

Response of Japonica and Indica Hybrid cultures of Rice to Nitrogen Manuring*

by

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Synopsis: The results of an experiment laid out to study the differential behaviour of three promising cultures of rice in comparison with their indica parent during 1961—1962 main season in the Agricultural College wet lands are presented in this paper.

Scientific manuring, particularly with nitrogenous fertilizers, is the surest means of increasing the yield of paddy in our country. Large scale experiments all over the country with increasing doses of nitrogen, have however established, that to get economically high yields to the level of other rice growing countries like Japan, the yield potential of our existing strains have to be improved. A hybridisation project with japonica types noted for their yield potential was therefore, initiated by the Food and Agricultural Organization of United Nations. The hybrid seeds so obtained were distributed to the important rice growing countries and states in India to test their adaptability and performance. Preliminary studies in Madras, Bombay and Hyderabad indicated that some of the hybrid cultures are capable of giving increased yields ranging from 3 to 25 per cent over their indica parent; but definite information as to their fertility requirement to exhibit their full yield potential is not however, available. An experiment was therefore, laid out to study the differential behaviour of three promising cultures in comparison with their indica parent in the Agricultural College wet lands at Coimbatore during 1961—'62 main season and the results obtained are presented in this paper.

Review of Literature: Systematic experiments were conducted to study the response of rice to graded doses of nitrogenous fertilizers at the important Rice Research Stations. Mithra and Guptha (1950) while working out the economics of manuring, have reported an average response of 11.4 lb. of grain per lb. of nitrogen at 30 lb. level. Ramiah *et al* (1952) stated that in India, on an average, an increased yield of 300 to 500 lb. grain was obtained from an acre when 20 to 30 lb. of nitrogen was added as top dressing. In an agronomical experiment conducted at Aduthurai during

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1954—'55, a response of 6.8 lb. and 4.8 lb. grain per lb. of nitrogen were recorded at 20 lb. and 40 lb. nitrogen levels respectively (Mariakulandai 1957). Parthasarathy (1953) recorded that in India, on an average with 20 to 40 lb. of nitrogen per acre, response of 15 lb. grain per lb. of nitrogen was obtained while with higher doses ranging from 50 lb. to 80 lb. nitrogen the response was as low as 10 lb. of grain and below. Ghose *et al* (1956) found that the rate of response varied considerably from place to place at different levels of nitrogen.

Narasinga Rao (1952) observed that 30 lb. nitrogen in the form of Ammonium sulphate gave economic return in Madras State. After reviewing the manurial experiments conducted in Madras State, Mariakulandai (*loc cit.*) recommended 30 lb. nitrogen per acre as top dressing for paddy. Digar (1958) observed 30 lb. nitrogen as economical dose in West Bengal as increased dose beyond 30 lb. level did not increase paddy significantly.

Narasinga Rao (*loc cit.*) stated that under normal conditions paddy varieties did not show any differential response to manure doses; but in years of insufficient rainfall certain varieties showed better response than others. Ramiah (1954) recorded that certain coarse varieties of indica responded to fertilizer application better than fine rice varieties. Negi and Gurucharan (1956) concluded that *Johna 349* and *Basumathi 370* exhibited differential response to manuring. Pot culture experiment conducted by Tanaka *et al* (1959) revealed that response of P. T. B. 10 was maximum at 20 ppm. nitrogen level, while japonica variety, *Akioku* showed a linear response upto 150 ppm. level.

Nobru Yamada (1959) recorded that variety *Murungakayan 302* did not respond to fertilizer application, but out-yielded all the other varieties under no manure condition. The hybrid culture H. 4, on the other hand, responded poorly to low fertility levels but expressed its high yield potential at heavy levels of fertilization.

From the foregoing it is evident that response of rice to nitrogen application beyond 30 to 45 lb. level of nitrogen is uneconomical. Few varieties respond differently to fertilizer application.

Materials and Methods: The three promising hybrid cultures obtained as a result of crossing between the indica type, G. E. B. 24 and the japonica types and the parent G.E.B. 24 were included in the experiment. The experiment was laid out in strip plot design and different fertility levels were brought about by the application of graded doses of Ammonium sulphate to supply 0 to 120 lb. nitrogen over the recommended basal dose of 5,000 lb. green leaf and 30 lb. P_2O_5 per acre.

Results: The analysis of the grain and straw yield data indicated that manurial effect and varietal differences were statistically significant for both grain and straw yields, while interaction effect came out significant only in respect of grain yield.

