

**Studies on Weed Infestations in a  
Bamboo Based Soybean Agroforestry  
System in Mizoram**

By  
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fulfilment of  
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*I certify that the dissertation entitled “**Studies on Weed Infestations in a Bamboo Based Soybean Agroforestry System in Mizoram**” submitted by Miss Phindrarilin Kharmujai for the partial fulfilment of Master of Science in Forestry of the North Eastern Hill University, Shillong embodies the record of original investigation by her under my supervision. She has been duly registered and the dissertation presented is worthy of being considered as partial fulfillment for the award of M.Sc. Degree. The work has not been submitted for any degree of any other university.*

***Dated, Aizawl the***  
***December 18,2001***

  
**( U.K. Sahoo )**  
**Supervisor**

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AIZAWL  
The 18<sup>th</sup> December 2001

*P. Kharmujai*  
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## **CHAPTER –I**

### **GENERAL INTRODUCTION :**

Agroforestry systems or agroecosystems are man made ecosystems managed for the purpose of increasing the productivity of the land as well as preserving the biophysical condition of the land. Weeds in agroecosystems are generally considered to be plants that are out of place, that adversely affect crop growth, and for a variety of reasons are difficult to control. Since both weeds and crops are plants, they have basically the same requirements for normal growth and development. They require and compete for adequate supply of same nutrient, moisture, light, heat, energy ( temperature ) carbon dioxide and growing space. Weeds being aggressive compete with the crop plants for nutrients and at the same time modify the environment within the community which in turn influences their own growth and population dynamics. Owing to their ecological amplitude, weeds often succeed in the struggle for existence compared to crop plants. Thus they can survive and flourish even in environmental conditions where growth of crop plants is extremely difficult. Some weeds can supplement aggressiveness by the release of toxic or growth inhibitory substances into the soil as root exudes or leachates of their dead or decaying vegetative matter or both, thereby reducing or eliminating competitiveness of crop plants as well as other weed species.

Weeds in agroforestry systems or agroecosystems can cause serious economic damage and their control often requires the commitment of substantial resources in the way of labour, capital or pesticides. Among other factors such as low fertility, pests and diseases , weeds are estimated to account for upto 40-50% of field losses ( Michieka, 1981). Agroecosystems built on the principles of fallow periods helps overcome weed infestations in addition to improving soil productivity and reducing other pest populations ( Jama *et al*, 1991 ). Short term intensive fallow systems that employ herbaceous and woody species to facilitate rapid restoration of soil productivity have evolved as an alternative to long-term fallows. Short term fallows can impact weeds at all growth stages and play a role in the integrated management of weeds and crops. Fallow management that promotes vegetative soil cover may reduce weeds recruitment due to attenuation of soil temperature and / or shift in light quality at the soil surface. Residues of litter fall from fallow species may alter the chemical and micorbialecolgy of the soil to favour losses from the weed vigour, or seed decay. In addition, fallow vegetation can influence weed seed perda tion Enhancement of soil productivity should increase the vigor of the crop growth and

enable crops to better compete with weeds. The burning of fallow species residues may result in weed seed death due to extreme temperatures or may induce seed germination by the release of mechanical dormancy or chemical germination cues ( Gallagher *et al* , 1990 ).

There is enough evidences in literature which suggests that forest trees and agriculture crops can be grown together in a particular land without deterioration of the side. The practice of Taungya cultivation practiced by the tribal community can be an example in which case the societies simulate forest conditions on their agricultural farms in order to obtain the beneficial effects of forest structures ( Fisher, 1976). There are several workers who also support this view. In fact mixed cropping ( Plantation of more than one crop together ) has several advantage over mono cropping as because the farmer can reduce weed and pest problem, interact with the edaphic factors optimally to increase crop productivity provided there is crop to crop compatibility. Similarly in the hilly terrains the land can be optimally used if there is suitable tree crop interaction. The legume can enriched the soil improving the productivity of the land while the non-legume can provide proper edaphic conditions for the growth of legume.

Bamboo is one of the most suitable species for agroforestry models. It has the fastest growing canopy and therefore it is preferred by development workers of agroforestry in different parts of the world. It has been estimated that 1/3 of the world's population used bamboo for timber fuel and food.

