INTRODUCTION
RICE (Oryza sativa L.) is an important food grain crop that is grown world wide. It is the only major cereal crops that is consumed at most exclusively by human. One in every three people depends on rice for more than half of their daily food. More then 90% of the world's rice is grown and consumed in Asia where 60% of the earth's people and about two thirds of the world's poor live Khush and Virk (2000). Rice accounts for more than two thirds of the calories consumed by the inhabitants of Bangladesh, Cambodia, Loas, Mynmar and Vietnam. In 1999, rice was planted to 155 million hectares of land with a production of 596 million tons. China and India is the leading producer of rice and jointly account for half of the total production of rice. Just over 4% of the world's rice production is traded internationally. Thialand is the world's leading exporter with around 6 million tonnes annually. India ranked second with 4.8 million tones exporter in 1998 while China, Pakistan, Vietnam and USA exported 3.8, 2.0, 3.9 and 3.1 million tonnes, respectively.

Importance of rice cultivation needs no emphasis, as it is staple food crops in India occupying 30% of total cropped area and contributing
42% of total food grain production. Further rice assumes magnitude as the base crop of the low land rice based farming system.

Major increase in rice production has occurred as a result of wide scale adoption of improved rice varieties developed at IRRI and by the national rice improvement by programs. Improved varieties are now planted to 70% of the world's rice land. As a result most of the major rice growing countries became self-sufficient. Also the price of rice adjusted for inflation is now 40% lower than that in the early 1960s. Current rice varieties have high yield potential, good grain quality, shorter growth duration multiple resistance to disease and insects and to learned to some of the abiotic stresses. Availability of best resistant varieties reduced the need for application of pesticides and facilitated the adoption of integrated pest management practices.

The population of rice consumers is increasing at the rate 1.8% a year. But the rate of growth in rice production has slowed down. It is estimated that rice production must increase by 50% by 2025. This increase must occur in spite of decreasing water supplies, less labour and reduced use of pesticides. Thus, we need varieties with high yield potential, better nutritional value and yield setability. Various strategies for increasing the yield potential include: Idcotype breeding, heterosis breeding, wide hybridization and genetic engineering.

Rice is an ancient crop. There are cultivated species of rice in the world, *Oryza sativa* L. and *Oryza glaberrima*. The genus *Oryza* probably
originated at least 130 million years ago and spread as a wild grass in Gondwanaland, the super continent that eventually broke up to become Asia, Africa, the Americas, Australia, and Antarctica. The common rice, *O. sativa* (grown all over the world) and the African rice, *O. glaberrima* (grown on a small scale in West Africa) are thought to be an example of parallel evolution. The wild progenitor of *O. sativa*, is the Asian common wild rice *O. rufipogon*, that shows a range of variation from perennial to annual types. Annual types, also given a specific name *O. nivara*, were domesticated to become *O. sativa*. The domestication of Asia rice may have occurred, about 10,000 years ago, independently and concurrently at several locations in a broad belt that extends from the plains below the eastern foothills of the Himalayas in India through upper Myanmar, northern Thailand, Laos, and Vietnam to southwest or south China (Chand 1976; Khush, 1997).

The total rice production has more than doubled since 1966 (Table 1). Indonesia, Philippines, and India which were major rice importing countries, became self-sufficient in rice production in the late 1970s. This also helped the increase in cereal consumption and caloric intake per capita. During 1965-1990, the daily calorie supply in relation to requirement improved from 81 to 120% for Indonesia, 86 to 110% for China, 82 to 99% for Philippines and 89 to 94% for India (UNDP, 1994).

Due to large-scale adoption of modern varieties, coupled with improved management practices, rice production has dramatically increased in major rice growing countries. Farmers get 5 to 7 tonnes/ha of unmilled rice
from high yielding varieties (HYVS) as compared to 1 to 3 tonnes/ha from traditional varieties. Farmers have raised average yield by substituting HYVS for traditional ones. Thereby increasing the proportion of the total area planted with HYVS. China 1966, when the first HYVS was released, the rice harvested area increased only marginally from 126 to 155m ha (23%) whereas the average rice yield has increased from 2.1 to 3.6 tonnes/ha (71%).

