

## Floristic Composition of the Weed Flora, Seasonal Variation and Phenology of Some Weeds of Agriculture Lands in Khasi Hills, Meghalaya

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Weeds, 115 in number, belonging to 30 families are shown to be associated with paddy, maize, potato and other crops in Khasi Hills of Meghalaya. Of these, 17 are restricted to paddy fields while 7 have been recorded in all fields. The dicotyledonous weeds are more in the number of species but lower in density than the monocotyledonous ones.

Significant variation is marked both in the number of species as well in density and frequency of individual species. Maximum number of weeds are seen during the period May to October, and the number gradually decreases during winter (December-January). The frequency of weeds like *Polygonum plebeium*, *Rotala rotundifolia*, and *Gnaphalium luteo-album*, increases from winter to summer, whereas the reverse is true with *Eragrostis unioides*, *Galinsoga parviflora* and *Ageratum conyzoides*.

**Key Words:** Weed flora, Seasonal variation, Phenology, Agriculture lands, Meghalaya

### Introduction

In a country like India where agriculture predominates, weeds have a major role to play in the economy of the country. However, these plants not only affect the crop plants by competing with them for necessary requirements, but also act as alternate hosts for various fungal, bacterial and viral pathogens of crop plants. For effective control measures of these unwanted plants, a knowledge of their floristic composition in different agro-ecosystems, and their seasonal behaviour and phenology, are essential. It is more so in a region like Khasi Hills where the agriculture practices

are quite different due to hilly terrain. Moreover, the 'jhumming' or shifting cultivation has influenced the composition of the weed flora to a great extent. The present investigation deals with the floristic composition, seasonal variation and phenological pattern of some common and dominant weeds of paddy, maize, potato, and other vegetable crops in Khasi Hills of Meghalaya.

Though there are numerous reports on the floristic composition and weed flora of agriculture fields (Pal & Bhattacharya 1956, Chakravarty 1957, Majumdar 1962, Dutta

& Maiti 1964, Tripathi 1964, Mahapatra et al. 1965, Bandopadhyaya 1972) studies dealing with the seasonal variation and phenological pattern are rather scanty. The only useful account of this nature has been given by Tripathi and Misra (1971). Tripathi (1977) has also discussed the weed problem in an ecological perspective, while Dutta and his co-workers have studied the autecology of a number of weeds of West Bengal (Dutta & Biswas 1972, Dutta & Roy 1972, 1973).

### Location and climate

The district of Khasi Hills lies in the state of Meghalaya (90° 45' and 92° 5' E longitude and 25° 5' and 26° 5' N latitude).

The region experiences a tropical monsoon climate. The Meteorological data for Khasi Hills for the year 1977 are given in figure 1, and based on the climatic factors, 3 seasons can be recognised—winter (November-February), summer or spring (March-April), and rainy (May-October).

### Materials and methods

Different agriculture fields varying in altitude from 100 m in Burnihat to 1496 m in

Shillong were selected for survey and study of weeds. The weeds were surveyed in all seasons regularly to get a complete picture of the weed flora. All the weeds are preserved in the herbarium of North-Eastern Hill University (NEHU\*) following routine herbarium practice (Jain & Rao 1976). The total number of weeds collected in different months were correlated with the mean monthly temperatures to study the variation pattern in floristic strength of these weeds in different months.

Three different fields at each of the 3 different altitudes namely Burnihat (100 m), Nongpoh (595 m) and Shillong (1496 m) were selected for study of seasonal variation in density and frequency of weed species. At least 10 dominant weeds were considered for this purpose. One m<sup>2</sup> quadrat was used for finding the density and frequency of these weeds. The number of quadrats varied depending upon the area of the fields and were studied randomly. All the seasons were studied using the same number of quadrats and from the same fields. Frequency and density of the weeds were calculated using the following formulae.

$$F = \frac{\text{No. of sampling units in which weed species occurred}}{\text{No. of quadrats studied}} \times 100$$

$$D = \frac{\text{Total No. of plants of a given weed in all the quadrats}}{\text{Total No. of quadrats studied}}$$

