

*CHAPTER = III*

**GENERAL  
DISCUSSION**

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### 11.1 CROPS AND WEEDS

Malda, the southernmost district of North Bengal, is situated near the center of the state of the state of West Bengal (India). The district is famous for its prized variety of Mango and for the production of raw silk yarn ( about 80 % of state out put). The landscape of the district is almost a plain land, mainly consists of alluvial loam and red muddy soil. The district is drained by three rivers, namely, the Ganga, the Mahananda and the Kalindri. Wide variety of crop plants are cultivated in the district throughout the year, which can be divided into three cropping seasons, namely, Boro, Aman and Rabi. Apart from large acreage of mango orchards, most of the cultivated lands produce two crops in a year.

As the district is an agrarian one and weed flora associated with crop is very much responsible for the ultimate production, so, in the present work attempt has been made to explore such plants in the district of Malda. For this purpose crops were selected in such a way (chapter 2) so that three seasons (*viz.* Boro, Aman and Rabi) of cultivation practice of an year of the district can be covered. Random sampling during the four years long survey has recorded 132 species of weeds. Compared with the available weed floras from other districts, the number is quite significant ( Majumder 1962, Paul and Bhattacharyya 1959, Chakroborty 1957, Prain 1905, Neogi and Rao 1980 ) because -

- (I) It is a very small district (3713 sq. km)
- (ii) Most of the fields are cultivated round the year
- (iii) Climate is quite dry with low and narrowly distributed precipitation
- (iv) Regular practice of weeding
- (v) The fast growth of crop plants which offers the highest degree of competition to weeds.

### 11.2 NATURE OF WEEDS

The recorded 132 weed species comes under 97 genera and 44 families of angiosperms and 2 genera and 2 species of pteridophytes. Dicotyledons are represented by 93 species, 74 genera and 37 families and monocotyledons are represented by 37 species, 23 genera and 7 families. More representative of bulky taxon dicotyledons is quite natural. But among the first three most successful families there are two monocotyledonous families with Poaceae at the top which is followed by Asteraceae and Cyperaceae respectively. This observation is nearly *at per* with other such floras. The exceptionally broad ecological

amplitude of the members of Poaceae rendered them as most successful weed in all floras. Their modes of propagation, development of apomictic embryo, high rate of vegetative propagation by runners, *sobols*, tillers, etc. are behind their success. Contribution of weeds of other two families Asteraceae and Cyperaceae are almost two parallel to Poaceae. Both the families are cosmopolitan in distribution, produce easily dispersible small seeds and have wide ecological amplitude. Further more members of Cyperaceae can produce numerous vegetative propagules, whereas members of Asteraceae have the special structure with their fruits. All these characters probably help the members of Cyperaceae and Asteraceae to be successful weed of crop fields. However success of other families like Scrophulariaceae, Euphorbiaceae, Acanthaceae, Amaranthaceae, Eriocaulonaceae etc. are due to their wide ecological amplitude, large number of small seeds, wide flowering and fruiting period etc. Analysis at the generic level shows that *Cyperus* contributed the highest number of six species, followed by *Lindernia*, *Digitaria*, and *Eragrostis* (each with 4 species) and all are widely distributed. Majority of them are either cosmopolitan or pantropic in distribution and others are very wide in regional distribution. There are also present some rare plants viz. *Cochleria cochlearioides*, *Dichondra repens*, and *Asphodelus tenuifolius*. These are basically with wide distribution but the frequency of occurrence is very low. *Orobanche aegyptiaca* (Orobanchaceae) a total root parasite has been recorded with a new crop *Cicer arietinum* and other eight new hosts for the parasite have also been recorded from the district of Malda during Rabi season. These newly recorded hosts are *Argemone mexicana*, *Fumaria indica*, *Launaea aspleniifolia*, *Leucas indica*, *Oxalis corniculata*, *Polygonum plebeium*, *Vernonia cinerea* and *Digitaria ciliaris*. This is for the first time so many wild hosts for *Orobanche aegyptiaca* have been recorded and among these hosts *Digitaria ciliaris* deserves special mention because it is the only monocotyledonous hosts recorded so far for the species. As this parasite has a large number of host-crops and the parasite is not visible before the emergence of scape when the crop plants are quite mature. So, special attention should be given to *Orobanche aegyptiaca* during the management practices. The weed flora of the district of Malda also contain 20 species (15.2 %) of naturalised exotics which are known to be the elements of the floras of America, South East Asia, Eurasia and Africa. These exotic weeds grow mainly during Rabi and Boro seasons. Among the two pteridophytic species *Marsilea quadrifida* grows throughout the year in varying densities Where as *Ceratopteris thalictroides* grows mainly during Aman season.

