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Studies on protein content and yield levels in rice

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Summary. Crosses between low and high protein varieties revealed the dominance of low protein over high protein content. The number of desirable segregants with the double combination of high protein and yield were scored in each generation. The increasing frequency of desirable segregants from the F_2 to the F_3 generation in all the crosses increase the chances of selecting desirable recombinants for propagating improved rice varieties. Hybridisation followed by selection may help in developing varieties with high protein content and superior yield potential.

Key words: Rice – Protein – Yield – Recombinants

Introduction

The nutritional status of a variety is mainly dependent on its protein content. Rice protein is nutritionally superior over most of the other food cereals in terms of amino acid composition. The major limitations are that it is available in low quantities and that most part of it (7–8%) is lost in milling. Protein content can be improved either by N-fertilisation or by genetic manipulations. The present study reveals the segregation pattern of protein content in various crosses.

Materials and methods

The genetic material used in the present study were derived from six crosses comprising of nin 'indica' cultivars. The crosses were, 'TH-6'×'TH-50', 'TH-50'×'Gottelu', 'TH-25'×'TH-41', 'HR-5-3'×'C-12-708', 'C-12-708'×'HR-5-3' and 'Nallavadlu'×'AC-1306'. The F_2 seeds of these crosses were collected and the F_2 lines were raised. The F_2 lines were grown along with the parents, F_1's and 'IR 8' as control. Seeds harvested from F_2 plants were again sown to obtain the F_3 generation. Seeds were collected plantwise in both the F_2 and F_3 generations for the estimation of protein content.

The protein content was estimated by the micro-kjeldahl method where the percentage of N obtained was multiplied with 5.7 to obtain crude protein content. To measure yield/plant, the number of productive tillers per plant were counted. Five healthy panicles from each of these plants were selected: number of grains were counted and 100 healthy seeds from each of the plant were weighed. Yield/plant was estimated applying the following relation (Nagai 1959; Gupta and Padalia 1971):

$$\frac{\text{No. of productive tillers} \times \text{No. of grains/panicle} \times \text{100 grain wt.}}{100} = X \text{ gms/plant}$$

In the present study individual plants measuring more than 10% protein and yielding more than 35 gm of seeds/plant were considered as 'high'.

Results and discussion

Mean protein content in the F_1 population was found to be more than the high protein parent in all the crosses, except in 'HR-5-3'×'C-12-708' and its reciprocal cross (5.5±0.00%), where it was closer to the low protein parent ('C-12-708'=5.8±0.04%).

In 'TH-6'×'TH-50', 'HR-5-3'×'C-12-708' and 'C-12-708'×'HR-5-3', a few transgressive segregants were observed which exhibited low protein content (Figs. 1, 4 and 5). In crosses 'TH-25'×'TH-41' and 'Nallavadlu'×'AC-1306' a large number of transgressive segregants were recovered and again a majority of these were of low protein content (Figs. 3 and 6). Only in 'TH-50'×'Gottelu', a few segregants with high protein content were observed (Fig. 2).