The phenological events like germination (G), vegetative (V), flowering (Fl), fruiting (Fr), seeding (S), and death (D) of 10 commonest weeds were noted in time sequence (table 3). For phenological study, information from field situations as well as from herbarium was gathered. Though considerable variation in the phenological pattern

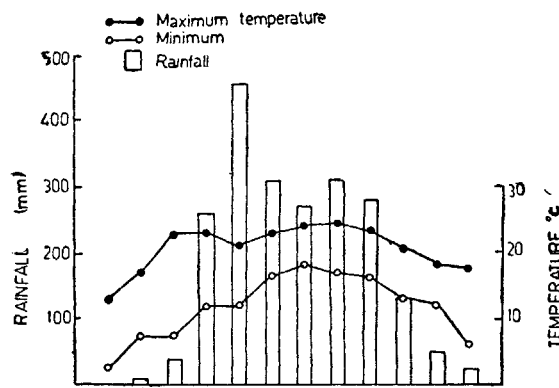


Fig. 1 Ombrothermic diagram for Shillong (1977)

\*The abbreviation 'NEHU' is yet to find a place in the Index herbariarum

existed at different altitudes, a generalised picture is presented for Khasi Hills.

### Results and Discussion

A detailed survey of the weed flora in different agricultural fields like paddy, maize, potato and other minor crop plants in Khasi Hills has yielded 115 weed species belonging to 30 families (table 1). As is evident from the table, the different agriculture lands support different characteristic weed species. Seventeen weeds were found exclusively in paddy fields while seven weeds were common in all the crop lands.

In general, the dicotyledonous species much outnumbered the monocotyledonous one but the density of monocotyledonous weeds was greater. Among monocotyledons, Poaceae and Cyperaceae top the list with 34 and 8 weeds respectively. Similarly Asteraaceae in dicotyledons with 13 species forms the dominant family. Most of the Poaceae and Cyperaceae members constitute characteristic weed flora of the paddy fields, during October to December, before the harvest of the paddy crop.

Significant seasonal variation in the weed flora was observed not only in the number of weed species in different months (figure 2), but also in the density and frequency of the individual species (table 2). It is seen that in general the no. of weed species increases with the increase in temperature from February onwards. January being the coldest month of the year supports very few weed species. The growth and vigour of crop plants coupled with the climatic factors of a given season play an important role in the distribution and spread of these weeds. During the growth period of paddy, when the fields are mostly inundated, aquatic weeds like *Echinochloa colonum*, *Ammannia multiflora*, *Rotala rotundifolia*, *Cyperus haspan*, *C. distans*, *Eichhornia crassipes*, *Monochoria hastata* and *Juncus prismato-*