### **11.3 PATTERN OF DISTRIBUTION OF WEEDS**

Basic informations about density, frequency and dominance of different members of a weed flora are the prerequisites to frame a strategy to combat them. Data collected from 180 quadrates (1m x 1m) have been analysed for the determination of Relative Density (RD), Relative Frequency (RF), Relative Dominance (RDm) and Importance Value Index (IVI). 61 species of higher plants have been recorded with the following seasonwise distribution: Aman 28 species, Rabi 35 species and Boro 18 species (Table 4.10 to 4.18)

of which many species have been observed to occur in more than one season. A total 28 species have been recorded from the fields of Aman Paddy. Among the 'Thanas' highest and lowest number of species have been recorded from Kaliachak (56.6 %) and Gazole (33.7 %) respectively. Within the survey period, highest number of individuals (4047) have been recorded during 1992 and largest area (68736 cm<sup>2</sup>) covered by weeds have been recorded during 1993. *Ludwigia perennis* has been recorded as most frequent weed (RF 78.33 %) during Aman and among the top ten frequent weeds, monocots occupied seven positions, dicot two positions and *Marsilea quadrifida*, a pteridophyte also has a position (7th) within first ten. *Murdannia nudiflora* (RD 10.43 %) has been recorded with highest Relative Density and among such first ten weeds, monocots occupied five positions, and dicots four positions. *Marsilea quadrifolia* has been recorded as most dominant weed (RDm 10.83 %). The determined IVI value revealed that *Ludwigia perennis* (IVI 96.00) is the most important weed of Aman. Among the top ten dominant and important weeds, monocots occupied seven positions (*Cyperus rotundus*, *C. difformis*, *Echinochloa colona*, *Tonningia axillaris*, *Cynodon dactylon*, *Fimbristylis miliacea* and *Murdannia nudiflora*) dicots two positions (*Ludwigia perennis*, *Alternanthera sessilis*) and pteridophytes one position (*Marsilea quadrifida*). So, over all in Aman season of the district monocotyledonous weed recorded as frequent, dense, dominant and important than dicotyledonous weed though *Ludwigia perennis* came out as most important weed during this season. Out of ten most important weed species, there are seven monocotyledons, again five of which are either grasses and sedges. Within the 'Thanas', 'Habibpur' has been recorded as most weeded one.

A total of 35 species have been recorded from the fields of mustard and pulses in the district of Malda during Rabi season. Among the 'Thanas', highest and lowest number of species have been recorded from Englishbazar (55.4 %) and Gazole (29.7 %) respectively. Within the survey period, highest number of individuals (1932) and largest area (40299 cm<sup>2</sup>) covered by weeds have been observed during the year 1992. During this season *Leucas indica* has been recorded as most frequent (RF 80.67), most dense (RD 19.39) most dominant (RDm 17.74) and most important (IVI 117.87) weed. For phytosociological characters of top ten weed species it has been observed that dicotyledonous weeds occupied 80 % - 100 % positions. Still, two monocotyledonous species *Cyperus rotundus* (8th) and *Cynodon dactylon* (9th) managed to enter within top ten important weeds probably due to their broad ecological amplitude, methods of propagation etc. Probably, dry soil, low temperature and low precipitation are the causes of dominance of dicotyledonous weeds during Rabi season in this district. It is common sight that in the field of pulses *Leucas indica* is growing in so abundance to give the idea that this is also cultivated species. The total root parasite *Orobanche aegyptiaca* is also observed in association with crops and weeds during this season. Among the 'Thanas', the most weeded one has been recorded as 'Gazole'.