Soybean on the other hand is an important legume cultivated over an area of 56.74 million hectare in India and is an important crop in north eastern states. The crop is an erect and bushy annual plant. The plant varies from 0.5 to 2.0 meter in height. The branches may be spreading or ascending short or elongated depending on cultivator and growing conditions. The root system of soybean consist of a tap root, a large number of secondary roots and much branched adventitious roots. The first nodule are visible about 10 days after sowing. The nodules initiated in the soybean roots by Rhizobium japonicum as soon as root hairs are present on the roots and at maturity the root system is extensively modulated.

Soybean has been called the miracle crop of the 20<sup>th</sup> century. It is outstanding in its nutritive value. It contains 43% biologically effective proteins, 20% fat. It is also rich in vitamins, mineral salts and essential aminoacids. Because of its slow growth habit in the initial stage it encounters weed infestation neavily in the early stages of crop growth ( Santharam, 1981) weeds which are the efficient competitors deprive the crop of the major requirements of nutrients,

moisture, light and space and create an extremely adverse environment which results in poor crop growth( Mani,1975) found that competition for nutrients in general and for nitrogen in particular in most situations was the serious factor in limiting the crop yield. Weeds usually grown faster than crop plants and thus absorbs the available nutrients earlier resulting in lack of nutrients for the growth of the crop plants. Thus the weed control is vitally important not only to check the loss caused by weeds, but also to increase the efficiency of the fertilizers appalled to the crops.

Although there has been some isolated studies on the usual role of the weeds in agroforestry systems, it is only recently that an ecological approach to weed management in these systems is being explored in a serious way. Many of the ideas in this direction looking at weed control have come from a deeper understanding of the traditional agroecosystems of the Tropics. In the north eastern Jhum system, the traditional farmer conserves 20% of the total weeds in their plots. The farmer on his empirical knowledge is able to discern when a weed becomes a 'non-weed' in his system. Therefore he does only a partial weeding rather than total weeding since they have important nutrient conservation roles in the system ( Ramakrishnan,1984 ).

Intensive studies on the aspect related to their direct control measures have been done and these aspects include plant population dynamics ( Yadav and Tripathi , 1981, Rai and Tripathi, 1984 a, Tripathi, 1985) reproductive strategies( Trivedi and Tripathi, 1982a; 1982 b) allelopathic potential ( Tripathi et al 1981; Rai and Tripathi,1983,1984 ) growth and population dynamics of weeds have drawn the attention of various workers. Recently studies on the reproductive strategies and allelopathic potential of a few exotic weed species invaded the north eastern region have also been made. Weeds in different region of North Eastern India have drawn the attention of agronomists and ecologists alike and their effective control in agriculture, horticulture and human habitation has been the main concern of researchers during the last two decades.

However, no effort has been made in Mizoram so far in understanding the population biology of weeds which requires a detailed study on these. Since the work involved in the proposed study was for a shorter duration, therefore studies on weeds in a bamboo based soybean agroforestry system was taken to cover :

- (a) Phytosociological analysis of weed communities and their ranking
- (b) Effect of weeds on the growth behavior of the crop with time.
- (c) The effect of weeds on the crop yield.

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## **CHAPTER – II**

### **REVIEW OF LITERATURE :**

As has been discussed earlier, weeds compete with the crop plants by virtue of their aggressive growth habit, obtaining and utilizing essentials of growth at the expands of crop plants. A voluminous amount of work on different aspects on weeds such as weed flora/species composition, competitive ability, allelopathy, population biology, reproductive strategies, growth and population dynamics, soil seed bank dynamics and various weed control have been worked out in both tropical and temperate countries during the past 3-4 decades.

Saavedra *et al* (1989 ) observed difference between winter, summer and intermediate ( Spring- summer and winter-spring ) weed floras in the middle valley of Guadelquivir Spain. They have attributed this difference to the crop type, crop cycle, soil management practices, irrigation types and a number of other edaphic factors. Thomas and Ivany(1990) and Anderson *et al*, 1991 also found these factors to be important in influencing the weed flora of crop fields.