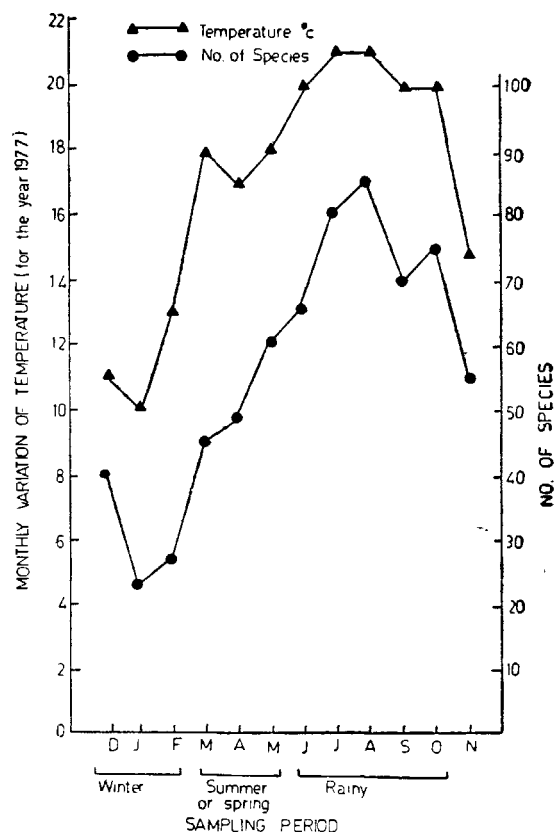


Fig. 2. Weed flora in relation to temperature

*carpus* appear. During and immediately after the harvest of paddy, when the fields are comparatively dry, weeds like *Hydrolea zeylanica*, *Polygonum plebeium*, *Eleusine indica*, *Sphaeranthus indicus* *Eragrostis uniolooides*, *Digitalia spp.*, *Fimbristylis dichotoma* and various members of Asteraaceae dominate. The frequency of weeds like *Polygonum plebeium*, *Rotala rotundifolia* and *Gnaphalium luteo-album* increases from winter to summer whereas reverse is the case with *Eragrostis uniolooides*, *Galinsoga parviflora* and *Ageratum conyzoides*, etc.

A distinct phenological pattern exists in different weeds. The phenological events

Table 1 Common weeds in different agro-Ecosystems of Khasi Hills

Sl. No.	Name of Species	Family	Crop fields			
			P	M	Pt	O
1.	<i>Achyranthes aspera</i> L.	Amaranthaceae	+	+	—	+
2.	<i>Ageratum conyzoides</i> L.	Asteraceae	+	+	+	+
3.	<i>Agrimonia eupatorium</i> L.	Rosaceae	—	+	—	+
4.	<i>Alternanthera sessilis</i> (L.) R. Br.	Amaranthaceae	+	—	—	+
5.	<i>Amaranthus spinosus</i> L.	—do—	—	+	—	—
6.	<i>Amaranthus viridis</i> L.	—do—	+	+	—	—
7.	<i>Ammannia multiflora</i> Roxb.	Lythraceae	+	—	—	—
8.	<i>Anaphalis contorta</i> Hk. f.	Asteraceae	+	—	+	+
9.	<i>Artemesia nilagirica</i> (Cl.) Pamp.	—do—	+	+	+	—
10.	<i>Arundinella bengalensis</i> (Spreng.) Druce	Poaceae	+	+	—	—
11.	<i>Axonopus compressus</i> (Sw.) Beauv.	—do—	+	+	—	+
12.	<i>Bidens pilosa</i> L.	Asteraceae	+	—	+	+
13.	<i>Brachiaria distachya</i> (L.) Stapf	Poaceae	+	+	+	—
14.	<i>Brunella vulgaris</i> L.	Lamiaceae	+	—	+	+
15.	<i>Bulbostylis barbata</i> (Rottb.) Kunth	Cyperaceae	+	—	—	+
16.	<i>Capillipedium assimile</i> (Steud.) A. Camus	Camus Poaceae	+	—	—	—
17.	<i>Centotheca latifolia</i> (Osb.) Trin.	Poaceae	+	+	—	—
18.	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	—do—	+	+	—	+
19.	<i>Coix lacryma-jobi</i> L.	—do—	+	+	—	—
20.	<i>Commelina benghalensis</i> L.	Commelinaceae	+	—	+	—
21.	<i>Crassocephalum crepidioides</i> (Benth.) Moore	Asteraceae	+	+	+	+
22.	<i>Cyanotis vaga</i> (Lour.) Schult. f.	Commelinaceae	+	—	+	—
23.	<i>Cynodon dactylon</i> (L.) Pers.	Poaceae	+	—	+	—
24.	<i>Cyperus distans</i> L.f.	Cyperaceae	+	—	—	—
25.	<i>Pycneus globosus</i> (All.) Peichb.	—do—	+	—	+	—
26.	<i>Cyperus haspan</i> L.	—do—	+	—	—	—
27.	<i>Cyperus iria</i> L.	—do—	+	+	—	—
28.	<i>Cyrtococcum accrescens</i> (Trin.) Stapf	Poaceae	+	+	+	—
29.	<i>Cyrtococcum oxyphyllum</i> (Steud.) Stapf	—do—	+	+	+	—
30.	<i>Dactyloctenium aegyptium</i> (L.) Beauv.	—do—	+	+	—	—
31.	<i>Desmodium triflorum</i> (L.) DC.	Papilionaceae	+	+	—	—
32.	<i>Digitaria adscendens</i> (H.B.&K.) Henr.	Poaceae	+	+	+	+
33.	<i>Drymaria cordata</i> (L.) R. & S.	Caryophyllaceae	+		+	+
34.	<i>Dysophylla quadrifolia</i> Benth.	Lamiaceae	+	+	—	+
35.	<i>Echinochloa colonum</i> (L.) Link	Poaceae	+	—	—	—
36.	<i>Echinochloa crusgalii</i> Beauv.	—do—	+	—	—	—
37.	<i>Eichhornia crassipes</i> (Mart.) Solms	Pontederiaceae	+	—	—	—
38.	<i>Eleocharis congesta</i> Don	Cyperaceae	+	—	—	+
39.	<i>Elephantopus scaber</i> L.	Asteraceae	+	+	—	+
40.	<i>Eleusine indica</i> (L.) Gaertn.	Poaceae	+	+	—	+
41.	<i>Eragrostis uniolooides</i> (Retz.) Steud.	—do—	+	—	—	—
42.	<i>Erigeron linifolius</i> Willd.	Asteraceae	+	+	+	+
43.	<i>Eriocaulon brownianum</i> Mart.	Eriocaulaceae	+	—	—	—
44.	<i>Chromolaena odorata</i> (L.) King & Robinson	Asteraceae	+	+	—	+
45.	<i>Euphorbia hirta</i> L.	Euphorbiaceae	+	+	+	—