Grain Yield: (a) Due to Varieties:

| Varieties | Grain yields in lb./acre (Mean) | SE of Mean | C. D. at 0.05 |
|-------------------|---------------------------------------|---------------|------------------|
| GEB. 24 (V_1) | 3040 | | |
| 30879 (V_2) | 4110 | 193.6 | 579.3 |
| 30859 (V_3) | 3601 | | |
| 30787 (V_4) | 3273 | | |

$$\overline{V_2 \quad V_3 \quad V_4 \quad V_1}$$

The comparison of yields of the hybrid cultures and the parent GEB. 24 has shown that the culture 30879 was significantly superior in yield over its indica parent. The yield of 30859 and GEB. 24 were however on a par.

(b) Due to Nitrogen:

| Manure level | Yield per acre | SE of Mean | C. D. at 0.05 |
|--------------|----------------|------------|---------------|
| $-N_0$ | 2427 | 144 | 436.7 |
| N_{30} | 3699 | | |
| N_{60} | 3888 | | |
| N_{80} | 3563 | | |
| N_{120} | 3656 | | |

$$\overline{N_{60} \quad N_{30} \quad N_{120} \quad N_{80} \quad N_0}$$

The overall comparison of the effect of different levels of nitrogen distributed over all the varieties indicated that the application of nitrogen significantly increased yields over no nitrogen. But among nitrogen levels there was no significant difference in yield.

(c) Interaction between the treatments (Varieties and manures,

| Manurial level | Acre yield of varieties in lb. at different levels of nitrogen | | | | SE of different levels of N at the same variety | C. D. at 0.05 levels |
|------------------|--|----------------|----------------|----------------|---|----------------------|
| | GEB. 24 | 30879 | 30858 | 30789 | | |
| | V ₁ | V ₂ | V ₃ | V ₄ | | |
| N ₀ | 2803 | 2842 | 2673 | 2577 | | |
| N ₃₀ | 3479 | 4099 | 3717 | 3520 | | |
| N ₆₀ | 3402 | 4263 | 4223 | 3791 | 371.4 | 760 |
| N ₉₀ | 2880 | 4472 | 3576 | 3453 | | |
| N ₁₂₀ | 2698 | 4878 | 3971 | 3137 | | |

S. E. of difference of any two varieties at the same level of N. 402.8

C. D. at 5 per cent level 835.6

Conclusions :

| | | | | | |
|----------------|-----|-----|----|-----|-----|
| V ₁ | 30 | 60 | 90 | 0 | 120 |
| V ₂ | 120 | 90 | 60 | 30 | 0 |
| V ₃ | 60 | 120 | 30 | 90 | 0 |
| V ₄ | 60 | 30 | 90 | 120 | 0 |

Levels of Nitrogen (in lb.)

| | | | | |
|-----|----------------|----------------|----------------|----------------|
| 0 | V ₂ | V ₁ | V ₃ | V ₄ |
| 30 | V ₂ | V ₃ | V ₄ | V ₁ |
| 60 | V ₂ | V ₃ | V ₄ | V ₁ |
| 90 | V ₂ | V ₄ | V ₃ | V ₁ |
| 120 | V ₂ | V ₃ | V ₄ | V ₁ |

From the mean grain yield of different varieties at different levels of nitrogen, it is evident that responses of the varieties to nitrogen application are not uniform. GEB. 24 exhibited no response to nitrogen application. On the other hand, Culture 30879 responded to every successive additional dose of nitrogen. Cultures 30859 and 30787 have shown responses but they are not consistent.

Varietal comparison at each level of nitrogen indicated that at lower levels of nitrogen i. e. 0, 30 lb. there was no significant difference between the varieties. At 60 lb. level the culture 30879 was only superior to GEB. 24, but at 90 and 120 lb. levels the culture out-yielded all the rest of the varieties.

Straw Yield: (a) *Due to Varieties* :

| Varieties | V ₁ | V ₂ | V ₃ | V ₄ |
|-------------------------------|----------------|----------------|----------------|----------------|
| Mean straw yields/plot in lb. | 28.00 | 23.84 | 26.08 | 23.08 |
| S. E. of Mean | 1.09 | | | |
| C. D. at 5% level | 3.53 | | | |

Conclusion: $\overline{V_1 V_3} \overline{V_2 V_4}$

Among the four varieties GEB 24 gave significantly increased straw yields than cultures 30879. There were no significant differences in straw yields between the cultures.

