

~~NOT FOR ISSUE~~

STUDIES ON WEED BIOLOGY OF
ECHINOCHLOA CRUSGALLI (L) BEAUV.
AND ITS COMPETITIVE
RELATIONSHIPS WITH RICE

(*ABSTRACT*)

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ABSTRACT

Rice is a major crop in the north-eastern region of India. While in Assam valley it is cultivated as a wetland crop, on the hills it may be grown as a wetland crop in the valleys (Toky and Ramakrishnan, 1981; Mishra and Ramakrishnan, 1981) or as direct sown crop on the hill slopes during shifting cultivation (Ramakrishnan et al., 1981). The present study aims at (i) an analysis of the weed community in the rice fields over an altitudinal gradient under both direct sown and transplanted conditions; (ii) an understanding of the ecological equipment of the weed Echinochloa crusgalli (L) Beauv. which is one of the important weeds over an altitudinal range from 54 to 1700 m; (iii) a detailed study of weed crop behaviour in pure and mixed stands under direct sown vs. transplanted conditions and also using different varieties of the weed Echinochloa crusgalli.

Observation on weed-rice association along an altitudinal gradient :

The phytosociology of rice fields along an altitudinal gradient at Gauhati (54 m) in Assam and at Nongpoh (540 m), Barapani (1100 m), Shillong (1500 m) and Upper Shillong (1700 m) in Meghalaya reveals that all the soil types of the above rice fields are slightly acidic, low in exchangeable calcium

and with a range of values for nitrogen (0.19 to 0.32%) and for phosphorus (44 ppm to 69 ppm).

The number of weed species and their period of dominance in the rice fields varied along the altitudinal gradients due to environmental factors and the method of cultivation.

Study on distribution, morphology and growth performance of *E. crusgalli* under natural habitats and reciprocal cultivation at Shillong, Barapani and Burnihat :

Natural populations of *Echinochloa crusgalli* from three altitudinal situations at Burnihat (100 m), Barapani (1100 m) and Upper Shillong (1700 m) were analysed. Though no qualitative differences were discernible between the populations, significant quantitative differences were observed. In their natural habitats, the Upper Shillong population was generally less vigorous compared to the other two. Reciprocal cultivation of the three populations suggested ecotypic differentiation of populations on an altitudinal basis, the high altitudinal population being more vigorous at this elevation and vice versa for the low altitudinal population, the mid-altitudinal population being intermediate between the other two.

Some ecological aspects of seed germination and seedling establishment of the Upper Shillong, Barapani and Burnihat populations of *Echinochloa crusgalli* (L.) Beauv.

The seeds of all the three populations have a long period of dormancy affecting germination and seedling establishment. The main conclusions are as follows:

- (i) Fresh seeds of *E. crusgalli* germinated poorly but on dry storage, germination increased considerably after seven months in July, under laboratory temperature conditions.
- (ii) Acid scarification for different times (2 to 5 minutes) proved to be effective in breaking seed dormancy and promoted germination.
- (iii) Increase in germination due to leaching with water is indicative of the presence of water-soluble inhibitors in the fresh seed.
- (iv) Storage of seeds at different constant temperature and tests done under different constant temperature regimes did not give any clear cut pattern though germination in general was found to be better when tested at 25°C.
- (v) Under alternating temperature regimes, Upper Shillong population responded poorly, Burnihat population gave better germination at 30/20°C and 25/20°C. Here

storage at low temperature (10°C) was advantageous for subsequent germination in the altitudinal regimes.

- (vi) Seedling establishment studies of the three altitudinal populations in water-logged and well drained soils at lower and higher elevations at Burnihat and Shillong respectively suggest that establishment of the Upper Shillong and Barapani populations were better than that of Burnihat population when the experiments were done at Shillong. The reverse was the case in both water-logged and well drained sites when the same experiment was done at Burnihat.

