CHAPTER VII

GENERAL DISCUSSION
Under slash and burn agriculture of the north-eastern India, *Imperata cylindrica* (L.) Beauv. is an important component of the agricultural system and of the early successional secondary falls (Toky and Ramakrishnan, 1983a; Kushwaha et al., 1983; Mishra and Ramakrishnan, 1983). This species is very vigorous due to the extensive under-ground rhizomes which are fire-resistant. In fact, frequent disturbance either due to slashing or burning, particularly during the dry season, is suggested to be a requirement for sexual reproduction to occur (Kushwaha et al., 1983; Schlippe, 1956).

The weed occurs under a variety of habitat conditions. Altitudinally, it is found right from sea level up to an altitude of 1700 m in Meghalaya. The wide ecological amplitude of this species could partly be accounted as due to extensive plastic adaptation in the species as shown through the present studies and partly be related to a certain degree of ecotypic differentiation of altitudinal populations which was more obvious during transplant experiments done in a neutral substratum at low elevations. The generally poorer growth of the populations of this species at high altitude may partly be due to temperature and partly to acidity in the soil under lower temperature. Similar temperature and acidity-dependant poorer growth of *Carex aquitilis* populations was also observed in arctic and alpine populations of this species by Chapin (1981).

The allocation pattern of biomass in the two populations at the two altitudinal sites indicate a strong phenotypic plasticity
of the species population adapted to the contrasting environmental conditions. The vegetative effort was not different in the two populations at either of the two sites. A large allocation of biomass and nutrients to the under-ground organs in *I. cylindrica* is to be expected in view of the rarity of sexual reproduction in this predominantly vegetatively reproducing species. Since there are larger allocations of available resources to under-ground parts of regeneration, the sprouting species are expected to have less allocation to sexual reproduction as compared to non-sprouters (Keeley and Keeley, 1977; Saxena and Ramakrishnan, 1983).

A number of micro-environmental changes occur during the early phase of secondary succession, such as fast changes in the moisture and nutrient status in the soil (Toky and Ramakrishnan, 1981; Ramakrishnan and Toky, 1981). Subsequent shading caused by larger shrubs and trees that come up after about 5-6 years of fallow regrowth also create unfavourable condition (Toky and Ramakrishnan, 1983a; Nishta and Ramakrishnan, 1983). Rapid colonization of the site by a number of herbaceous weedy species would result in increased competition for nutrient resources in the soil (Saxena and Ramakrishnan, 1984).

Under such a transient environment of the early successional phase, the demography of *I. cylindrica* population is bound to change drastically with the age of the jhum fallow. The study done over a two year period showed that at both low and high elevation sites, the size of the original population was markedly reduced.
with the age of the fallow so much so that in a 5-year old fallow the ultimate population size was extremely small compared to a 1-year old fallow. Similarly the germination and establishment of individuals through seed and tiller populations declined drastically in older fallows, so much so that in 5- and 10-year old fallows all the introduced individuals died.

The strategy of a weedy species coming soon after slash and burn agriculture should be to have either an efficient method of reproduction through seeds as in *Eupatorium odoratum* (Saxena and Ramakrishnan, 1982) or it should have an efficient vegetative reproduction as in *I. cylindrica* with extensive under-ground rhizomes. The growth of the above-ground parts from the perennating rhizome is very rapid in a 0-year old fallow due to the stored food resources in the rhizome and due to the open environment where light is not a limiting factor and that the competition from other species in the community is minimal. The decline in growth with the age of the fallow could be partly related to competition from other species such as *Eupatorium odoratum* (Kushwaha *et al.*, 1983), and partly due to reduced light availability in older falls as shown by Kushwaha and Ramakrishnan (1982).

The initial decline in the below-ground biomass in a 0-year old fallow and the simultaneous increase in the above-ground biomass explains rapid transfer of resources from below to above-ground organs. This is a strategy of under-ground perennating plant species to conserve the resources within the plant itself and transfer it to the growing organs at the time of need (Schier and Zasda, 1973).
A similar strategy was also observed by Saxena and Ramakrishnan (1983) in many sprouting species. The biomass allocation to under-ground organ component increased markedly in the older fallow, an effective strategy for survival during the subsequent slash and burn phase.

In a successional environment during the early phases, on a steep slope abandoned after slash and burn agriculture, there is bound to be considerable heterogeneity in soil chemical characteristics. Such an environment is occupied by both C3 and C4 plant species. Our earlier comparative studies have shown (Saxena and Ramakrishman, 1983) that C3 and C4 species are different with respect to nutrient uptake and use efficiency. C4 species was shown to have a higher efficiency in this regard. The C3 species with a large uptake and utilisation of nutrients for a given dry matter yield are suited to occupy nutrient rich microsites, while C4 species with a lower uptake and higher efficiency of utilisation of nutrients can successfully colonise nutrient poor microsites. The C4 species with a higher efficiency of nutrient use (Brown, 1978) were accompanied by a greater efficiency in nutrient uptake. This may be a case of parallel evolution with the C4 strategy developed under the generally nutrient-poor status of tropical environment (Black, 1971; Brown, 1978) where efficient uptake of nutrients could be important for survival. This niche differentiation of the C3 and C4 species may ensure their co-existence in the post-burn environment I. cylindrica with a C4 photosynthetic strategy is thus adapted to occupy nutrient poor micro-environmental site. The decline in the uptake efficiency of I. cylindrica
with the age of the fallow may be related to reduced availability of nutrient in older fallows where associated species in the fast developing community (Toky and Ramakrishnan, 1983b) compete for the available soil nutrients. The reduced nutrient use efficiency, on the other hand, may be related to the reduction in the vigour of this species in older fallows.

The natural control of *I. cylindrica* in normal course of slash and burn cycle would occur if the fallow period is longer than about 10-years (Toky and Ramakrishnan, 1983a; Mishra and Ramakrishnan, 1983) as it would naturally get eliminated from the successional community after about 5-6 years of fallow development as shown through the present studies. However, other methods of control assume importance under a short jhum cycle and under plantation conditions such as tea and rubber introduced into the region. It must be however noted that the chemical measures are expensive and therefore can have only limited application under plantation conditions where the cost can be effectively met with. Glyphosate was shown through this study to be an effective herbicide, as also suggested by others (Ivens, 1973; Dickens and Buchanan, 1972,1975). Effective control of both aerial and underground parts was achieved over a short term interval after application. Further, application during July-September when adequate moisture is available in the soil was found to be the most effective, as moisture stress could interfere with the absorption and translocation of this chemical (Whitewell and Santlemann, 1975). Under the shifting agricultural system, the more practical control
measure would be to keep the jhum cycle long with a minimum fallow phase of 10 years so that this species could be biologically controlled during secondary succession.
REFERENCES