During Boro season lowest number (18) of weeds has been recorded for the district. Again among 'Thanas', 'Englishbazar' has been recorded with highest number of species (77.4 %) and 'Bamongola' with lowest number of species (50.9 %). Within the survey

period highest number of individuals (1632) and largest area covered (19315 cm<sup>2</sup>) have been recorded during 1994 and 1993 respectively. During this season *Alternanthera sessilis* (RF 93.33) has been recorded as most frequent weed, whereas, *Cyperus rotundus* is with highest Relative Density (29.17 %), highest Relative Dominance (22.48 %) and most important (IVI 143.68) weed. In this season, for phytosociological characters of top ten weed species, it has been observed that dicotyledonous weeds occupied 70 % positions. Still *Cyperus rotundus* with high degree of ecological amplitude and by their methods of propagation occupied the rank of most important weed. *Cynodon dactylon* for the similar reason occupied the fourth position. From the middle of February day temperature starts rising and growth of a new set of weeds is now expected in the field. But, among the ten most important species such a picture is not available. Species like *Caesulia axillaris*, *Lindernia perviflora* and *Gnaphalium purpurium* were in the field in Winter now became prominent probably due to the decrease of some other weeds. But, increase in day temperature, some amount of precipitation and cultivation practice increase the number of monocotyledonous weeds (38.9 %) in comparison with Rabi season (20.0 %). Among the 'Thanas', the most weeded one has been recorded as 'Manikchak'. The result of sampling of consecutive years in the crop fields of Malda District has revealed that the growth period of sampled species are not restricted to a particular season only (Table 4.22). Specially the plants preferring the warmer climate has gained long life-span. From annual calculation, *Cyperus rotundus* came out as most frequent (RF 61.48 %), most dense (RD 10.60 %) and most important (IVI 79.89) weed. But the pteridophytic species *Marsilea quadrifida* has been appeared as most dominant weed. For phytosociological characters of top ten weeds except for dominance, dicotyledonous weed occupied 5 position, monocotyledonous weed 4 position and 1 position by the pteridophytic *Marsilea quadrifida*. For dominance the ratio between dicot and monocot has been observed as 2:1. The most important ten weed species with respect to IVI value, of the district of Malda are *Cyperus rotundus* (79.89), *Alternanthera sessilis* (66.85), *Cynodon dactylon* (59.86), *Ludwigia perennis* (51.82), *Marsilea quadrifida* (50.86), *Leucas indica* (47.59), *Eclipta alba* (38.64), *Echinochloa colona* (37.22), *Caesulia axillaris* (36.48) and *Tonningia axillaris* (30.83). Of these six species (*Cyperus rotundus*, *Cynodon dactylon*, *Alternanthera sessilis*, *Caesulia axillaris*, *Ludwigia perennis* and *Marsilea quadrifida*) grow throughout the year but with varying degree of abundance. This is due to (i) their broad ecological amplitude, (ii) long life span, (iii) long flowering and fruiting period and (iv) a broad range of germination period. However out of ten plants with highest recorded IVI value there are perennials and can propagate by seeds and propagules.

In the picture of annual and seasonwise assessment of weeds, dicotyledonous plants have been outnumbered the monocotyledonous ones and with only one pteridophyte. But in Aman the number of dicot and monocot species are in close contact, 14 and 13 respectively. This is due to high temperature, humidity, precipitation and water saturated soil condition of the paddy field which helped the growth of helophytic plants dominated by sedges. But on the other hand moist soil, low temperature and low precipitation favour the growth of broad leaf weeds.

## **11.4 LIFE STYLE OF WEEDS**

Phenology embraces all studies of the relationship between climatic factors and periodic phenomena in organisms (Sundriyal 1990). Phytosociological studies generate knowledge on distributional aspects of weeds, but it is not enough for weed management unless phenological data are supplied to support it. Phenological data, taking side by side phenology of the concerned crop plants, can help us to decide the time and method of weed eradication.