(b) *Due to manure* :

| Manure | N ₀ | N ₃₀ | N ₆₀ | N ₉₀ | N ₁₂₀ |
|----------------------------|-----------------|-----------------|-----------------|-----------------|------------------|
| Mean straw yield/plot (lb) | 16.33 | 21.85 | 26.23 | 28.08 | 33.78 |
| S. E. of Mean | 0.73 | | | | |
| C. D. at 5% level | 2.19 | | | | |
| Conclusion: | N ₃₀ | N ₉₀ | N ₆₀ | N ₃₀ | N ₀ |

Comparing the straw yield at different nitrogen levels, it was found that there was positive significant increase in straw yield for every successive increase of nitrogen.

Discussion and Conclusion : The results of the study indicate that the cultures in general registered higher yields than their indica parent, GEB. 24. The better performance of the culture 30879 indicates that the japonica parent has contributed to the increase of yield potential of the indica types. Pawar *et al* (1954) and Parthasarathy (1954) have also recorded superiority of other japonica x indica hybrids over their indica parents.

The varietal difference in response of the hybrids at high fertility levels leads to the conclusion that maximum yield potential of the hybrids will be expressed only when favourable soil conditions are provided and a variety has to be tested under varying fertility conditions before ascertaining its superiority.

GEB. 24 did not respond to the application of nitrogen and even exhibited a tendency for negative though not significant response at highest doses. The culture 30879 on the other hand, continued to respond to every successive doses of manure and registered significantly higher yield over all the other varieties tried at 120 lb. nitrogen level. The consistent high response of the variety at high dose of manures may be due to the fact

that this variety combines in itself the high efficiency of japonicas type at high fertility levels and the adaptability of indica parents. The japonica types, therefore, offer great scope for introducing the high yield potential under heavy doses of nitrogen into indica types cultivated in India and other tropical regions.

TABLE I

The rate of different varieties at different levels of Nitrogen/lb.

| Levels of Nitrogen | Grain yield per lb. of Nitrogen: | | | |
|--------------------|----------------------------------|------|------|------|
| | V1 | V2 | V3 | V4 |
| 30 | 22.5 | 41.6 | 32.1 | 31.4 |
| 60 | 9.8 | 23.6 | 24.5 | 20.2 |
| 90 | 0.8 | 18.0 | 8.6 | 9.7 |
| 120 | (-) 0.87 | 16.9 | 10.1 | 4.6 |

At all fertility levels, maximum responses per lb. of nitrogen were recorded by the culture 30879 and minimum by GEB. 24. Even at as high a level as 120 lb. N, this culture yielded an economical response of 16.9 lb. of grain per lb. nitrogen against - 0.87 lb. grain registered by GEB. 24.

TABLE II

Economics of growing these cultures under different fertility levels

| Manures level | Profit per acre of different varieties. | | | |
|---------------|---|--------|--------|--------|
| | V1 | V2 | V3 | V4 |
| 0 | 201.95 | 196.17 | 197.90 | 159.63 |
| 30 | 302.75 | 372.05 | 325.30 | 282.60 |
| 60 | 270.50 | 379.80 | 385.95 | 311.85 |
| 90 | 171.80 | 395.45 | 255.10 | 240.15 |
| 120 | 129.20 | 446.65 | 307.05 | 17.60 |

Economics of manuring of this variety (culture 30879) also indicate that it is profitable to manure this culture at all nitrogen levels. At 120 lb. level, it recorded a profit of Rs. 446.62 per acre which has not been obtained for any of the culture at any level of nitrogen. This confirms the view of Parthasarathy (*loc cit.*) and Ghose *et al* (*loc cit.*) that with intensive cultivation and increased use of fertilizers emphasis should be on the varieties which are not only high yielding but also responsive to heavy fertilization.

Summary: The study has revealed that the japonica x indica hybrid cultures are not only high yielding but also respond well to heavy fertilization. The culture 30879 has registered as high a yield as 5000 lb. per acre.

The culture has registered an economic response of 16.9 lb. of grain per lb. of N even at 120 lb. nitrogen per acre.

Due to their comparative short stature and thick culms the japonica x indica cultures are non-lodging and are capable of responding to heavy doses of manures. The cultures tried, however, require varying fertility levels to express their full yield potential.

The study also brought out the possibility of utilizing japonicas to introduce the high yield potentiality under heavy manured condition into indica type cultivated in India and other tropical regions and testing a variety under a wide range of fertility levels to ascertain its superiority.

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