1967). Variable results have been obtained in the spacing trial conducted with paddy crop in different localities and it is reported that the optimum spacing of paddy in a locality is determined largely by the variety, its duration and nature of the soil. A spacing of 12"×6" has been recommended for varieties susceptible to lodging and 6"×6" for others (Samad and Vijayan, 1956). Sahu and Lenka (1966) have reported that a spacing of 20×20 cm was superior to both closer spacing of 15×15 cm and wider spacing of 25×25 cm.

Materials and Methods: Field trials with IR 8, Tainan 3 and CO 32 during 1967 *Kharif* and IR 8, Tainan 3 and ADT 27 during 1967 and 1968 *Rabi* were conducted in split plot design. Three spacings and five levels of N in 1967 *Rabi* season and six levels of N and same spacings in 1967 *Kharif* and 1968 *Rabi* season were tried. The spacings adopted were 20×5 cm, 20×10 cm and 20×15 cm. The N levels were0, 40, 80, 120, 160 and 200 kg/ha; P_2O_5 and K_2O at 50 kg/ha in the first season and at 80 kg/ha in the latter two

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seasons, were applied uniformly to all plots before planting. The nitrogen was applied in two doses, 75% at planting and 25% at floral initiation. Variety cum spacing was taken as main plot treatments while N levels as sub plot treatments. Planting was done at two seedlings per hole. Ancillary characters like height, tiller, panicle length, number of grain and chaff were recorded besides taking the grain and straw yield. Data on yield of grain and straw were analysed statistically, response curve fitted and economics worked out.

Results and discussion: The results revealed that varieties IR 8 and Tainan 3 responded up to the maximum level of N tried (200 kg N/ha) in all the three spacings in both the seasons. In ADT 27 the yield increased with higher levels of N up to 160 kg/ha. Strain CO 32 responded only upto 120 kg N/ha and the yield got reduced under 160 kg and 200 kg N levels. A spacing of 20×10 cm was found significantly superior to 20×5 cm and 20×15 cm under 40, 80, 120, 160 and 200 kg N levels in IR 8 and Tainan 3 and 80, 120, 160 and 200 kg N in CO 32 and 80, 120 and 200 kg N in ADT 27. There was no significant difference in yield among the spacings under 40 kg N in ADT 27 and CO 32 and under 160 kg N, 20×10 cm and 20×15 cm yielded on par in ADT 27. The summary of results is given in Table 1

TABLE 1. *Grain yield (kg/ha)*

Nitrogen levels in kg/ha	Varieties—yield in kg/ha—(S1=20×5 cm, S2=20×10 cm, S3=20×15 cm)											
	IR. 8 (CD=189)			Tainan 3 (CD=189)			ADT. 27 (CD=189)			CO. 32 (CD=138)		
0	2946 S1	2748 S2	2629 S3	3095 S2	2768 S3	2589 S1	3383 S1	3234 S2	3115 S3	2692 S1	2551 S2	2251 S3
40	4226 S2	3988 S1	3770 S3	4881 S2	4375 S1	3552 S3	4117 S2	3929 S1	3819 S3	3592 S2	3541 S3	3538 S1
80	5069 S2	4712 S3	4564 S1	5427 S2	4980 S1	4246 S3	4484 S2	4206 S3	4186 S1	4902 S2	4455 S3	4301 S1
120	5685 S2	5367 S1	5129 S3	5635 S2	5486 S1	4702 S3	4762 S2	4563 S3	4365 S1	5041 S2	4643 S3	4222 S1
160	6389 S2	5982 S3	5764 S1	6230 S2	5754 S1	5040 S3	4891 S2	4742 S3	4504 S1	4831 S2	4552 S3	4191 S1
200	7183 S2	6667 S3	6071 S1	6607 S2	5853 S1	5476 S3	4593 S2	4365 S3	4117 S1	4630 S2	4352 S3	4103 S1

Response curves were fitted to grain yield data taking the mean yield for all the three spacings. The curves were quadratic in nature for all the four varieties. The fitted curves are as follows :

