# Effect of N-fertilization on rice quality characteristics

**Paroussis E., Ntanos D.**

*in*

**Mourzelas M. (ed.).**
**Qualité et compétitivité des riz européens**

**Montpellier : CIHEAM**
**Cahiers Options Méditerranéennes; n. 15(4)**

**1995**
pages 137-140

# Effect of N-fertilization on rice quality characteristics

**E. Paroussis**, NAGREF, Soil Science Institute of Thessaloniki (Greece)
**D. Ntanos**, NAGREF, Cereal Institute (Greece)

**Abstract.** The effect of N-fertilization on yield, total milling yield, vitreosity, grain length and grain ratio of the length/width of the rice varieties Strymonas, Roxani and Ispaniki A was investigated in 1989–90. Nitrogen was used in 0, 40, 80, 120, 160 and 200 kg/ha. There was a significant influence of nitrogen on the yield (rough rice). There was a tendency of increase (not significant) of the total milling yield. Vitreosity was improved at the levels of 80 and 120 kg/ha of nitrogen. The lodging of the stems that was higher at higher nitrogen levels might also have influenced the vitreosity. The grain length was greater at higher nitrogen levels but grain ratio length/width was smaller.

## Introduction

Fertilization is one of the most complicated problems in rice cultivation that requires updating research for new varieties developed. Those varieties are highly productive, mainly short stem varieties and demanding large quantities of nutrients.

Most researchers consider the N-fertilization of primary importance. It is thus more essential to estimate nitrogen requirements than phosphorus and potassium needs (Atanasiu and Samy, 1983). The new varieties dit not react to the last elements used in the experimental station of Kalochori-Thessaloniki where rice research and seed production are carried out (Boudonas and Karagiannis, 1966).

Excess of N-fertilizer for each variety is of great importance because it endangers the development of *Pyricularia oryzae* (Nagai, 1962).

Varieties reacting to high N-fertilization develop shorter internode distance compared to the non reacting to Nitrogen varieties (Chandler, 1969), while, there was a negative correlation between production and height of plants (IRRI, 1967).

High levels of N-fertilizer increase the number of stems (IRRI, 1967) positively correlated to the production, while there is doubt if production in the mill is influenced significantly (Giamoustaris and Ntanos, 1991).

## I – Materials and methods

The experiment was established in the experimental station in Kalochori-Thessaloniki for the years 1989–90. A complete randomized split-plot design was used. Six nitrogen levels in four replications were used as follows:

| Total fertilizer | On seeding | 35 days after seeding |
|---|---|---|
| 0 kg N/hja | 00 kg N/ha | 0 kg N/ha |
| 40 >> | 10 >> | 30 >> |
| 80 >> | 50 >> | 30 >> |
| 120 >> | 90 >> | 30 >> |
| 160 >> | 130 >> | 30 >> |
| 200 >> | 170 >> | 30 >> |

with a basic fertilization of 40 kg/ha $P_2 0_5$ and 80 kg/ha $K_2 0$; with the exception of the control, ammonium sulfate was used. Each experimental plot was 4 m x 5 m = 20 $m^2$.

Each year the experimental plots were established on a new place where barley has been cultivated the previous year. The soil used had the following characteristics. It was a soil with pH 7.5, organic matter 1.6%, 17.9 $P_2O_5$ (Olsen) and 12.7 $K_2O$ mg/100 g soil. The water table was at 1.10 m depth in May when the soil samples were taken, while during the growing season it reached the soil surface. Seeding was done by spreading by hand between 15th–20th May. The varieties used were Strymonas, Roxani Ispaniki A. The seeds were wet for 24 hours before seeding. Irrigation started at seeding and continued for 10 days before harvesting. Irrigation was continuous, except for two days before adding fertilizer when the water was taken out in order to favour tillering. The water level was kept at 5–10 cm. Herbicide molinate was used 12 days after seeding.

The harvest was carried out between 20th–30th October. That was done by sickle and two days later the yield was ground. The grain moisture content was measured after harvesting while yield was estimated for a moisture content of 14%. The total milling yield was estimated using 100 g samples of rice. The percentage of lodged plants was estimated. The vitreosity percentage was estimated on 30 seeds of each treatment randomly taken considering seeds with the smallest spot as chalky. On those seeds the grain length and width were measured and the grain ratio length/width was estimated.

## II – Results and discussion

The rice yield, total milling yield and marketable yield are shown in *Tables 1, 2* and *3*, respectively. All the varieties responded to N-fertilization. The Strymonas and Ispanki A varieties increased the yield significantly until the 16 kg N-fertilizer treatment; the Roxani variety until the 120 kg N-fertilizer treatment. Yield was significantly higher in 1989 on account of the drought in 1990. All three varieties showed significant differences on the yield. Ispaniki A was the best (7,310 kg/ha) followed by Strymonas (4,950 kg/ha) *(Table 1)*.