Pure population studies on rice (*Oryza sativa* L.) and *Echinochloa crusgalli* (L.) Beauv.;

1. This study deals with the effect of intra-specific competition in wetland rice varieties (Pusa 2-21, Jaya, IR-8 and Manoharshali), the Upland variety of rice (US-1) and *E. crusgalli* populations collected from three altitudes of (i) Burnihat (100 m), (ii) Barapani (1100 m), and (iii) Upper Shillong (1700 m). While four wetland varieties were grown at Burnihat at an altitude of 100 m, the upland variety was grown at Shillong at an altitude of 1500 m. Burnihat population of *E. crusgalli* was grown at Burnihat while all the three populations of this species were grown at Shillong.

2. Density dependent mortality was observed in all the rice varieties and E. crusgalli populations. Mortality was higher in Mancharshali compared to other wetlands rice varieties. However mortality in the upland variety was generally lower than the direct seeded wetland varieties.
3. Density dependent mortality was generally higher under direct seeding compared to transplantation.
4. A significant difference in mortality due to fertility status could be observed only in some varieties/species.
5. Altitudinal ecotype populations could be discernible in E. crusgalli. Thus the Burnihat population from a lower altitude was more susceptible to mortality compared to high altitudinal population from Upper Shillong suggesting close adaptation of high altitudinal population to a high altitude environment.
6. The growth-yield of all varieties of rice and populations of E. crusgalli were adversely affected due to increased density stress. However, the response was different depending upon varietal/ecotypic make-up and also on the basis of environmental conditions. Thus, among the wetland varieties, Mancharshali showed greatest sensitivity compared to others. Similarly, the Burnihat population grown at Shillong was more sensitive compared to the Upper Shillong population showing a close adaptation to altitudinal conditions. Different parameters like height of plant, leaf area, dry weight yield of plant, seed output/

plant were also affected.

7. This differential response in growth extended also to the proportion of flowering individuals in the population. It is interesting to note that the low altitudinal population of E. crussalli from Burnihat failed to flower at the high altitude at Shillong.
8. The dry weight yield/m² increased with increase in density and then either declined, levelled off or maintained the increase at the density levels tried. This was dependent upon the variety or ecotype population.
9. The seed output/m², however, increased with initial increase in density and always declined at very high densities, suggesting a differential allocation of photosynthate to different organs.
10. Seed weight of different varieties of rice and populations of E. crussalli tended to decline with increase in density stress.

Mixed population studies on rice (Oryza sativa L.) and Echinochloa crussalli (L.) Beauv. at two altitudinal situations at Burnihat and Shillong

This study deals with weed-crop interaction between rice varieties and E. crussalli - populations at two altitudinal situations at Burnihat (100 m) and Shillong (1500 m). For the

study done at Burnihat, two rice varieties Pusa 2-21 and IR-8 were grown in mixtures with the Burnihat altitudinal population of E. crusgalli. The experimental set up had a constant density of the crop with varying densities of the weed which permitted the study of inter-specific effect of the weed on the crop and a comparison of the differential effect on the two rice varieties. In competition with Burnihat population of E. crusgalli the mortality was higher in Pusa 2-21 and plastic characters like leaf area, tiller number, shoot yield, percentage flowering and seed weight all were more adversely affected for IR-8. Conversely, mortality and plasticity was more pronounced in the weed when in competition with IR-8. Growth yield of the crop and the weed was generally higher in a high nutrient soil. At higher elevation at Shillong, a similar mixed culture experimental set up was done but using an upland rice variety and all the three altitudinal populations of E. crusgalli from Burnihat, Barapani and Upper Shillong. A differential response of the crop and the weed was noticed in the mixtures. The weed population from a low altitude at Burnihat was less vigorous in growth when cultured at high altitude situation at Shillong. The Burnihat population failed to flower under this condition. The crop growth was least affected when competing with Burnihat population of E. crusgalli than when associated with the two high altitude populations of Barapani and Upper Shillong. This differential behaviours of the altitudinal populations of E. crusgalli tallies very well with this adaptation to their

natural environmental conditions and it has been suggested that in weed-crop studies the conventional species cannot be treated as a homogenous entity.