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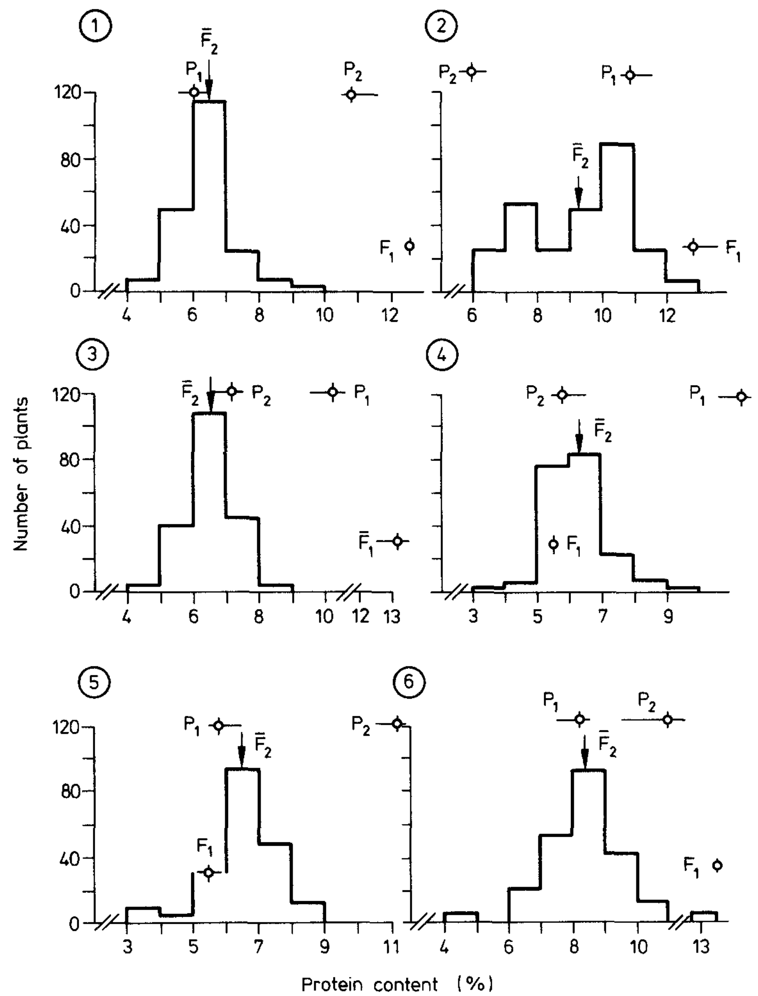

Figs. 1–6. Distribution of protein content in F_2 plants and range of parents and F_1's in different crosses. **1** 'TH-6' × 'TH-50'; **2** 'TH-50' × 'Gottelu'; **3** 'TH-25' × 'TH-41'; **4** 'HR-5-3' × 'C-12-708'; **5** 'C-12-708' × 'HR-5-3'; **6** 'Nallavadlu' × 'AC-1306'

The mean F_2 value as well as the high frequency of low protein genotypes among transgressive segregants revealed the dominance of low protein over high protein. Govindaswamy and Ghosh (1974) also observed a large number of transgressive segregants in the low protein range. Dominance of low protein content over high has also been acknowledged by several investigators (Ericson 1969; Mohanty and Reddy 1972; Hillerislambers et al. 1973; IRRI 1977). Certain High protein content segregants from 'TH-50' × 'Gottelu' may serve as a good source for developing lines with better protein content.

A majority of studies pertaining to the genetics of protein content have revealed that this character is controlled by polygenes. However, in certain cases, the inheritance was observed to be controlled by a small number of genes. According to Govindaswamy and Ghosh (1974) the partial dominance of low protein over high is because of this involvement of a few genes.

The hybridisation followed by selection may be fruitful in obtaining certain desirable recombinants with high protein level and superior yield potential (Govindaswamy and Ghosh 1974; Johnson and Lay 1974; Narahari and Bhatia; Sraon et al. 1975). Segregants with high protein and high yield were scored in each of the F_2 and F_3 populations in different crosses. There was a consistent increase in number of desirable segregants from F_2 to F_3 generation in all the crosses (Table 1).

Table 1. Frequency of high protein content segregants with high yield in F_2 and F_3 generations (%)

Sl. no.	Cross	F_2	F_3
1.	'TH-6' × 'TH-50'	1.06	9.23
2.	'TH-50' × 'Gottelu'	19.04	28.98
3.	'TH-25' × 'TH-41'	2.04	6.48
4.	'HR-5-3' × 'C-12-708'	4.30	16.15
5.	'C-12-708' × 'HR-5-3'	5.37	15.00
6.	'Nallavadlu' × 'AC-1306'	10.23	35.23

Selection of lines with high yield and protein content from each of these crosses might prove to be more fruitful in subsequent generations.

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