The total milling yield percentage did not show significant differences affected by the number of years or fertilizer treatment. There was only a significant difference between Strymonas and Roxani *(Table 2)*. Although fertilizer treatments did improve the percentage of total milling yield, there is a tendency of increase. That becomes significant when multiplied by "the increased by N-fertilizer treatments yield" to estimate the marketable yield *(Table 3)*. The latter showed the same significance pattern as the yield.

The lodging of the plants before ripening was significantly higher at the higher N-fertilizer treatments for every year and for all the varieties *(Table 4)*.

Vitreosity showed the highest percentage at 80 and 120 kg/ha N-fertilizer treatments considering both the number of years and the different varieties. Although that may lead to the conclusion that higher N-fertilization deteriorates vitreosity, it may be an indirect effect due to the greater lodging of the stems *(Table 5)*.

The grain length was significantly different according to years and varieties *(Table 6)*. Grain length was greater at the three higher N-fertilizer treatments. The grain ratio length/width was also different according to years and varieties *(Table 7)*. The N-fertilizer treatments affected significantly the ratio. Yet, it was lower at higher fertilizer levels due to greater increase of the width. Although higher N-fertilizer levels seem to have increased grain length and decreased the grain ratio length/width, we suggest further investigation of factors as the lodging of the plants and higher N-fertilizer levels in combination with other nutrients.

### References


• **Atanasiu, N. and J. Samy** (1983). *Rice effective use of Fertilizers.* Centre d'Etude de l'Azote, Zyrich, p.88.

• **Boudonas, G. and J. Karagiannis** (1966). Interaction of rice varieties and N-fertilizers. *Scientific Issue* No. 15. Cereal Institute of Greece.

- **Chandler, R.F.** (1969). In: Physiological aspects of crop yield. *Am. Soc. Agron.*, 265, 285.
- **Giamoustaris, G. and D. Ntanos** (1991). Effect of several Nitrogen levels on grain production and other rice characteristics (*Oryza sativa L).* Proceedings of the Panhellenic Meeting of Agricultural Research.
- **International Rice Research Institute** (1967). Annual report, Los Baños, Philippines, pp. 152-156.
- **Nagai, I.** (1962). Japonica rice: its breeding and culture, Yokando Ltd., Tokyo, pp. 722-732.


**Table 1. Effect of N-fertilizer on the yield (in kg/ha and moisture 14%) of the varieties Strymonas, Roxani and Ispaniki A in 1989–1990**

| N-fert. (Kg/ha) | Yield (kg/ha) | | | | | |
|---|---|---|---|---|---|---|
| | | Varieties | | | Years | |
| | Mean | Strymonas | Roxani | Ispaniki A | 1989 | 1990 |
| 0 | 3640 e | 3310 j | 3130 j | 4500 h | 4000 f | 3290 g |
| 40 | 4500 d | 3930 i | 2470 j | 6100 de | 4890 e | 4110 f |
| 80 | 5650 c | 4300 h | 4960 g | 7700 c | 6310 c | 5000 e |
| 120 | 6480 b | 5490 f | 5860 e | 8080 b | 6960 b | 5990 d |
| 160 | 6940 a | 6240 d | 5870 e | 8730 a | 7440 a | 6450 c |
| 200 | 6770 a | 6430 d | 5110 g | 8780 a | 7120 b | 6420 c |
| Mean | | 4950 b | 4730 c | 7310 a | 6120 a | 5210 b |

**Table 2. Effect of N-fertilizer on the total milling yield of the varieties Strymonas, Roxani and Ispaniki A in 1989–1990**

| N-fert. (Kg/ha) | Total milling yield (%) | | | | | |
|---|---|---|---|---|---|---|
| | | Varieties | | | Years | |
| | Mean | Strymonas | Roxani | Ispaniki A | 1989 | 1990 |
| 0 | 68.6 | 67.3 | 70.1 | 68.3 | 68.6 | 68.5 |
| 40 | 68.5 | 67.0 | 70.4 | 68.2 | 68.5 | 68.5 |
| 80 | 69.4 | 67.3 | 71.4 | 69.3 | 69.2 | 69.5 |
| 120 | 69.5 | 67.7 | 71.3 | 69.6 | 69.7 | 69.3 |
| 160 | 69.4 | 68.1 | 70.7 | 69.3 | 70.0 | 68.7 |
| 200 | 70.6 | 68.0 | 73.8 | 70.1 | 72.3 | 68.9 |
| Mean | | 67.6 b | 71.3 a | 69.1 ab | 69.7 | 68.9 |

**Table 3. Effect of N-fertilizer on the total milling yield of the varieties Strymonas, Roxani and Ispaniki A in 1989–1990**

| N-fert. (Kg/ha) | Yield (kg/ha) | | | | | |
|---|---|---|---|---|---|---|
| | | Varieties | | | Years | |
| | Mean | Strymonas | Roxani | Ispaniki A | 1989 | 1990 |
| 0 | 2500 e | 2230 j | 2190 j | 3080 h | 2740 f | 2260 f |
| 40 | 3080 d | 2640 i | 2440 j | 4160 de | 3340 de | 2820 ef |
| 80 | 3930 c | 2900 h | 3540 g | 5330 c | 4350 bc | 3500 d |
| 120 | 4510 b | 3730 f | 4180 e | 5620 b | 4850 ab | 4170 c |
| 160 | 4820 a | 4250 d | 4150 e | 6060 a | 5210 a | 4430 bc |
| 200 | 4860 a | 4370 d | 3820 g | 6380 a | 5210 a | 4500 bc |
| Mean | | 3350 b | 3390 b | 5100 a | 4280 a | 3610 b |