### **11.4.1. GERMINATION**

It has been observed that majority of dicotyledonous species germinate between May and October with a peak during June and majority of monocotyledonous species germinate between May and July with a peak during June. Little rain during April - May and high rain fall between June and September moisten the soil and increase the rate of germination of dicots. On the other hand in case of monocotyledonous, too, little to high rainfall between May and July, stagnant water of the cropfields helps to increase the rate of germination. For both dicot and monocot high temperature (above 30<sup>0</sup>) and high relative humidity (above 90 %) also favour the rate of germination. Majority of dicotyledonous weeds of Rabi crops germinate during October and onwards, when precipitation, temperature and relative humidity starts to decline. The length of germination period of majority of the weed species is more than one month, whereas, *Leucas indica* and *Parthenium hysterophorus* shows two distinct germination seasons.

### **11.4.2 VEGETATIVE GROWTH**

Germination is followed by vegetative growth, which continues till the initiation flowering. It has been observed that after germination next one or two months are favourable for vegetative growth. As majority of weeds are annual and to compete with vigorous crop plants for their growth, they became adapted to early flowering for the production and dispersal of seeds in a quite short time. So, vegetative growth does not continue very long. In case of late germinated seeds, it has been observed that vegetative growth becomes restricted even to the one or two leafed condition only.

### 11.4.3 FLOWERING AND FRUITING

Majority of the dicot species flowered during November to January with a peak in December (96.7 %) and majority of the monocot species during August to November with a peak in September (86.5 %). So, in case of dicot flowering is favoured by the decreasing precipitation, temperature, humidity and the initiation of short photoperiod, whereas in monocotyledonous weeds it is favoured by high precipitation, high temperature, high humidity and long photoperiod. There are 32 species of weeds (both monocot and dicot) which flowered more or less round the year, though the rate of flowering is not same in different months. However, majority of weeds in Rabi season (mustard and pulses) including a few monocot are with very short flowering period e.g. *Anagallis arvensis*, *Leucas cephalotes*, *Butomopsis latifolia*, *Cyperus compressus*, *Asphodelus tenuifolius* etc.

As the majority of the weed-species are with short life span, so, flowering and fruiting are simultaneous process in them. So, in a plant fruits of all the stages of maturity are generally available at a time. In case of dicotyledonous weed December and January are the peak fruiting period which is again matching with their flowering period. In case of monocotyledonous weeds it happens in the month of September.

Determination of the death phase of crop field weeds is very hard because of (i) weeding practice and (ii) harvesting of one crop is immediately followed by the preparation of the next crop. However the recorded dicotyledonous and monocotyledonous weeds show maximum death during the month of April. This is due to the dry condition of the soil, developed due to almost no precipitation during the previous months, low humidity etc. But there are also several months during which no death of the recorded species have been observed.

### 11.4.4 LIFE FORM

Weed flora of this district is dominated by Therophytes (92.42 %) which in *at per* with the field conditions. Change in season, tilling, weeding and cover of crop plants are mainly responsible for the selection of annuals or therophytes. Weeds are largely entomophilous (54.6 %) and majority of the weeds (89.9 %) have been observed to disperse their seeds by water.

### 11.4.5 DISPERSAL AND THE SELECTION OF WEEDING PERIOD

As most of the dicotyledonous weeds produce fruit during November - February and monocotyledonous weeds during August to November, so, weeding has to be done before

that period, otherwise the produced seeds of the weeds would be dispersed and buried under the soil and will produce a further generation with the onset of favourable conditions.