In India, 32, IRRI in bred lines have been released, Number of IRRI breeding lines named as varieties, in national programmes of several rice growing countries has already reached 334. More than 1,000 imported varieties have also been developed by various national programmes. 25% of than being the progenies of crosses with IRRI in bred varieties or elite breeding lines (Khush, 1995a).

With 1.4% annual rate of growth in human population world is continuing to add 80 million people every year. Moreover, the population of rice consumers is increasing faster at the rate of 1.8% annually. The number of rice eaters is expected to increase by 40% and rice requirement by 50% during the next 25 years. This increase is unlikely to be met by increasing area planted to rice. In fact, some of the best lands are being taken out of agricultural production due to urbanization, industrialization and infrastructure developments, such as roads and parking lots. Several other factors contributing to shrinking croplands are soil erosion and depletion of aquifers.

Among the activities involving exploitation of natural resource, irrigation is by far the most important. World wide about 253 million hectares
of crop land are irrigated land are China and India alone account for 100 million hectares of irrigated land (Frederiksen et al. 1993).

Rice is grown under diverse environment that are classified into five major categories for convenience (Khush, 1984, 1997). Irrigated rice accounts for about 55% of the total Asia. Another 5% is favorable rain fed lowland where improved varieties and technology have been adopted. About 80% of the world rice production comes from 60% of their favorable rice growing area. However very few varieties or little new technology have been developed for the unfavorable (rain fed lowland, upland, deep water and tidal wetland) environment that constitute 40% of the area planted to rice. The further challenges for rice improvement are two fold:

(a) To develop varieties for the irrigation areas with higher yield potential greater yield stability and better nutritional value and

(b) To develop improved varieties with tolerance to biotic stresses and with their yield potential for unfavorable environment.

Conventional hybridization and selection is a time-tasted strategy for developing crop cultivars with higher yield potential. This approach has been the basic of varieties development at IRRI in late 1960s and largely 1970s yield of IR 8 used to be in the range of 9 to 10 tonnes/ha under favorable irrigated condition at IRRI in the Philippines. However the yield of IR 8 now unclear similar condition at IRRI range 7 to 8 tonnes/ha whereas the recently bred cultivars such as IR 72 and PSVRC-52 yield between 9 to 8 tonnes or save as IR 8 in the 1960s. This suggests that yield potential of indica in bred
has not changed during the past 30 years. However, the regression of yield versus year of release of IRRI bred cultivars indicates an annual increase of 1% in yield per year based on the present yield of IR 8 (Peng et al. 1999). It appears that due to new biotic or abiotic constraints or changes in soil biology, IRRI cannot attain the same yield potential now as it did in the late 1960s. The varietal improvement during the last 30 years has resulted in cultivars resistant to their constraint. Without those improvements, the yield of high-yielding cultivars would have eroded by 25-30%.

The yield potential of *indica* inbred cultivars in the tropics is 9 to 10 tonnes/ha during the dry season. Plant physiologists have suggested that physical environment in the tropics is not a limiting factor to increasing rice yield. Maximum yield potential was estimated to be 15.9 tonnes/ha (Yoshida 1981). In the past, quantum jumps in yield potential of crop plants have generally resulted from the modification of plant types. The modification in plant architecture allowed the yield potential of rice to be doubled in the 1960s. To further enhance the genetic potential of rice from its present level of 10 tonnes/ha to 12 tonnes/ha, a new plant type was conceptualized in 1989 at IRRI.

Modern high-yielding rice varieties have a harvest index of 0.5 and total biomass of about 20 tonnes/ha under optimal conditions. By raising the biomass to about 22 tonnes/ha and the harvest index to 0.55, it is possible to obtain yield of over 12 tonnes/ha. Breeding work for the new plant type was initiated at IRRI in 1989 when about 2000 entries from IRRI's genetic
resources centre were grown to identify donors possessing desirable traits for the NPT project. The suggested modification to HVY'S plants architecture included reducing in tiller number (5.6), increase in the number of grains per panicle, deeper root system, thicker and dark green leaves and straw stiffness. (Khush, 1995).