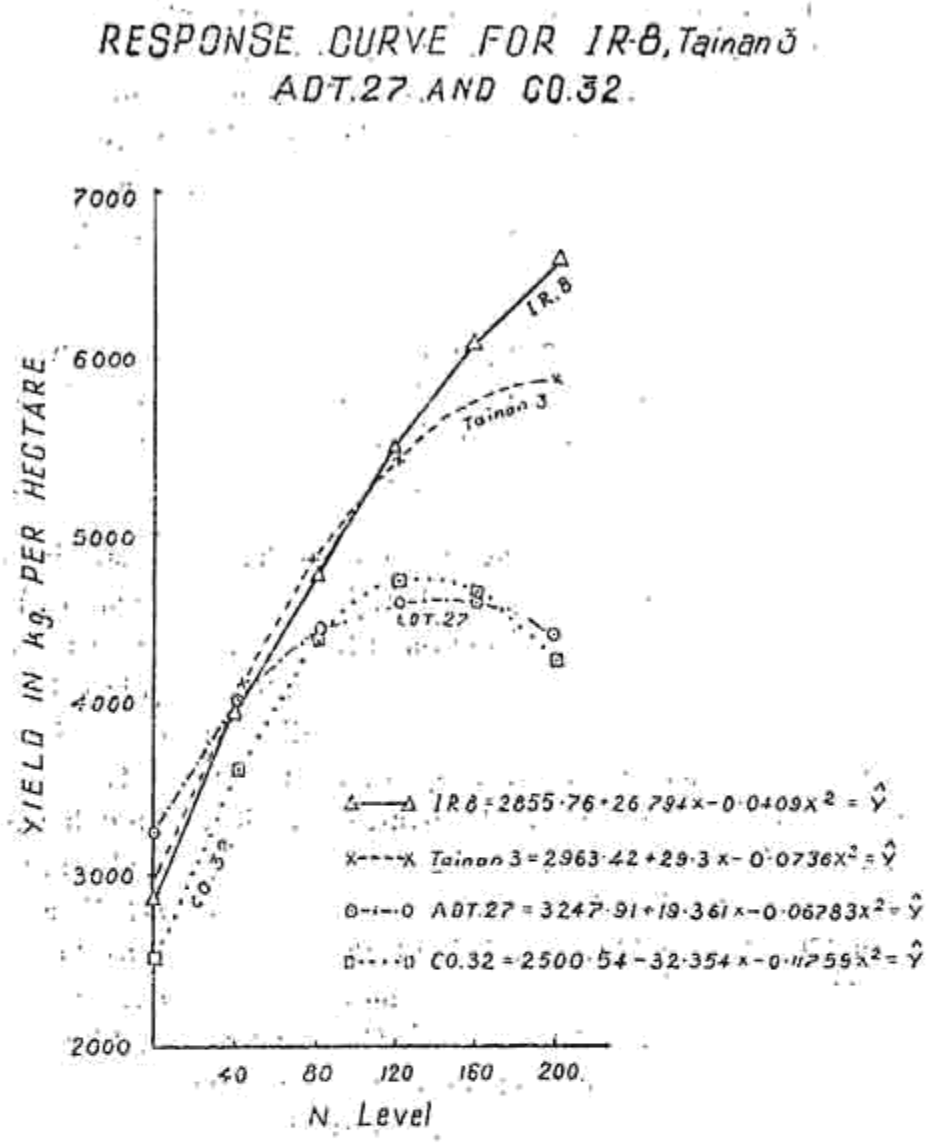
IR 8 $\hat{Y} = 2855.76 + 26.794\ X - 0.0409\ X^2$

Tainan 3 $\hat{Y} = 2963.42 + 29.3\ X - 0.0736\ X^2$ *RABI* SEASON

ADT 27 $\hat{Y} = 3247.91 + 19.361\ X - 0.06783\ X^2$

CO 32 $\hat{Y} = 2500.54 + 32.354\ X - 0.11759\ X^2$ *KHARIF* SEASON

where $\hat{Y}$ = estimated grain yield in kg per hectare and X = nitrogen level



Economics: The total dry matter produced and the additional income worked out over the control, deducting the cost of fertilizer are presented in Table 2.

TABLE 2. *Economics of cultivation*

Nitrogen levels (kg/ha)	0N	40 N		80 N		120 N		160 N		200 N	
	A kg	A kg	B Rs.	A kg	B Rs.	A kg	B Rs.	A kg	B Rs.	A kg	B Rs.
IR. 8	5561	8412	604	10535	1043	12011	1356	13781	1605	14815	1884
Tainan-3	6227	9606	739	11324	1071	12803	1324	13837	1540	14654	1639
ADT. 27	7401	9434	413	11032	582	11905	687	12638	712	13006	539
CO. 32	6718	10371	547	13872	1208	15479	1281	17840	1222	18527	991

N.B.: A=Total dry matter (kg/ha.) B=Value of additional produce (Rs.)

There was a progressive increase in the total dry matter with additional doses of N in all the varieties. In the case of IR 8 and Tainan-3, the

additional income obtained with higher levels of N was also in the progressive side. But in ADT 27 and CO 32, the additional income declined beyond 160 kg N and 120 kg N respectively. In ADT 27, though there was a slight increase in the additional income from application of N at 120 to 160 kg/ha, the difference was insignificant (Rs. 25 only). Again between 80 and 120 kg N, the difference in additional income was Rs. 105 in ADT 27 and Rs. 72 in CO. 32.

