I- Introduction and literatur review

1.1- Background and objectives

The world population is expected to reach 8 billion in the next two decades (Cakmak, 2001) with a yearly increase of 80 million people, principally in developing countries. To feed the world with such a marked increase in population, a great improvement in food production must be achieved (Cakmak, 2001). Rice is one of the most important staple food crops of the world (Chang, 1995; Gosal et *al.*, 1997, Fischer, 2000). To meet the rice demand projected in 2025, production must be about 65% higher than today (Fischer, 1998) and reach about 2.7 billion tons by the year 2025. This will require almost 300% more nitrogen fertiliser than the present rate in irrigated environments if the technologies that affect nutrient utilisation by the rice crop remain unchanged (Fischer, 1998).

In Asia, 24% of the increased rice production from 1965 to 1980 was attributed to better crop nutrition due primarily to the increase use of N fertiliser. Intensive crop production requires huge amounts of chemical nitrogen fertiliser (Cakmak, 2001) which is the major factor limiting growth under most conditions (Dawe, 2000).

In West Africa, the rice demand is growing faster than the local production (Fig. 1.1). Trends in rice production in Africa show a gap between rice production and consumption. Urbanisation and population growth are the main reasons of increased rice demand (WARDA, 2000). Consequently, to supplement the low level of production, African countries have to import the bulk of rice mainly from Asia. In three decades, rice imports have increased over twelve fold, to over 3.2 million tonnes a year, at a cost of almost 1 billion US$ (WARDA, 2000) (Fig.1.1).

Fertilisers play a major role in meeting global food demand. The impressive increase of agricultural yields during the last decade has largely resulted from the intensified application of nitrogen fertilisers. The development of fertiliser–responsive varieties in the Green Revolution, coupled with the realisation by farmers of the importance of nitrogen, has led to high levels of N fertiliser use on rice (Dawe, 2000). The term

"Green Revolution" stands for introduction of appropriate cultivars which were able to convert such increased N supply into higher product yields.

The use of nitrogen per hectare on rice is especially high in countries where most rice is grown under irrigated condition because fertiliser use is much higher in the irrigated ecosystem than in rained, upland, or flood-prone ecosystems (Dowe, 2000).

Agriculture's focus in developed countries has been on maximising yields per unit area. Environmental consequences of over application of nutrients were considered only recently (Schlegel et *al.*, 1996, cited by Rauna & Johnson, 1999).

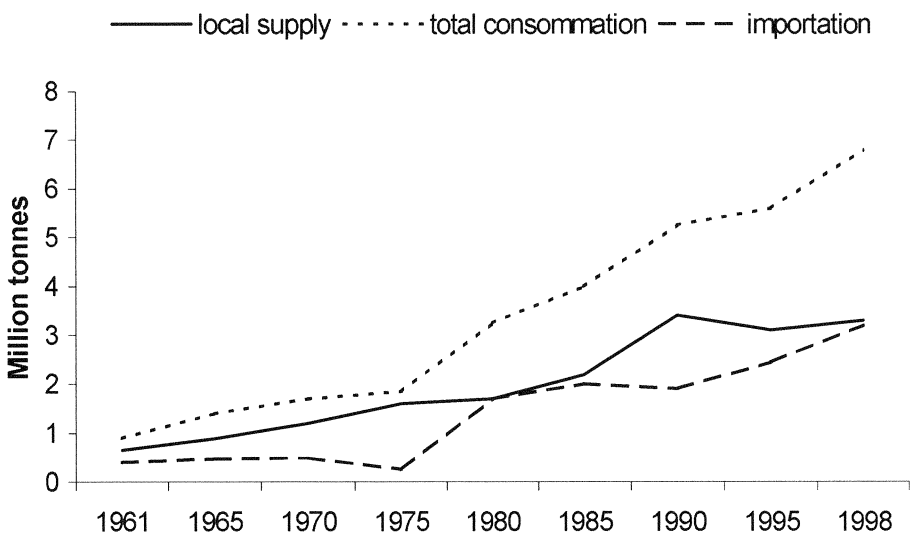

Fig. 1.1: Rice Trends in West Africa. WARDA (West African Rice Development Association), 2000.

Since there is limited opportunity for increasing the area sown because of environmental concerns, urbanisation, and diminishing water resources (Cakmak, 2001), the yield increase must come mainly from productivity improvement. To improve profitability of rice production and prevent environmental degradation in irrigated rice, nitrogen-use efficiency (NUE) of rice cropping must be improved (Fischer, 1998, Rauna & Johnson, 1999). Ideal rice cultivars would be those that perform well under low soil fertility conditions but also respond well to applied fertilisers (Ladha et *al.*, 1998).

The objectives of this studies are to contribute to a better understanding of genetic variation in nitrogen efficiency in West African rice material. Cultivars of the Asian

rice (*Oryza sativa*) will be investigated and compared with African rice (*Oryza glaberrima*).

The study consists of three parts:

(i) Investigation of in vitro methods to produce double haploid plants from *O. sativa* and *O. glaberrima* for a rapid development of new breeding material,

(ii) Analysis of variation in nitrogen efficiency among cultivars of irrigated rice in Senegal,

(iii) Genetic analysis of segregating F3 populations of three different crosses.