A preliminary analysis of 30 varieties showed a wide range of variation between the varieties. Protein content (%) was highly significant (Table 1), both genotypic and phenotypic variances (Table 2) were greater than environment variance. Coefficient of variability was low. The range of mean protein content of 30 varieties was from 6.56 to 13.59 with the general mean being 9.0095%. Protein percent was found to be positively correlated with height (Table 3) and negatively correlated with yield per plant, flag leaf index and effective tillers per plant respectively. Regression of protein percent on yield (Fig. 4-I(a)) was significant (Table 4-I(b)). The distribution of 30 varieties along the regression line are shown in Fig. 4-I(a). Variance analysis of the regression of protein percent on other traits were also estimated and it was found that yield/plant, tiller numbers, height, flag-leaf-index and second-leaf-index were significant and are shown in Table 4-I(b), 4-VIII(b), 4-IX(b), 4-X(b) and 4-XI(b) respectively and their respective distribution along the slope can be seen in Fig. 4-I(a) to Fig. 4-XI(a) respectively.

Variance analysis for yield per plant were highly significant. Both phenotypic and genotypic components of variance were greater than environmental variance components. P.C.V. and G.C.V. were moderate having a range from 1.79 to 5.24 and a general mean value
of 2.98. This trait was positively correlated with number of filled grains, wt. of 100 grains and number of effective tillers at different significant level (Table 3).

Variance analysis for filled grains per panicle was highly significant with more or less equal phenotypic and genotypic components with low environmental effects. Number of grains per panicle was significantly and positively correlated with number of sterile flowers per panicle and length of the panicle but it was negatively correlated with 100 grain wt.

Analysis of variance for 100 grain wt. was highly significant and both genotypic and phenotypic components were identical with low environmental variance. P.C.V. and G.C.V. were moderate and the range of this trait was from 0.98 to 3.02 with the general mean of 2.14. This trait was significantly correlated negatively with number of sterile flowers and positively correlated with second leaf index.

Variance analysis for number of sterile flowers was also significant (Table 1) with similar components of phenotypic and genotypic effect and showed a moderate environmental effect. P.C.V. and G.C.V. were high. The trait showed a range from 7.72 to 50.17 and the general mean was 22.75. Correlation results showed that it was positively correlated with length of the panicle and height (Table 3).

Variance analysis for length of the first panicle was highly significant (Table 1). Both phenotypic and genotypic components were similar with poor environmental effect. P.C.V. and G.C.V. were low, the means ranged from 20.8 cms to 30.43 cms. with a general mean of 26.16 cms.
Analysis of variance for days to flower was found to be highly significant. The genotypic and phenotypic components were greater than the environmental component; G.C.V. and P.C.V. were low. The range of the mean was from 84.53 to 142.65 with the general mean 110.70. This trait was also positively correlated with the flag leaf index (Table 3).

Analysis of variance for number of tillers was also found to be highly significant (Table 1). Both the genotypic and phenotypic components were greater than environmental variance. P.C.V. and G.C.V. were moderate. The range of the means was from 4.62 to 20.04 with the general mean 12.52.

Variance analysis for the trait height was also found to be highly significant. Phenotypic and genotypic components were greater than environmental variance. G.C.V. and P.C.V. were moderate. The range of the mean height was from 67.77 cms. to 153.87 cms. with the general mean 119.08 cms. Variance analysis for flag leaf index was found to be significant (Table 1). The phenotypic and genotypic components were identical and greater than environmental variance. G.C.V. and P.C.V. were moderate. The mean ranged from 2.29 to 6.68. General mean was found to be 4.4031.

Variance analysis of second leaf index was found to be significant. Phenotypic and genotypic components were equally greater than environmental variance. G.C.V. and P.C.V. were consistent. The general mean 2.4031 was found to be within the range of 1.16 to 4.43.
On the basis of the results obtained (Fig. 4-I(a)) 7 varieties lying above and below the regression line and showing the maximum deviation were selected, keeping in mind the other desirable qualities among the 30 varieties, for diallel analysis with the expectation that the negative association would be minimized. Fresh calculations were made and the new values of correlation coefficient obtained for the different desirable traits are shown in (Table 3-4). The seven varieties were identified as Patnai-23 (P-I), Radhunipagal (P-II), ARC-15570 (P-III), ARC-5995 (P-IV), Pirurutong (P-V), Pankaj (P-VI) and IR-8 (P-VII) respectively.