Mani *et al* (1968) reported that losses on account of high weed infestation are estimated to be much more in vegetables as compared to cereals and pulses. It has been estimated that losses in yield due to weed alone vary from 10 to 70% depending upon the extent of weed infestation.

Ennis (1977) reported that an efficient weed management system integrates preventive measures, crop rotations, soil fertility and water management practices, cultivation natural enemies and herbicides.

Sharma *et al* (1988) reported that application of atrazine before transplanting or at 2 or 20 days after transplanting effectively controlled the weeds significantly increased grain and stover yield. Also there was no phytotoxic effect on succeeding crops.

Singh and Singh ( 1988 ) reported that field studies conducted during kharif seasons revealed that continuous submergence was more effective in controlling weeds and increasing grain yield, where as alternative wetting and drying was least effective.

According to Vaishya and Khan (1989) the initial 20 to 50 days period was the most critical period for weed removal in pigionpea.

Gautam ( 1980 ) and Kang *et al* (1980) observed that increased level of nitrogen fertilization lowered the weed intensity.

Moody ( 1978 ) found that herbicides gave excellent weed control understanding water and performed poorly in absence of water.

Panwar and Pandey ( 1977) also found that pre-emergence herbicides such as alochlor and nitrofen proved as effective as hand weeding in controlling monocot as well as dicot weeds in legumes.

Nieto and Staniforth ( 1961) and Agboola and Udom (1964) reported that if crop is more responsive to nutrients than the weeds, reduction in yield due to weed infestation may be minimized by additional nitrogen and result in disproportionate yield reduction with increasing weed infestation.

Govindakrishnan and Singh ( 1985) noticed a reduction in weed growth in succeeding wheat crop due to residual effect of naatribuzier and oxyflworfen applied to potato crop.

According to Katyal *et al* (1980 ) the infestation of weeds has posed a serious threat under the modified microclimate of wheat crop. The average grain yield losses by weeds in wheat crop in India has been estimated to the tune of 30-40%.

Bhan *et al* (1976), Gautam and Bharadwaj ( 1977 ) found that one of the serious constrains which is limiting the yields of maize is heavy weed infestation.

Ahmed and Moody (1980) reported that the number of weeds in transplanted paddy crop was less than 50% and these weighed only 5% as much as the dry seeded crop.

Murdock (1986) reported that a uniform soybean population of 323,000 plants per ha regardless of row spacing, pitted mormingglory at an average density of 226000 plants/ ha reduced soybean yields by 27% over a 2 years old period.

Harrison *et al* (1985) found that post emergency herbicides applied later than 15 days after emergence ( with adequate rainfall ) resulted in soybean yield loss even when giant foxtail was controlled. They also noted concurrent decrease in soybean yields.

Dillon *et al* (1989) identified palmer and amaranth as an increasing problem in soybeans on sandy soils where conventional pigweed control methods failed to provide satisfactory control.

According to Yamoah *et al* (1986) and Budelman ( 1988) fast growing MPTs such as *Glericidia*, *Lepeum*, *Cassia*, *Siamea* and *Fleminga*. *Macrophylla* effectively suppress weeds under alley cropping through the effect of their slow decomposition leaf litter.

Jama *et al* (1991) observed that weeds alone may account for significant losses of crops, leucaena alley cropping could give weed control and enhanced crop yields.

Effective weed control depends on the persistence of the applied Mulch layer. This persistence is affected by the type of mulch and its rate of decomposition. High nitrogen and low lignin and polyphenols contents lead to fast decomposition ( Budelman, 1982, Tian *et al*, 1992 ).

Kamara *et al* (2000) reported that the effectiveness of mulch to suppress weeds is related to its persistence on the ground. This in turn depends on turn over rate of the mulch materials. Although *Gliricidia Sepium* decomposed faster than *Cassia Siamia* and as fast as *Leucaena leucocephala* it controlled weeds to the same extent as *Cassia Siamia*.

Weed emergence in relation to crop emergence is an important factor in weed crop competition. Weeds that emerge prior to the crop plants may reduce crop yields more than the weeds which emerge later. Generally weed competition during the first 6 weeks or so after the crop planting tend to have the greatest adverse effect on crop yields competition and presence of vegetative and reproductive parts of weeds at or near to harvest have the greatest adverse effect on crop quality (A. S. ...).