The increased yield for every kg of added N over 40 N was in the order of 23 kg under 80 N, 20 kg under 120 N, 19 kg under 160 N and 18 kg under 200 N in IR 8, 21 kg, 19 kg, 16 kg, 14 kg in Tainan-3, 9 kg, 8 kg, 6 kg and 3 kg in ADT 27 and 33 kg, 18 kg, 10 kg and 7 kg respectively in CO 32.

The study on ancillary characters showed that wider spacing reduced the height of plant in all the varieties, 14.0 cm in IR. 8, 8.0 cm in Tainan-3, 9 cm in CO 32 and ADT 27. Addition on N from 0 to 200 kg/ha was found to increase the height of plant by 31 to 34 cm, number of tillers by 3 to 6, weight of 1000 grains by 0.8 gm to 2.6 g in all varieties. The sterility percentage was also found to increase by increasing the levels of N. Wider spacing and addition of N increased the panicle length, and number of grains per panicle in all the varieties. IR. 8 and Tainan-3 did not lodge at any stage under the different levels of N and spacings whereas ADT 27 and CO 32 lodged under 120, 160 and 200 N levels in all the spacings, 16 to 20 days after flowering. The intensity of lodging was more in closer spacing. The grain straw ratio worked out to 1:1 to 1:1.3 for IR. 8 and Tainan 3 irrespective of the difference in levels of N and spacings given. In ADT 27 and CO 32 the straw yield was found increasing significantly with additional N under all spacings, the ratio being 1:1.3 to 1:1.5. The yield of straw was highest under closer spacing with the maximum level of N by all these strains.

Summary and conclusion: Four varieties viz., IR 8, Tainan-3, ADT 27 and CO 32 were studied for their optimum spacing and nitrogen requirement. The results revealed that a spacing of 20 cm between rows and 10 cm between plants was the best for all the varieties. The optimum dose of N for IR 8 and Tainan-3 can be fixed as 160 kg N/ha. The increased yield of grain per kg of added N in CO. 32 was found to be 33 kg, 18 kg, 10 kg and 7 kg under 80 N, 120 N, 160 N and 200 N levels respectively. Therefore the most economical and optimum level of N for CO 32 strain is 80 kg/ha. The results also help to fix the optimum N level for ADT 27 as 80 kg/ha as the increased yield of grain per kg of added N got reduced from 9 kg under 80 N to 3 kg under 200 N. It was also found that CO 32 and ADT 27 lodged under 120, 160 and 200 N levels in all spacings at dough stage. Hence it is not advisable to give N beyond 80 kg level for the above varieties.

From the economics worked out for additional income it was found that there was a progressive increase in the total dry matter produced with additional application of N in all the varieties. The additional income obtained with higher levels of N was also in the progressive side in IR 8, Tainan-3. But in CO 32 and ADT 27 the additional income beyond 120 was insignificant and between 80 and 120 N the difference was very little.

The data on ancillary characters showed that wider spacing reduced the plant height in all the four varieties. But addition of N was found to increase the plant height and number of tillers and weight of 1000 grains, and percentage of sterility. The panicle length and number of grains per panicle got increased by wider spacing and higher levels of N in all the varieties. It was also found that closer spacing hastened flowering by 2 to 4 days. This study in general have revealed the optimum spacing and N level for the four varieties IR 8, Tainan-3, ADT 27 and CO 32 as 20 cm × 10 cm and 160 kg N/ha for IR 8 and Tainan-3 and 80 kg N/ha for ADT 27 and CO 32.

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REFERENCES

Anonymous. 1967. AICRIP Progress Report *Rabi* 1967.

Beachell, H. M. and P. R. Jennings. 1964. Breeding Rice for Nitrogen Responsiveness. *I.R.C. News letter*, **13**: 31–9.

Mahapatra, I. C. and C. R. Padalia. 1964. Date of planting × Nitrogen × variety × spacing. *Agric. Res.*, **4**: 19.

Ramiah, K. 1954. Fertilizer use for increased production. *I.R.C. News letter*, **10**.

Richaria, R. H., S. Patnaik, and M. S. Chowdry. 1965. High Yield of Taiwan varieties through intensive manuring. *Fert. News*, **10**: 118–21.

Sahu, B. N. and D. Lenka. 1966. Cultural cum Manurial trials on Paddy. *Indian J. Agron.* **11**: 127–37.

Samad, A. and P. K. Vijayan. 1956. Agronomic practices contributing high yields in Rice *Madras agric J.*, **43**: 600–7.