DISCUSSION:

The 30 varieties investigated originated from different ecogeographical region and as expected a large mean deviations among them were evident, M.S. of all the traits was found to be highly significant.

Co-efficient of variation of the twelve traits were more or less uniform and moderate with the exception of low C.V. for length of the first panicle, days to flower indicating more consistency. On the otherhand the traits sterile flower per panicle showed a high variability. Phenotypic variances were more or less similar to genotypic variances indicating, thereby, greater genetic involvement for the traits. It is evident and was also observed in the field that environmental components interacted with genotypic variance in the manifestation of phenotypic expression for certain traits like height, tiller number, sterile flowers per panicles and thus
ultimately affected the yield. As reported above the dependance of the above traits on environmental component in this investigation were less as compared to the genetical component. It is suggested that this was due to the small block size and the relative uniformity of micro and macro climatic factors; also it was not possible to test the above material in different locations and years.

The correlation and regression analysis of protein percent on the 11 traits showed that it was negatively correlated with yield per plant, effective number of tillers, flag leaf index and second leaf index significantly, while this trait was positively correlated with height significantly. The prediction of protein percent from phenotypic characters, though possible, were interfered or affected by the yield trait as yield trait was more important than protein percent; while wt. of first panicle, 100 grain wt. tiller numbers showed a positive association with yield, these traits also showed negative association with protein percent. The number of filled grains per panicle, days to flower had the same directional association with protein percent but both the traits were insignificant. So, prediction would be ineffective. Such negative correlation of the percent protein with yield was also shown by Lin et al. (1969); Hillerislambers et al. (1973); Higashi et al. (1974); Mohanty et al. (1973); Govindaswamy et al. (1973); Ghosh et al. (1976); Moura et al. (1980) and Chang (1974). The tendency of high protein lines to have lower grain protein percentage is possibly due to limited or diluted source for protein production. Coulson et al. (1964) had shown in wheat that protein source limitation appears among high protein classes because the source size
remains relatively constant while the yield size greatly increased. As a result the plant no longer can adequately supply energy or nitrogenous substances needed to produce high protein content. He suggested that we should find out and try to identify or develop more efficient plant lines.

In this investigation, therefore, 7 varieties namely Patnai-23 (P-I), Radhunipagal (P-II), ARC-15570 (P-III), ARC-5995 (P-IV), Pirurutong (P-V), Pankaj (P-VI) and IR-8 (P-VII) were identified on the basis of their greater deviations from the regression slope (Fig. 4-I(a)) to minimize the negative association of protein percent with yield/plant.

In the fresh correlation coefficient analysis among the 9 important traits in the above 7 parental lines (Table 3A) revealed, that the direction of association of protein percent with yield remained constant while the magnitude of association was minimized to a considerable limit. (P<0.01 to marginal significance of P<0.05). Ghosh et al. (1976) had also suggested that the ability to synthesize higher protein (upto 12%) did not also result in the reduction of grain productivity. Tanaka and Takagi (1970) studied mutant derivatives of Norin-8, and despite the presence of negative correlation, showed that selection for fairly high yield and high protein percent was possible.

Similarly, protein percent was negatively associated with panicle wt., though it was not significant, while yield was highly significant with panicle wt. (Table 3A) but correlation of the two traits (Protein and Yield) with panicle wt. were not significant amongst the seven parental lines taken.
The correlation of protein percent with grain wt. was negative but not of a significant nature, while yield showed a high positive correlation with grain wt. Although in the above experiment the seven parental lines showed positive correlation of grain wt. with yield but protein percent was negatively correlated with grain wt. which was not found to be significant. On the otherhand Hillerislambers et al. (1973), Tanaka (1973), Kuo et al. (1978) found significant negative correlation of protein percent with grain wt. This difference in the results obtained, in our opinion, was due to inclusion of parental lines like Pirurutong, Patnai-23 where protein and grain wt. are high.

Correlation of protein percent with tiller numbers was found to be significant (r=-0.589) and yield per plant with tiller numbers (r=0.789). In the 7 varieties the association of protein with tiller numbers remained directionally the same but 'r' was not significant. Yield/Plant positively correlated with tiller numbers which indicated improvement of yield and protein percent through higher tiller number could be an important predictable means.