Table 1 (contd.)

Sl. No.	Name of Species	Family	Crop fields			
			P	M	Pt	O
46.	<i>Fagopyrum cymosum</i> Meisan.	Polygonaceae	+	+	—	+
47.	<i>Fimbristylis dichotoma</i> Vahl	Cyperaceae	+	—	—	+
48.	<i>Floscopa scandens</i> Lour.	Commelinaceae	+	—	—	—
49.	<i>Galinsoga parviflora</i> Cav.	Asteraceae	+	+	+	—
50.	<i>Gnaphalium luteo-album</i> L.	—do—	+	—	+	+
51.	<i>Hedyotis scandens</i> Roxb.	Poaceae	+	—	+	—
52.	<i>Heliotropium indicum</i> L.	Boraginaceae	+	+	—	+
53.	<i>Hemarthria compressa</i> (L.f.) R. Br.	Poaceae	+	—	—	—
54.	<i>Hydrolea zeylanica</i> Vahl	Hydrophyllaceae	+	—	—	—
55.	<i>Hymenachne assamica</i> (Hk. f.) Hitch C.	Poaceae	+	—	—	+
56.	<i>Hypocharis radiata</i> L.	Asteraceae	+	+	+	+
57.	<i>Ichnanthus vicinus</i> (F.M. Bail) Merr.	Poaceae	+	+	—	+
58.	<i>Imperata cylindrica</i> (L.) Beauv.	—do—	+	+	—	+
59.	<i>Juncus prismatocarpus</i> R. Br.	Juncaceae	+	+	—	+
60.	<i>Justicia procumbens</i> L.	Acanthaceae	+	+	—	+
61.	<i>Lantana camara</i> L.	Verbenaceae	+	+	—	+
62.	<i>Leersia hexandra</i> Sw.	Poaceae	+	—	—	—
63.	<i>Leptochloa chinensis</i> (L.) Nees	—do—	+	+	—	—
64.	<i>Leucas lavandulifolia</i> Sm.	Lamiaceae	+	+	—	+
65.	<i>Lindernia crustacea</i> (L.) Muell.	Scrophulariaceae	+	—	+	+
66.	<i>Lophatherum gracile</i> Brongn.	Poaceae	+	+	—	+
67.	<i>Ludwigia octovalvis</i> (Jacq.) Raven	Onagraceae	+	—	—	+
68.	* <i>Lygodium flexuosum</i> Sw.	Schizaeaceae	+	+	—	—
69.	<i>Mimosa pudica</i> L.	Mimosaceae	+	—	+	+
70.	<i>Mikania micrantha</i> H. B. & K.	Asteraceae	+	—	—	—
71.	<i>Monochoria hastata</i> (L.) Solms	Pontederiaceae	+	—	—	—
72.	<i>Nasturtium indicum</i> L.	Brassicaceae	+	—	—	+
73.	<i>Nicandra physalodes</i> (L.) Gaertn.	Solanaceae	+	—	+	+
74.	<i>Oplismenus compositus</i> (L.) Beauv.	Poaceae	+	+	—	—
75.	<i>Oabeckia capitata</i> Benth.	Melastomataceae	+	+	+	+
76.	<i>Ottelia alismoides</i> (L.) Pers.	Hydrocharitaceae	+	—	—	—
77.	<i>Oxalis corniculata</i> L.	Oxalidaceae	+	—	+	+
78.	<i>Oxalis corymbosa</i> DC.	—do—	+	—	+	+
79.	<i>Panicum auritum</i> Presl.	Poaceae	+	+	—	+
80.	<i>Panicum brevifolium</i> L.	—do—	+	—	—	—
81.	<i>panicum paludosum</i> Roxb.	—do—	+	—	+	—
82.	<i>Panicum psilopodium</i> Trin.	—do—	+	—	+	—
83.	<i>Paspalidium flavidum</i> (Retz.) Camus	—do—	+	—	—	—
84.	<i>Paspalidium punctatum</i> (Burm.) Camus	—do—	+	—	+	—
85.	<i>Paspalum conjugatum</i> Berg.	—do—	+	—	+	+
86.	<i>Paspalum orbiculare</i> Forst.	—do—	+	—	+	+
87.	<i>Plantago major</i> L.	Plantaginaceae	+	+	—	+
88.	<i>Pogonatherum crinitum</i> Trin.	Poaceae	+	+	—	—
89.	<i>Pogostemon brachystachys</i> Benth.	Lamiaceae	+	+	—	+

