INTRODUCTION
CHAPTER – I

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Rice is one of the world’s most important food crop. It is grown in 115 countries in different parts of the world and provides staple food to more than half of the world’s population. In Asia alone, 90 percent of the world’s rice is produced and consumed (Khush, 1997). Rice is cultivated over an area of 147.30 million hectares in different parts of world, which produces 518.40 million tonnes of grain. India has largest area under rice in the world and ranks second in production next to China. These two countries account for over 55 percent of the total production from about 50 percent of the world’s area under rice (Taimni, 1996). Among the rice growing countries, India contributes about 82 million tonnes with the productivity of 1851 kg per hectare (Venkataramani, 1999). In Chhattisgarh, rice is cultivated over 4.0 million hectares and the average yield of rice in Chhattisgarh is 12 qtls / ha (Anonymous, 2000).

It is foreseen that the world’s population may exceed eight billion by the year 2025 and will need about 765 million tonnes of rice, 70 percent more than that wheat is consumed today.
There has been no increase in the area planted under the rice crop since 1980. Rather, in coming future, an increasing urbanization and industrialization is expected to reduce the area (FAO, 1998). Therefore, the increased estimated rice production can only be achieved by raising the average production of rice.

The adoption and spread of modern rice technology has contributed substantially to increased rice production. However, the spread of semi dwarf varieties, continuous rice cropping, increased use of nitrogenous fertilizers, close spacing and reduced genetic variability has led to domination of only a few genotypes and thus has increased the vulnerability of the crop to disease and insect pests, resulting into outbreaks of pest epidemic in several countries (Khush and Virmani, 1985).

Rice is the host of more than 60 disease organisms and 100 insects. Cramer (1976) reported 34% yield loss to the rice crop due to insects in tropical countries. In India, annual yield loss has been calculated to vary from 28% (Kalode, 1987) to 35% (Way, 1976). There has been a tremendous change in the status of several rice insect pests in the recent past. Thus, relatively minor insect pests in the past such as leaf folder, case worms, Army worms and cut
worms have gained major importance. Like wise gall midge, brown plant hopper (BPH) and green leaf hopper (GLH), besides stem borer have become major problem during last 3 decades.

The rice gall midges, *Orseolia oryzae* (Wood-Mason) and *O. oryzivora* Harris and Gagne (Diptera: Cecidomyiidae) are important pests of rice in Asia and Africa, respectively. In Chhattisgarh losses up to the 60 percent have been reported Mishra and Sarawgi (1997). Whereas, globally the losses have been estimated to exceed US $550 million annually (Herdt, 1991).

In India, gall midge has been reported from all most all the rice growing States except the western Uttar Pradesh, Uttaranchal, Punjab, Haryana and the hill States of Himachal Pradesh and Jammu and Kashmir.

The characteristic symptom of attack of *Orseolia oryzae* (Wood-Mason) on rice plant is the formation of gall commonly called "Silver shoot", which is a modified leaf sheath. Galls arise as a cellular response to an irritant secretion of salivary glands containing 'Cecidogen', which causes abnormal proliferation of cells at the site of feeding (Chiu-foon, 1980). clustering of leaf blades at flowering (Rajamani *et al*., 1979), infestation of terminal shoot apices, tender grains in panicles just at flowering, abnormal
twisting and curling of leaf sheaths, profusion of leaf primordial from panicle initiation to ripening etc.

The insect being an endoparasite, chemical control is not very effective and expensive too. Therefore, the use of resistant varieties is the most effective strategy to manage this pest. The high degree of variability of this insect has reduced the stability of resistant varieties.

Similarly the related species Orseolia Oryzivora Harris and Cagne, the African Rice gall midge, is a problem in Nigeria and several other African countries (UK wungwu and Joshi 1992 and Taylor et al, 1995). Insect pressure is highest in wet seasons when the atmospheric relative humidity is consistently high. Periods of dry weather in the rainfed ecosystem reduce the insect pressure and are a limitation in screening of breeding material for gall midge resistance. Richharia 1972 estimated the losses to the extent of Rs. 2 coroer annually in Madhya Pradesh only.

Host plant resistant is an ideal way to control this insect pest. But emergence of new insect biotypes or new variants or intrinsic variation in insect population limits the success of host plant resistance. Biotypes variability of gall midge appears to be the major factor for the variable reaction of resistant donors. The occurrence of
gall midge biotypes first suspected by (Shastry et al., 1972) has now been confirmed in several investigations (Heinrich and Pathak, 1981; Kalode and Bentur, 1987). Based on differential interaction six different biotypes of gall midge have been identified so far in India (Kalode and Bentur, 1989, Nair and Devi, 1994, and Singh, 1996).

To overcome these complications, it is necessary to have clear understanding of inheritance of resistance and allelic relationship of gene(s) for resistance present in different donors. The allelic study provides information on genetic relationship among different sources of resistance. Identification of more than one source of resistance is necessary not only for developing varieties with wider adaptability through gene pyramiding but also to have a check on genetic vulnerability of crops to the changed biotypes of the insect.

Breeding for resistance is not an easy task. It need clear out understanding of mode of inheritance of resistance, a suitable donor, recipient and lot of resources along with Lengthy, tedious screening and selection. Linkage may provide a useful tool to ease the task of selection. Anthocyanin pigmentation has occurred in various parts of the rice plants such as coleoptile, leaf sheath, ligule, hul, auricle, apiculus etc. In earlier studies purple
pigmentation have been reported to be associated with gall midge resistance (Shastry et al., 1973 and 1975). However, anthocyanin pigmentation is not correlated with yield parameters, but it may help in selection if any economic characters are linked with the plant part pigmentation. Therefore, the present study was formulated.

The systematic study on gene identification at Indira Gandhi Agricultural University, Raipur and other centers have led to the identification of nine different genes for gall midge resistance (Chaudhary et al. 1986, Shrivastava et al. 1993, Yang et al. 1997, Kumar et al. 1999, Kumar et al. 2000, Shrivastava et al. 2002). However, out of the three hundred genotypes identified to provide resistance against different biotypes of gall midge, genetics and allelic relationships of the gene(s) they carry are not yet clear.

Therefore, the present study is proposed to be conducted with following objectives:

1. To study inheritance of gall midge resistance in some of the known resistant cultivars of rice.

2. To investigate and confirm inheritance of purple leaf colour in rice.

3. To find out linkage relationship of gall midge resistance with purple leaf colour.