The relationship of protein percent with height was positive (r=0.389) and with yield it was negative but not significant. The associations in the case of 7 parents were not significant. Such positive correlation was also found by Moura et al. (1980) but other workers reported negative correlations.

Protein was negatively correlated with flag-leaf-index (r=-0.524) but among the seven varieties both the 'r' values were
significant but opposite in direction. So it might not be possible to predict protein percent and yield/plant simultaneously.

From the above observations and the discussions it may be concluded that traits like length of the panicle, number of filled grains per panicle, wt. of the grains, height, flag leaf index and second leaf index are either directly or indirectly important for both yield and protein percent. It is, therefore, necessary to know the nature of gene action and mode of inheritance in the above traits of the 7 parents, which will further be discussed in following chapters.
Table 4-I(b): ANOVA for Regression of Protein % on yield/plant in Rice.

<table>
<thead>
<tr>
<th>Source</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>93.3971</td>
<td>1</td>
<td>93.3971</td>
<td>12.2347</td>
</tr>
<tr>
<td>Error</td>
<td>213.7455</td>
<td>28</td>
<td>7.6338</td>
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</tr>
</tbody>
</table>

Table 4-VIII(b): ANOVA for Regression of Protein percent on the effective filler number in Rice.

<table>
<thead>
<tr>
<th>Source</th>
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<th>M.S.</th>
<th>F</th>
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</thead>
<tbody>
<tr>
<td>Regression</td>
<td>106.4074</td>
<td>1</td>
<td>106.4074</td>
<td>14.4074</td>
</tr>
<tr>
<td>Error</td>
<td>200.7352</td>
<td>28</td>
<td>7.1691</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-IX(b): ANOVA for Regression of Protein percent with Height in Rice.

<table>
<thead>
<tr>
<th>Source</th>
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<th>M.S.</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>46.4097</td>
<td>1</td>
<td>46.4097</td>
<td>4.9839</td>
</tr>
<tr>
<td>Error</td>
<td>260.7329</td>
<td>28</td>
<td>9.3119</td>
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</table>

Table 4-X(b): ANOVA for Regression of Protein percent with Second leaf index in Rice.

<table>
<thead>
<tr>
<th>Source</th>
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<th>d.f.</th>
<th>M.S.</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>54.7577</td>
<td>1</td>
<td>54.7577</td>
<td>6.0749</td>
</tr>
<tr>
<td>Error</td>
<td>252.3849</td>
<td>28</td>
<td>9.0137</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-XI(b): ANOVA for Regression of Protein percent with Flag leaf index in Rice.

<table>
<thead>
<tr>
<th>Regression</th>
<th>S.S.</th>
<th>d.f.</th>
<th>M.S.</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>84.4764</td>
<td>1</td>
<td>84.4764</td>
<td>11.0022</td>
</tr>
<tr>
<td>Error</td>
<td>7.6781</td>
<td>28</td>
<td>7.6781</td>
<td></td>
</tr>
</tbody>
</table>
FIG. 4-1(a) REGRESSION OF PROTEIN PERCENT WITH YIELD PER PLANT

\[ b = -0.1408 \]

\[ \hat{P} = 11.7944 - 0.1411 X_1 \]
FIG. 4-11 REGRESSION OF PERCENT PROTEIN WITH WT. OF FIRST PANICLE

\[ b = -0.3773 \]

\[ p = 10.1354 - 0.3773 \times x_2 \]
\[ b = 0.0007 \]
\[ \hat{P} = 8.9165 + 0.0007 X_3 \]
$b = 0.2388$

$p = 2.763 \times 10^{-6}$

**FIG. 4. VI**; REGRESSION OF % PROTEIN ON LENGTH OF FIRST PANICLE IN RICE.
\[
\begin{align*}
\hat{y} &= 12.135 - 0.2497 x_8 \\
b &= -0.2497
\end{align*}
\]
\[ b = 0.0244 \]
\[ \hat{P} = 6.1038 + 0.0244 \times g \]
FIG.-4-X  (a) REGRESSION OF PERCENT PROTEIN ON 2ND (FROM TOP) LEAF INDEX

\[ b = -0.9111 \]
\[ p = 11 \cdot 2035 - 0.9111 X_{11} \]
FIG. 4. XI-(a) REGRESSION OF PROTEIN PERCENT ON FLAG LEAF INDEX

\[ b = -0.7216 \]

\[ P = 12 \times 1868 - 0.7216 \]