\*Pteridophyte

Table 1 (contd.)

Sl. No.	Name of Species	Family	Crop fields			
			P	M	Pt	O
90.	<i>Polygonum hydropiper</i> L.	Polygonaceae	+	—	—	+
91.	<i>Polygonum orientale</i> L.	—do—	+	—	+	+
92.	<i>Polygonum plebeium</i> R. Br.	—do—	+	—	+	+
93.	<i>Pottentila mooniana</i> Wt.	Rosaceae	+	+	+	+
94.	<i>Pouzolzia zeylanica</i> (L.) Benn.	Urticaceae	+	+	+	—
95.	<i>Pseudochinoleana polystachya</i> (H.B.&K.) Stapf	Poaceae	+	+	—	+
96.	<i>Rotala rotundifolia</i> (Don) Koehne	Lythraceae	+	—	+	+
97.	<i>Rubia cordifolia</i> L.	Rubiaceae	+	+	—	+
98.	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	+	—	+	+
99.	<i>Rungia parvi flora</i> Ness.	Acanthaceae	+	+	+	—
100.	<i>Sacciolepis indica</i> (L.) Chase	Poaceae	+	—	—	—
101.	<i>Schoenoplectus juncooides</i> (Roxb.) Palla	Cyperaceae	+	—	—	—
102.	<i>Scutellaria discolor</i> Coleb.	Lamiaceae	+	+	—	+
103.	<i>Setaria glauca</i> (L.) Beauv.	Poaceae	+	+	—	+
104.	<i>Setaria palmifolia</i> (Koen.) Stapf	Asteraceae	+	—	+	+
105.	<i>Siegesbackia orientalis</i> L.	—do—	+	+	—	+
106.	<i>Spergular arvensis</i> L.	Caryophyllaceae	—	—	+	+
107.	<i>Sparganium ramosum</i> Huds.	Typhaceae	+	—	—	—
108.	<i>Solanum myriacanthum</i> Dunn.	Solanaceae	+	+	—	+
109.	<i>Solanum nigrum</i> L.	—do—	+	+	—	+
110.	<i>Sporobolus diander</i> (Retz.) Beauv.	Poaceae	—	+	—	—
111.	<i>Thysanoleana maxima</i> (Roxb.) O. Kuntze	—do—	+	—	+	+
112.	<i>Tridax procumbens</i> L.	Asteraceae	+	—	—	+
113.	<i>Trifolium repens</i> L.	Lamiaceae	+	—	+	+
114.	<i>Vernonia cinerea</i> (L.) Less.	Asteraceae	+	+	—	+
115.	<i>Xanthium strumarium</i> L.	—do—	+	—	+	+