### 11.5 RECOGNITION OF SEEDLINGS

Weeds are more injurious in the early stages of the crop (Tiwari 1953 - '54). So, it is much necessary to recognise them as early as possible. Seedlings of 45 common dicotyledonous weed belonging to 20 families have been morphologically diagnosed for this purpose. As, weed seeds are very small, low in germination rate, low in survival rate and majority have a very short life-span, so, the initial growth rate of the weeds of crop-field is higher than the crop. Because of that, at the initial stage, they utilize more nutrients from the soil, dominate over crop seedlings and become very injurious. So, eradication of the weeds at their early stage would be helpful to attain a good crop yield. In the present work an attempt has been made to identify the weeds at their early stage by means of morphological characters and the key prepared for the purpose will be helpful. The tremendous variation in morphology within the population of different weeds, use of seedling morphological characters are much dependable for their early recognition which is very much essential to decide over the eradication procedure. However seedling morphological characters are also useful in taxonomic studies ( Kamilya and Paria, 1993, '94).

### 11.6 REPRODUCTIVE CAPACITY AND SEEDLING ESTABLISHMENT

In angiosperms adaptive significance of seeds is associated with the reproductive efficiency and successful establishment of seedlings in nature (Stebbins 1970). The out put in a particular habitat may be an important factor in determining the occurrence as well as frequency or abundance of a species in natural conditions (Salisbury 1942). Again,, the magnitude of the reproductive capacity is also related to the frequency and abundance. Reproductive capacity of a species is as much a characteristics as any other specific features and of considerable ecological interest. It also has an importance in dispersal of seeds and establishment of seedlings. In the present work Reproductive Potential of 114 species of crop field weeds of the district of Malda has been worked out. During this work three aspects have been taken into consideration - (i) number of seeds per fruit (ii) number of seeds per plant (iii) weight of 1000 seeds. *Orobanche aegyptiaca* (Orobanchaceae), a total root parasite, has been observed to produce highest number of seeds per fruit (1400-1500) among dicotyledonous and *Monochoria vaginalis* with 140-150 seeds per plant ranked 1st in monocotyledonous weeds. Among dicotyledonous weeds 71.8 % weeds bear more than 1 seed per fruit but among the monocotyledons only 17.2 % weeds bear more than 1 seed per fruit. In species level among dicotyledonous

weeds, *Ludwigia perennis* and *Centella asiatica* have been observed to produce highest number (218287) and lowest number (56) of seeds per plant respectively. In monocotyledonous weeds, highest and lowest number of seeds per plant have been observed to produce by *Scirpus articulatus* (12688) and *Butomopsis latifolia* (208) respectively. Concerning the weight of 1000 seeds, highest and lowest among dicotyledonous weeds have been observed in *Ipomoea aquatica* (42.980g) and *Hydrolea zeylanica* (0.001g) respectively. Among monocotyledonous weeds highest and lowest seed which have been observed in *Commelina benghalensis* (2.500g) and *Monochoria vaginalis* (0.002g) respectively. In the present weed flora the most successful families are Poaceae, Asteraceae, Cyperaceae, Euphorbiaceae, Scorophulariaceae and Amaranthaceae. Among the recorded weeds of these families, 71.4 % species bear more than 1000 seeds per plant and 76.8 % species shows seed weight less than 1.0g per 1000 seeds. While, Poaceae and Cyperaceae have a special mode of vegetative propagation, Asteraceae has some special devices of dispersal like pappus, hooks etc. Euphorbiaceae, Scorophulariaceae, Amaranthaceae mainly consist of clitochore species and they rely on dispersal in time rather than space, they also have the ability to continue seed production for as long as the growing conditions permit. So, high seed number with small seed size, special mode of dispersal and other related characters enable the plants of these families to establish them as most successful weeds of the crop-field in the district of Malda. Comparative study of the seed number and seed weight of some weeds common with other floras indicate the high plasticity of weeds, due to which seed numbers vary from hundred to some thousands and difference in weight is due to selection, competition, collection, cleaning and proper drying of seeds.