**Table 4. Effect of N-fertilizer on lodging % of the varieties Strymonas, Roxani and Ispaniki A in 1989–1990**

| N-fert. (Kg/ha) | Lodging (%) | | | | | |
|---|---|---|---|---|---|---|
| | | Varieties | | | Years | |
| | Mean | Strymonas | Roxani | Ispaniki A | 1989 | 1990 |
| 0 | 0 d | 0 h | 0 h | 0 h | 0 f | 0 f |
| 40 | 0 d | 0 h | 0 h | 0 h | 0 f | 0 f |
| 80 | 3 c | 6 g | 0 h | 3 gh | 6 e | 0 f |
| 120 | 17 b | 18 de | 16 ef | 17 ef | 21 c | 12 d |
| 160 | 26 a | 32 b | 20 d | 26 c | 32 a | 20 c |
| 200 | 25 a | 36 a | 14 f | 25 c | 28 b | 22 c |
| Mean | | 15 a | 8 c | 12 b | 15 | 19 |

**Table 5. Effect of N-fertilizer on vitreosity % of the varieties Strymonas, Roxani and Ispaniki A in 1989–1990**

| N-fert. (Kg/ha) | Vitreosity (%) | | | | | |
|---|---|---|---|---|---|---|
| | | Varieties | | | Years | |
| | Mean | Strymonas | Roxani | Ispaniki A | 1989 | 1990 |
| 0 | 46 c | 44 h | 7 k | 87 c | 45 e | 47 d |
| 40 | 48 b | 46 g | 9 j | 89 ab | 47 d | 49 ab |
| 80 | 49 a | 46 fg | 12 i | 89 a | 49 bc | 50 a |
| 120 | 49 a | 47 f | 11 j | 88 b | 48 c | 49 abc |
| 160 | 46 c | 44 h | 10 j | 64 d | 45 ef | 47 d |
| 200 | 44 d | 44 h | 7 k | 80 e | 43 g | 45 f |
| Mean | | 45 b | 9 c | 86 a | 46 f | 48 a |

**Table 6. Effect of N-fertilizer on the grain length of the varieties Strymonas, Roxani and Ispaniki A in 1989–1990**

| N-fert. (Kg/ha) | Grain length (mm) | | | | | |
|---|---|---|---|---|---|---|
| | | Varieties | | | Years | |
| | Mean | Strymonas | Roxani | Ispaniki A | 1989 | 1990 |
| 0 | 6.05 d | 6.20 f | 6.50 c | 5.45 j | 6.07 e | 6.03 e |
| 40 | 6.14 c | 6.25 e | 6.50 c | 5.66 i | 6.14 d | 6.13 d |
| 80 | 6.23 b | 6.24 ef | 6.60 b | 5.66 h | 6.26 b | 6.19 c |
| 120 | 6.29 a | 6.34 d | 6.69 a | 5.84 h | 6.33 a | 6.25 b |
| 160 | 6.29 a | 6.33 d | 6.65 a | 5.90 g | 6.33 a | 6.26 b |
| 200 | 6.27 a | 6.30 d | 6.60 b | 5.90 g | 6.28 b | 6.25 b |
| Mean | | 6.28 b | 6.59 a | 5.77 c | 6.23 a | 6.19 b |

**Table 7. Effect of N-fertilizer on the grain ratio length/width of the varieties Strymonas, Roxani and Ispaniki A in 1989–1990**

| N-fert. (Kg/ha) | Grain ratio length/width (mm) | | | | | |
|---|---|---|---|---|---|---|
| | | Varieties | | | Years | |
| | Mean | Strymonas | Roxani | Ispaniki A | 1989 | 1990 |
| 0 | 2.37 a | 2.58 a | 2.41 c | 2.11 e | 2.36 ab | 2.37 a |
| 40 | 2.35 a | 2.58 a | 2.41 c | 2.08 ef | 2.35 ab | 2.35 abc |
| 80 | 2.33 b | 2.56 a | 2.38 cd | 2.05 fg | 2.32 de | 2.34 bcd |
| 120 | 2.31 c | 2.51 b | 2.37 d | 2.05 fg | 2.29 f | 2.33 cde |
| 160 | 2.31 c | 2.51 b | 2.38 cd | 2.05 g | 2.30 f | 2.33 de |
| 200 | 2.32 bc | 2.52 b | 2.39 cd | 2.05 g | 2.31 ef | 2.33 cde |
| Mean | | 2.54 a | 2.40 b | 2.06 c | 2.32 b | 2.34 a |