For increasing the yield potential of rice in the tropics, exploitation of hybrid vigour or heterosis is another explanation. Hybrid rices have a yield advantage of about 15% over conventional high yielding varieties and have been grown in China since 1976. However, the Chinese hybrids were not adapted to the tropical environment. IRRI initiated work on hybrid rice 1978. The higher yield of indica indica hybrids is due to increased total biomass and higher spikelet number and grain weight (Ponnuthurai et al. 1984).

Almost all rice hybrids developed at IRRI and those grown in China have come from crosses between indica lines. However greater diversity between parents is expected to on hence heterosis as expected hybrids developed from cross between indica and japonica lines had greater heterosis for yield as compared to indica indica hybrids (Yuan et al. 1998). However, indica/temperate japonica hybrids are partially sterile (Zhu et al. 1997). Initial result show that hybrids between indica and tropical japonica lines are also more heterotic then indica indica hybrids.

The extent of success in plant breeding programme for improving yield and adaptability depends upon genetic information on various morphophysiological characters related to plant architecture and grain yield.
For synthesis of super rice cultivars, selection of desirable parents and appropriate breeding methodology are of prime importance. The basic information on nature of gene action involved in the expression of all these characters and the extent of heterosis over diverse environment are necessary for determining most appropriate breeding methods and handling of segregating populations. The enormous potential of several tropical Japonica developed by IRRI (Khush, 1998) have not yet been exploited along with improved indica cultivars in the rice improvement programme in India and require through investigation under diverse conditions.

Keeping the above in mind, the present investigation entitled "Inheritance studies of new biotypes and certain quantitative characters in rice (Oryza sativa L.) was undertaken. It involved 8 rice strains/lines to make crossing in diallilic pattern. The objective of the study are as follows:

1. To study the gene actions involved in the inheritance of various traits.
2. To study the general and specific combining ability variances and effect, so that good general combiners and the best specific cross combinations may be pinpointed for further utilization in rice breeding programme.
3. To estimate the nature and magnitude of hybrids vigour manifested over better parent, standard variety in different combinations.
4. To study the intensity of inbreeding depression for different traits in F₂ generation.
5. To determine the heritability and expected genetic advance for predicting the advancement to be gained during selection.
6. To estimate the correlation coefficients and further partitioning into direct and indirect effect.
Table 1: Total area, coverage of high yielding varieties and increase in rice production in selected countries of Asia.

<table>
<thead>
<tr>
<th>Countries</th>
<th>Total area planted (In Hectare)</th>
<th>Area planted To HYV (%)</th>
<th>Production (M. Tonnes)</th>
<th>Increase Production (%)</th>
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<tbody>
<tr>
<td></td>
<td>1966</td>
<td>1999</td>
<td></td>
<td>1966</td>
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<tr>
<td>Bangladesh</td>
<td>9.1</td>
<td>10.5</td>
<td>52</td>
<td>14.3</td>
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<td>China</td>
<td>31.3</td>
<td>31.7</td>
<td>100</td>
<td>98.5</td>
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<tr>
<td>India</td>
<td>35.2</td>
<td>44.8</td>
<td>73</td>
<td>45.6</td>
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<tr>
<td>Indonesia</td>
<td>7.7</td>
<td>11.6</td>
<td>77</td>
<td>13.6</td>
</tr>
<tr>
<td>Myanmar</td>
<td>4.5</td>
<td>5.5</td>
<td>72</td>
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<td>Pakistan</td>
<td>1.4</td>
<td>2.4</td>
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<td>Philippines</td>
<td>3.1</td>
<td>4.0</td>
<td>89</td>
<td>4.1</td>
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<tr>
<td>Sri Lanka</td>
<td>0.5</td>
<td>0.8</td>
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<tr>
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<td>10.0</td>
<td>68</td>
<td>13.5</td>
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<tr>
<td>Vietnam</td>
<td>4.7</td>
<td>7.6</td>
<td>80</td>
<td>8.5</td>
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