### 11.7 WEED CALENDAR

Weed calendar is the excerpt of some basic data recorded for the phenology of the crop field weeds of the district of Malda. Weed calendar was prepared to indicate appearance, presence and disappearance of each and every weed species in the crop fields of the district of Malda. Presence of highest number of dicotyledonous weed species has been observed during November and December (92 species each) after that their number go on decreasing till June (65 species) but from July again it starts to increase. While, highest number of monocotyledonous weeds has been observed during October (36 species). Their number decreases after that and trend continues till May (22 species) and then from June new weeds starts appearing. Highest number of dicotyledonous and monocotyledonous weeds have been observed to appear during the month of June (41 species and 31 species respectively). While no species of dicotyledons has been observed to appear during February and March, and in case of monocotyledons, no species has been observed to appear during December, January and February. Very low temperature and precipitation are probably the main causes behind this. Regarding disappearance, it is the month of April when highest number of dicotyledonous weed (40 species) and during March - April, when highest number of monocotyledonous weeds (17 species) have been

observed to complete their life cycle. Among two species of pteridophyte, *Marsilea quadrifida* has been observed to present in different stages of their life cycle throughout the year. The other recorded pteridophyte *Ceratopteris thalictroides*, an annual, has been observed to appear during June, stays upto November and disappear during December. With this calendar in hand, protective measures may be taken against the appearance or spread of different weeds in advance

### **11.8 NEED OF ALLELOPATHIC SURVEY**

In agriculture , weeds always offer competition to the normal growth of crop plants by various means which also include the production of some chemicals which leached into soil causing allelopathic effect. As has already been discussed in chapter 8, such effects of numerous weeds is well known to the scientist. However, six common weeds of Malda have tested which showed that all are active in allelopathic effect at least at certain concentration. As Salisbury (1957) indicated that the major allelopathic effect is to restrict the germination of seeds of other plants. It also affects the growth and metabolism of other plants (Del Morel and Cates, 1971).

So, When we find a large number of weeds growing round the year in the crop fields of Malda District and also many other weeds growing on boundary walls and fallow lands, these plants are certainly releasing a considerable amount of leachetes, specially during rainy seasons, which contain germination and growth reterdants.

Controll measures against such allelopathic effects can be formulated only after knowing such effects of various weeds growing in a region. That is why it is essential to take up allelopathic studies of various weeds on different crop plants of Malda District.

### **11.9 IMPORTANCE OF WEEDS**

Weeds though have many harmful effects upon crops but also have their many fold uses. In our present survey work informations were gathered from the local people about the uses of crop-field weeds. There have been recorded five types of uses of the weed species by the local people (i) weeds used as food for man (ii) weeds used for food for animals (iii) weeds used as medicine (iv) weeds used as fuel (v) miscellaneous uses (as soil binder and ceremonial). So, weeds are not useless plants. many of them even need to be cultivated to meet up our demand or there are possibilities of more exploration. However, some other phenomena like (I) atmospheric nitrogen fixation by leguminous weeds (ii) bringing up nitrogen compounds from lower strata to upper strata of soil, in part, by the growth and decay of weed species (Campbell 1924) i.e. to make it easily available for crop

plants, (iii) conservation nitrogen by early, late and winter annuals at times when no cultivated plants are present on land etc. are all beneficial aspects of weeds.

### 11.10 CONCLUSION

Through the full set up of the present work informations from different angles on the very rich flora of crop field weeds of Malda district have been accumulated which might be helpful in drawing strategies to improve the yield of various crop plants.

The weed flora, phenology of most of these plants (including the calendar) their distribution pattern - regionwise and seasonwise, mode of propagation, early identification through seedling morphological characters etc. are important and can be used in the programs of weed management.

The weedy plants of this district also include a few rare and interesting plants like *Dichondra repens*, *Asphodelus tenuifolius*, *Cochlearia cochlearioides* etc. The usefulness of weedy plants has been discussed and it is found that many weeds offer food to the man and often sold in the market. In addition there are also a large number of medicinal plants, many of which are also used by the local inhabitants. The role of weeds in drawing deeply located nitrates to the upper strata of soil has also been remembered.

Weeds are not useless plants. They constitute a very important part of the Country's fabulous biodiversity and in future many of these weeds might be treated as important cultivable plants when their proper method of utilisation will be discovered.