DYNAMICS OF WEED POPULATIONS IN HILL AGROECOSYSTEMS OF MEGHALAYA

ABSTRACT

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The crop fields under 'jhum' (slash and burn agriculture) and terrace cultivation in north-eastern India are heavily infested with a large variety of native and exotic weeds due to favourable climatic conditions of the region. In absence of any effective weed control measure, weeds pose a serious threat to the crop growth and yield under both the systems of cultivation. Since an understanding of their population and growth behaviour is important both from agronomic and ecological view points, a study of the population behaviour of the dominant weeds in different fields under 'jhum' and terrace agroecosystems was undertaken. The study was carried out during 1988-1990 in the 'jhum' and terrace fields located at Upper Shillong (high altitude site) and in terrace fields at Barapani (low altitude site) near Shillong. At high altitude site, the experimental fields of Central Potato Research Station, representing the terrace system and nearby crop fields of a farmer under 'jhum' system were selected for the study. At low altitude the study was conducted in the Research Complex of Indian Council of Agricultural Research for North-Eastern Hill Region. The study was carried out in potato, maize, radish and cauliflower crops at Upper Shillong and in maize, radish, groundnut and linseed crops at Barapani.

The composition of weed flora varied between 'jhum' and terrace fields and also between high and low altitudes. The altitudinal variation in composition was more prominent than the difference between 'jhum' and terrace fields. At high altitude, the number of weeds was much lower (16) than the low altitude fields (39). In 'jhum', the number of weeds identified in potato, maize, radish and cauliflower fields was 14, 15, 14 and 14, respectively, while the corresponding number in terrace was 14, 16, 16 and 15, respectively. At low altitude, in both maize and groundnut fields 39 species were recorded, while 31 and 22 weed species were identified in radish and linseed fields, respectively. The number of annual species was more than the perennials in all the fields at both the altitudes but the relative proportion of perennials was more at the low altitude.

At Upper Shillong, almost all fields under 'jhum' and terrace were dominated by *S. arvensis*, *P. alatum* and *G. ciliata*, which together shared more than 70% dominance. At Barapani on the other hand, dominance was shared by many species and three dominant species *E. sonchifolia*, *G. ciliata* and *R. pilosa*, selected for study shared *ca* 30-35% dominance. Peak density and mean IVI values of dominant weeds were always higher at Upper Shillong than Barapani and 'jhum' fields showed higher values than the terrace fields. The abundance of individual species varied from one crop field to another. Species diversity was higher in terrace fields than in 'jhum'.

In order to explain the population behaviour of the dominant weeds in different crop fields, four microenvironmental variables viz. photosynthetically active radiation (PAR), relative humidity, soil moisture and soil temperature were regularly measured at fortnightly interval during the study period. PAR was consistently higher at high altitude throughout the year. In all the crop fields, light interception by the crop-weed canopy increased up to 60 days of the crop age and then declined until harvest. Interception was significantly higher (56-68%) in 'jhum' than terrace fields (36-58%). Cropwise interception was 53-68% in potato, 50-65% in cauliflower, 49-65% in radish and 36-57% in maize field. Greater light interception in the 'jhum' fields was attributed to the plant population density, which was about two fold higher in 'jhum' than terrace fields. Seasonal variation in relative humidity was prominent at both the sites; the values were higher in rainy season than autumn and winter. Altitudinal difference in soil moisture i.e., relatively higher value at low altitude (23.5% at Barapani vs. 21.4% at Upper Shillong during peak rainfall period) despite low rainfall seemed to be related to soil texture, which was clay loam at Barapani and sandy loam at Upper Shillong. Higher mean soil temperature at Barapani (21.5°C) than Upper Shillong (17.5°C) was related to air temperature which was higher throughout the year at the former site.

In most of the crop fields weed seedlings were recruited in three distinct cohorts. The first cohort was recruited within 10

days of crop sowing, second and third cohorts emerged after about 15 and 45 days of emergence of the first cohort. In general, the emergence percentage decreased in successive cohorts, the value was much higher in the first cohort than the second and third cohorts. Emergence percentage in different cohorts of the dominant weed species varied significantly between the two altitudes among different crops, but the variation between 'jhum' and terrace was insignificant. The cohortwise seedling emergence was significantly influenced by PAR, relative humidity, soil moisture and soil temperature. The relative importance of these factors, however, varied from crop to crop and also from species to species.

The mean population density of total recruited seedlings of all the weed species, was significantly higher in 'jhum' (3014 plants/m^2) than the terrace fields (1541 plants/m^2) at high altitude. Low altitude site had much lower mean density (677 plants/m^2). The density of *G. ciliata* was higher in terrace, while that of *P. alatum* and *S. arvensis* was higher in 'jhum' fields. *G. ciliata* which was present at both the altitudes showed higher population density at the high altitude.

The survivorship curves of *P. alatum, S. arvensis, G. ciliata, E. sonchifolia* and *R. pilosa* were similar. The first and second seedling cohorts exhibited high juvenile mortality, while the third cohort was characterised by constant rate of mortality throughout the life. Half-lives of the early

recruiting cohorts were significantly higher than the late recruiting cohorts.

In order to characterise the weed population flux in different crop fields, seedling recruitment (K), survivorship (p) and fecundity (F) rates and rate of increase in the viable buried weed seed population in soil (λ) were computed. The seedling recruitment rate ranged between 6-44% in terrace and 6-31% in 'jhum' depending on the crop. The survivorship rate ranged between 21-50% in 'jhum' and 25-47% in terrace. The fecundity rate was more in terrace than 'jhum' and was related to the population density of adult plants which was two fold higher in the latter than the former. The chief cause of higher annual rate of increase in viable buried seed population in 'jhum' than terrace was the traditional method of weed control in 'jhum' wherein the uprooted weeds, some of which bearing a large number of seeds are buried in the field it self. On the other hand, removal of uprooted weeds from the field and use of herbicides were responsible for the reduction in the total buried weed seed population in the terrace fields.

The growth of weeds was assessed on the basis of dry matter production, which varied between the two agroecosystems. Total average dry matter production of weeds was 1012 $g.m^{-2}$ in 'jhum' fields and 790 $g.m^{-2}$in terrace fields. At Upper Shillong major portions of dry matter production (66-78%) was contributed by *S. arvensis*, *P. alatum* and *G. ciliata* while that at Barapani (30-

39%) was contributed by *E. sonchifolia, G. ciliata* and *R. pilosa*. In all the species, first cohort contributed about 75%, while the share of second and third cohort was 20% and 5%, respectively. This clearly indicates that along with survival, growth of the late emerging cohorts was also adversely affected by the early recruited cohorts of different weed species as well as by the established crop plants in the field. PAR and soil moisture were the two most important environmental variables, which influenced the dry matter yield of different weeds. At low altitude, however, influence of soil moisture was stronger than PAR. The reduction in crop yield was more in 'jhum' (20-48%) than terrace fields (19-34%).

In a nutshell, the seedling emergence, survivorship and half-lives of dominant weeds as well as the dynamics of total weed population was broadly similar in 'jhum' and terrace agroecosystems. However, the dominance distribution pattern in the weed community, rates of seedling emergence and fecundity, population density of recruited seedlings and buried weed seed populations were different in the two agroecosystems and were also influenced by the altitudinal variation in the study sites.