Takabayashi ( 1976 ) and Somez and Karaca ( 1975) have reported that weed competition in the first 40 days in case of potato belonging to the family of brinjal and beans crop reduced yield significantly. Nandal *et al* (1988) also reported that brinjal crop kept weed free between 20-40 days after transplanting may yield equivalent to weed free condition and reduce the cost of weeding.

Agboola and Udam ( 1967) reported that if crop is more responsive to nutrients than the weeds, reduction in yield due to weed infestation may be minimized by additional nitrogen and result in disproportionate yield reduction with increasing weed infestation.

Enyi ( 1973) reported that dense canopy provided by intercropping suppressed the weed growth by competition and cut down the requirements of growth factors.

Weeds heavily infest the crop and ultimately reduce the grain yield of finger millet. The reduction in grain yield due to weed competition was estimated from 35 to 50% ( Patro and Das, 1972, Sankaran *et al* 1972).

According to Guneyli *et al* ( 1968) weeds which emerge with the crop thereby depriving the crop of available nutrients and resulting in poor yields.

Brar *et al* ( 1973) and Sidhu ( 1982) observed that weeds compete with the crop plants not only for light, nutrients and moisture but also inhibits pegging. They reduce the crop yields from 60-70%.

According to Gill *et al*( 1986) the maintenance of weed free conditions for initial 6 days after sowing in case of groundnut is essential and the crop tolerate weed control for initial 30 days after sowing provided weeds are removed thereafter immediately.

According to Sen ( 1982) Arid zones weed have a large ecological amplitude even in changed environment. Since they have unique potentialities for adaptation, they thrive almost in any environment and adjust themselves to changed conditions.

Weed pose a serious problem in pea as they compete with the crops for various growth factors such as nutrients moisture light and space. Weed competition especially during early stages seriously affects crop growth and results in 40-50% reduction in grain yield ( Singh and Tripathi,1984, Sharma and Vats,1996 )

It was reported by Moody and Shetty ( 1981) that prevalence of inter cropping or mixed cropping in traditional agriculture provides a possibility of better control of weed vis-a-vis sole cropping.

According to Singh and Tripathi ( 1982) due to severe competition between crop and weeds the growth and yield of cauliflower is substantially reduced and its quality is impaired.

According to Oliver *et al* ( 1976) morning glory removed by 6 to 8 weeks after planting permitted maximum soybean yields. Entire leaf morning glory previously referred to as tall morning glory become competitive and reduced yields of soybeans planted in 1 m rows by 6,8 and 10 weeks after soybean emergence at densities of 1 plant/ 15,30 and 61 cm of row respectively.

Burnside and Colville ( 1964) found that narrow- row soybeans shaded the ground earlier and enhanced herbicide effectiveness at lower rates by increasing interference.

It was reported by Orwick and Schreiber(1979) that under weed interference from red root pigweed and robust white foxtail or robust purple foxtail narrow- row soybeans ( 38 cm) decreased weed growth, increased soybean yield.

Knake and Slife ( 1965) noted that soybean yields were reduced only when giant foxtail emerge at the same time as the soybeans. Giant foxtail seeded 3 weeks after soybeans failed to grow well and did not interfere with soybean seed production.

Hagood *et al* (1980) reported that leaf, stem and root dry weights of soybeans were reduced across densities of 2.4 to 40 plants per m<sup>2</sup> of velvet leaf emerging with the crop.

Oliver (1979) found that weed competition had the greatest effect on the number of pods per plant. In Arkansas, velvet leaf emerging with the crop was twice as competitive with soybeans planted in mid may as in soybeans planted in mid June.

Mosier (1986) found that there is no significant effects of planting date or morning glory or common cocklebur interference.

Klingman and Oliver (1994) reported that the selection of optimum planting dates may be a viable means in reducing losses due to weed interference in soybean.

According to Regnuier (1986) common cocklebur, jimsonweed and velvet leaf infest many soybean fields in the corn belt decreasing soybean yield by interference. The weeds can germinate and emerge at the same time as the soybeans, eventually growing taller than soybeans later in the growing season.