P, Paddy; M, Maize; Pt, Potato; O, Other cultivated land

Table 2 Seasonal variation in density and frequency of 10 dominant weed species

Name of species	Density per m <sup>2</sup>			Frequency (%)		
	Winter	Spring	Summer	Winter	Spring	Summer
<i>Ageratum conyzoides</i>	2.9	1.3	0.8	50%	35%	10%
<i>Echinochloa colonum</i>	1.3	0.6	0.3	35%	25%	10%
<i>Eragrostis uniolooides</i>	1.8	0.5	0.2	25.5%	5%	5%
<i>Galinsoga parvi flora</i>	2.9	1.6	0.1	18.2%	17.5%	10%
<i>Gnaphalium luteo-album</i>	2.8	4.2	6.1	40%	50%	65%
<i>Hydrolea zeylanica</i>	6.1	1.8	0.7	48%	20%	10%
<i>Ludwigia octovalvis</i>	4.7	0.9	0.5	63%	25%	10%
<i>Polygonum plebeium</i>	3.5	5.3	0.7	73%	22%	100%
<i>Rotala rotundifolia</i>	4.6	5.0	5.8	68%	82%	80%
<i>Setaria glauca</i>	1.7	4.5	0.2	31%	22.5%	10%

Table 3 Phenology of 10 common weeds

Sl. No.	Name of species	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1.	<i>Ageratum conyzoides</i> L.	S,Fr.	S,D	G	G	V	V	V	Fl.	Fl.	Fl.	Fl,Fr.	Fr,S
2.	<i>Echinochloa colonum</i> (L.) Link					G	G,V	Fl.	Fl,Fr.	Fr,S	Fr,S	S,D	
3.	<i>Eragrostis uniloides</i> (Retz.) Steud.					G	G	G,V	V	V	Fl,Fr.	Fl,Fr.	Fl,Fr.
4.	<i>Galinsoga parviflora</i> Cav.	S	S,D	G	G,V		V,Fl.	V,Fl.	Fl.	Fl.	Fl,Fr.	Fl,Fr.	Fr.
5.	<i>Gnaphalium luteo-album</i> L.	D	G	G	G,V	G,V	V,Fl.	Fl.	Fl.	Fl,Fr.	Fl,Fr.	Fr,S	Fr,S
6.	<i>Hydrolea zeylanica</i> Vahl	Fl,Fr.	Fr.	Fr,S	S,D						G	G,V	V,Fl.
7.	<i>Ludwigia octovalvis</i> (Jacq.) Raven	D						G	G,V	V,Fl.	Fl,Fr.	Fr.	S
8.	<i>Polygonum plebetium</i> R. Br.	S	S,D			G	G,V	V	V	Fl.	Fl,Fr.	Fr.	Fr,S
9.	<i>Rotala rotundifolia</i> (Don) Koen.	V,Fl.	Fl.	Fl.	Fl,Fr.	Fr.	S	S,D	G	G,V	V	V	V
10.	<i>Setaria glauca</i> (L.) Beauv.						G	G,V	V,Fl.	Fr,S	S,D		

of 10 dominant weeds have been given in table 3. Most of the weeds flower and fruit during June to November. Weeding has to be done therefore before this period. Otherwise the seeds of weeds produced would be disseminated and buried in the soil. Whenever favourable conditions prevail, these seeds germinate and contribute to the weed population. Monocotyledonous weeds generally flower and fruit earlier in comparison to the dicotyledonous weeds.

Phenology of 10 common weeds is discussed. Most of the weeds germinate during May-June and bloom during August-October. The severe frost during winter months destroys much of the weed flora and only

the hardier taxa like *Eupatorium* spp. manage to thrive during winter.

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