4. General discussion and conclusion

The yield of grains in the farmer's field is determined by the interaction of the genotype with the environmental conditions. To achieve the optimum yield of grains, it is imperative to manipulate the growing conditions of the plant in order to redress the physico-chemical stresses of the environment. While no effective control can be exerted on the climatic factors, manipulations of other factors can be done in the field. The most important of these factors, which influence the yield of grains significantly, are water depth and soil fertility. Loss of yield due to inefficient use of water and fertilizers has been very great. Further, with the increase of energy crisis in the world, it has been essential to minimize the use of fertilizers. Therefore to rationalize the use of fertilizers, first it has been necessary to find out the stage at which the response of the plant is maximum to the treatment. Secondly fertilizer utilization in the field condition is interlinked to the depth of water; which is to be manipulated with proper irrigation.

Apart from this, it has been observed that the theoretical (potential) yield of grains is not achieved under the best agronomic conditions in the field. The problem has been more acute in the tropical countries, where the temperature is high and weather conditions are unpredictable. Before any attempt is made to break the yield barrier or to develop resistance in the plant to stresses, physiological research is necessary to find out
the causes limiting the yield of grains. Considerable support exists in the literature to support the view that the yield capacity of the rice plant is limited by the provision of assimilates. Therefore suggestions have been made to increase productivity by increasing the photosynthesis and/or the partitioning of assimilates to the panicle. In different sections of the thesis, these propositions have been tested.

In order to find out a method for the rational use of fertilizers and water in the field, it has been necessary to compare the cost of cultivation with the benefit in both wet and dry seasons. At high fertilizer treatment, the gross profit from cultivation is very high due to the high yield of grains (Table 4.1). The second condition which merits recommendation in favour of high fertilizer treatment is the high water use efficiency of the plant at this treatment. However, the benefit:cost ratio has declined with increase in fertility. Similarly the enhancement in the yield of grains has decreased with the increase in the level of fertility, suggesting a curvilinear pattern of relationship between these two parameters (Figure 4.1). These observations suggested low fertilizer use efficiency of the plant at high fertility. However, such observations find no favour as the gross return is more important for the economy and total food grain production.

To find out the mechanism of influence of the fertilizers and irrigation treatments on the yield of grains, various morphological and physiological measure-
### Table 4.1: The Economics of Application of Fertilizer

<table>
<thead>
<tr>
<th>Years</th>
<th>1982</th>
<th>1983</th>
<th>1984</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UET</td>
<td>UET</td>
<td>ORY</td>
</tr>
<tr>
<td>Unit</td>
<td>Total</td>
<td>Unit</td>
<td>Total</td>
</tr>
<tr>
<td>-------</td>
<td>-------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Yield</td>
<td>25.4</td>
<td>23.0</td>
<td>21.8</td>
</tr>
<tr>
<td>Profit/Unit</td>
<td>4.78</td>
<td>5.80</td>
<td>6.65</td>
</tr>
</tbody>
</table>

**Notes:**
- C = Cost of Fertilizer per unit = $246.34
- B = Benefit per unit = $148.00

Cost of Fertilizer per unit = $246.34 Cost of grain per quintal = $148.00

B = Benefit. C = Cost of Fertilizer.
Legends to Figure

Figure 4.1

Correlation between fertility level and grain yield in wet and dry seasons.
GRAIN YIELD $q_{\text{ha}^{-1}}$

WET

\[ \hat{y} = 29.56 + 5.76x - 0.6x^2 \]

\[ R^2 = 0.9995 \]

DRY

\[ \hat{y} = 22.22 + 11.52x - 1.03x^2 \]

\[ R^2 = 0.9996 \]
ments were undertaken for different parts of the plant. The fertilizer treatment and shallow submergence increased the yield of grains primarily by increasing the grain number. The contribution of increase in weight of the grains were secondary. The grain number increased because of the survival of more number of tillers and spikelets in the panicle. The treatments also increased many of the vegetative characters of the plant, such as the plant height, weight of shoot and roots, leaf and tiller number, root volume, root spread, leaf area and the yield of straw at maturity. Only the length of the root decreased under the influence of the treatments imposed. However, the treatments did not influence the grain: straw ratio. All these observations indicated that the yield of grains increased primarily due to a direct effect of the treatments on the activity of the source (leaf photosynthesis) which increased the total dry matter accumulation of the plant. The cloudy conditions probably interrupted photosynthesis in the wet season and therefore the yield was lower in this season than that in the dry.

The treatments of fertilizers and shallow submergence improved the availability of the nutrients in the soil and absorption increased to improve N, P and K concentration in the plant parts. It has been discussed that the rise in concentration of these essential elements might have improved the photosynthesis of the leaf. The net assimilation rate of the plant must have increased under the
influence of the treatments before the sampling initiation (day 15 after transplantation) to account for the difference in dry weight in between the treatments. During the later part of the sampling period, the difference in growth might have been due to difference in leaf area.

However, during the sampling period no clear effect of the treatments was found in the net assimilation rate of the plant. Often fertilizer treatment was found to decrease the NAR. Further, NAR correlated negatively with the yield of grains. It might be possible that the photosynthetic efficiency of the plant decreased due to increase in mutual shading in the presence of higher leaf number in the canopy at high fertility. In contrast to this, the measurement of photosynthetic assimilate contents of the leaf indicated that, photosynthetic efficiency might have increased under the influence of the treatments imposed. This apparent contradiction has no reality as no mutual shading occurs on the upper leaves.

The treatments improved the assimilate concentration of the leaf lamina and more assimilates were translocated to the growing panicle. The assimilate concentration, e.g., fresh weight growth of the panicle increased under the influence of the treatments. This coincidence implied a relationship between the two, supporting the hypothesis that panicle growth is under the control of the provision of assimilates. However, analysis of soluble carbohydrates and free amino acids of the primary branches did not support
this view. The variation in between the primary branches located at different parts of the axis has been very wide in the dry weight, number of spikelets and fertile grains. This difference is not equally matched by a difference in the concentration of assimilates.

Thus it is hard to believe that provision of assimilates can directly improve growth, development and yield of grains in the panicle. There has been no shortage of these material in that part of the panicle, where retardation in growth and development is seen. The treatments of fertilizers and shallow submergence might have improved fertility by some alternative mechanisms, which influenced sink capacity directly or indirectly. The physiological nature of such a mechanism presently remains unresolved.