

# BIOLOGY OF *Imperata cylindrica* (L.) BEAUV.

ABSTRACT



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## ABSTRACT

The study deals with the ecology of an important weed of the north-eastern region, namely Imperata cylindrica (L.) Beauv. This species is found in highly disturbed sites. They form early successional species after slash and burn agriculture (locally called jhum), as part of the weed community during the first 5-6 years. Under short jhum cycle of 4-5 years (the length of the intervening fallow phase between two successional croppings), this weed along with others forms part of an arrested succession. Regeneration through extensive underground rhizomes contributes to the vigour and rapid spread of this species. Reproduction through seeds also occur under intense biotic disturbance. The present study deals with its altitudinal adaptation, demography and population dynamics of natural as well as introduced population, resource allocation strategies and possible control measures.

1. Studies on adaptational behaviour of two populations of Imperata cylindrica (L.) Beauv. along an altitudinal gradient.

In the present study reciprocal transplants of two populations of Imperata cylindrica from a low elevation at Burnihat and a high elevation at Shillong was done to study their growth behaviour. The lower elevation population showed vigorous growth when grown in its native site than when transplanted to an alien site at higher elevation. The higher elevation population showed a more vigorous growth at lower elevation site than in its native site. This greater vigour of the two populations at lower elevation is related to more favourable temperature conditions. Allocation pattern for biomass

in the two populations did not show any difference at the two altitudes.

Concentration of nutrients such as nitrogen, phosphorus and potassium was more in the two populations when raised at Shillong compared to that at the lower elevation at Burnihat. Allocation of phosphorus and potassium was more for the below-ground organs in the populations at both sites compared to the allocation of nitrogen. Though accumulation of nitrogen, phosphorus and potassium followed a similar trend with the biomass accumulation in the above-ground and below-ground parts, the phosphorus accumulation in the below-ground organs showed a sharp increase for the Shillong population raised at Shillong compared to that for the Burnihat population.

Nutrient uptake efficiency was more in the two populations raised at Burnihat whereas nutrient use efficiency was higher in the case of phosphorus only in the two populations grown at Shillong. Vegetative effort was similar in the two populations raised at the different altitudes. Poor growth behaviour in the two populations when raised at higher elevation Shillong may be attributed to the low soil nutrient status and environmental conditions such as temperature. The present studies suggest the existence of altitudinal ecotypes within the species, though the two populations show a high degree of phenotypic plasticity.

## II. Population dynamics of *Imperata cylindrica* (L.) Beauv. var *majur* related to slash and burn agriculture (jhum) in north-eastern India at two different altitudes.

*Imperata cylindrica* is a noxious weed coming up in early successional fallows after slash and burn agriculture (jhum) which is prevalent in the north-eastern hill regions of India. The

regeneration and establishment patterns through tillers is more vigorous in younger fallows and is drastically curtailed in older ones as evident from mortality/natality patterns and age structure of the tiller populations. The regeneration of the tiller was enhanced in burnt plots as compared to unburnt plots. Differences were observed with respect to recruitment pattern in different cohorts studied. This was related to environmental conditions as well as to increase intra- and/or inter-specific competition. The implication of the results in natural control of this weed under longer slash and burn cycles and arrested succession under shorter cycles has been discussed.

III. Fate of introduced Rhizomes and seeds of Imperata cylindrica (L.) Beauv. after slash and burn agriculture (jhum) in north-eastern India at two different altitudes.

Establishment of the introduced populations of Imperata cylindrica through seeds and rhizomes was studied in 0, 3, 5 and 10-year old fallows with or without the associated herbaceous vegetation. The establishment of the population through both these decreased drastically with the age of the fallow. While the removal of associated herbaceous vegetation improved establishment only in a 0-year old fallow, absence of such a difference in older fallows is related to the presence of the larger shrubs and trees in the community. Mortality was a continuing risk the introduced populations had often to face rather than it being confined to the early phases of establishment alone. Further, density dependant mortality was evident with higher mortality rate at higher densities of the introduced population. The significance of these results

are discussed from the point of view of weed vigour in jhum fallows.

IV. Growth and resource allocation of *Imperata cylindrica* (L.) Beauv. after slash and burn agriculture (jhum) in north-eastern India at two different altitudes.

Growth and resource allocation strategies of *Imperata cylindrica*, an important early successional rhizomatous perennial species, were studied in fallows after slash and burn agriculture at two elevations in Meghalaya. In this species, reproduction is through vegetative sprouts and seeds reproduction is seldom attempted except under stress. The growth of the above-ground parts from the perennating rhizome was rapid in the 0-year old fallow. In 3- and 5-year old fallows, the build up of the under-ground perennating organs was rapid. A greater allocation of biomass to stem component and relatively lesser allocation in older fallows to the leaf component, as compared to the younger fallows may be related with the need of the species to grow taller in older fallows for shade avoidance. The vegetative reproductive allocation increased markedly with the age of the fallow and this may help its success as a weed in the jhum plots during the subsequent slash and burn and cropping. Preferential allocation of nutrients like nitrogen, phosphorus and potassium to the leaf component would help in quicker growth and establishment in the initial phases of fallow regrowth while more allocation of nutrients to the rhizome in a 5-year old fallow would help in its survival through another slash and burn cycle. The decrease in nutrient uptake efficiency of *I. cylindrica* with the age of the fallow may be related to decline in

plant vigour, competition and reduced nutrient availability. The decreased nutrient use efficiency in older fallows may also be a function of reduced vigour of the plants. Since phosphorus is an element absorbed in larger quantities by the herbaceous vegetation, the high phosphorus use efficiency of I. cylindrica may be a conservative mechanism as far as this nutrient is concerned. The growth and allocation strategy of this perennial weed coming after slash and burn agriculture is indicative of its extreme ruderal behaviour.

#### V. Control of Imperata cylindrica (L.) Beauv.

The study deals with the various aspects of the control of Imperata cylindrica (L.) Beauv. In experiment conducted with pure stands of this weed, glyphosate (0.8 kg ai/ha) in two applications at 6-week interval gave lasting control in terms of top growth and damage to the under-ground parts. Although only a low degree of control was observed through sickling, the dry weight of shoot and soluble sugar and starch declined to a level which can be compared to the most effective herbicide treatment obtained through glyphosate. Application of dalapen (3.0 kg ai/ha) followed by paraquat (0.4 kg ai/ha) for six times at 2-week interval provided only short term control through damage to the aerial parts only without any effect on the under-ground rhizomes. Six rounds of application at interval of 15 days or three applications at 10 days interval followed four more at 20 and 30 days intervals gave better control. A 15 days interval and application at longer intervals than 10 days after three rounds can be more effective. Application of glyphosate in August and September was most effective for controlling this weed which coincides with adequate moisture content in the soil. Further, during the active period of growth this

weed was more susceptible to glyphosate.

The results presented here show that successful control of a rhizomatous perennial like I. cylindrica can be obtained with a herbicide such as glyphosate which is rapidly absorbed and translocated before the compound itself is damaged through metabolic activity, as suggested by Sprankle et al., (1975). Further, a herbicide with foliar application and phloem-translocated at a proper stage of growth of the weed and in the presence of adequate moisture in the soil is effective to get sufficient basipetal translocation to the under-ground organs. Another aspect that comes out of the study is that repeated application of contact herbicide such as paraquat can have only limited control of the aerial mass without killing the under-ground vegetative rhizome.

Biological elimination during secondary succession after 5-6 years of fallow regrowth through a jhum cycle of 10 years or more is perhaps the most effective control measure for this weed.

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