Stoller *et al*<sup>(1985)</sup> reported that common cocklebur and jimsonweed and velvet leaf are comon broad leaf weeds in soybean fields in the corn belt. Common cocklebur causes greater soybean yield reductions than jimsonweed or valvet leaf at equivalent densities.

Most of the soybean yield reduction from jimsonweed and velvet leaf interference can be ascribed to shading by the weed leaves above the soybean canopy, however, this shading accounts for only about one half the yield reductions caused by common cocklebur interference (Stoller and Wooley 1985).

Geddes *at al* (1987) reported that common cocklebur exploited a greater volume of soil for water than soybeans when both were grown in intraspecific strands.

Higgins *et al* (1984) reported that velvet leaf grown with soybeans had greater leaf abscission and decreased branching than when grown in mono culture.

Regnier and Stoller (1989) found that the initial growth in height of velvet leaf jimsonweed and common cocklebur appeared to be greater when the weeds were grown with soybean interference than when grown alone.

The presence of weed flora/species composition depends upon the buried seeds, underground vegetative plant part and the transport of propagules to the crop fields. Besides the contamination and transportation of weed seeds/propagules, the other factors which largely determine the appearance and growth of weeds in crop fields are the agronomic practices, types of crops and time of crop sowing (Freyer and Makepeace, 1977, Sahoo, 1997) and also on the

composition of the seed pod, its longevity and size which in turn are strongly related to the past history of the land ( Mayor and Pyott, 1966, Harper 1977 ) and present management practices ( Sagar and Mortiner, 1976, Harper, 1977, Sahoo, 1977).

Purvis *et al* ( 1995) observed that agricultural soils usually contain large quantities of weed seeds which can remain viable for several decades waiting for the appropriate stimuli from crop plants and their post harvest residues.

It was reported by Tripathi ( 1977) and Dastgheib ( 1989) that in agroecosystems weed seed output into the soil occurs through contaminated crop seeds, manure irrigation water, machinery and other farm tools, livestock, birds and wind.

Soil disturbance provides primary indirect stimulus for weed seed germination in arable fields ( Egley, 1986, Forcella and Lindstrom, 1988)

Roberts and Dawkins ( 1967) reported that in frequently cultivated soils viable weed seed population decreases more rapidly than in the undisturbed or less disturbed soils.

In the “Jhum” fields higher number of survivors ( Plants growing to maturity) than in terraces was responsible for high seed input in the former through seed rain ( Mishra *et al*, 1992).

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## **CHAPTER – III**

### **DESCRIPTION OF STUDY SITE, CLIMATE, SOIL AND VEGETATION :**

#### **STUDY SITE :**

The studies on weed infestation was carried out from April to September, 2001 in a bamboo based agroforestry system located at Paite Veng ( Latitude 21°51' -24° 31' North and 92° 61' and 92° 26' East longitudes Altitude 1100 m above Sea level ) about 6 KM East of Aizawl, the capital city of Mizoram in North East India ( Map 1 ). For the purpose, two plots viz weed free and un-weeded were selected which were adjacent to each other. The plots were moderately sloped ( about 25% slope). The site was owned by a local farmer who had been practicing agroforestry model( bamboo- soybean) for the last three years. The details of the agronomic practices followed in the aforesaid plots are described in Table 3.1.

#### **CLIMATE :**

The climate of the study sites is monsoonic with average annual rainfall from 1,600 to 2,200 mm with high relative humidity upto 100% . Temperature varies from 15.5 C<sup>0</sup> to 29.6 C<sup>0</sup>. The months from May to October experience heavy rainfall although occasional showers are received during November to March as well. June and July are the wettest months of the year ( Fig 3.1). Based on the temperature and rainfall data, the year can be divided into four seasons.

- 1) Spring or mild summer ( March to April )
- 2) Rainy or wet summer ( March to September)
- 3) Autumn ( October)
- 4) Winter ( November to February)

The 'Spring' season is characterized by a gradual increase in temperature over that in the preceding winter months with further increase in temperature the spring gives way to 'Summer' which is characterized by gusty wind ( upto May ) and abundant rainfall, with the retreat of monsoon the season changes and the fall of temperature heralds the advent of autumn.

“ Autumn” is cool and pleasant and represents a transition period between rainy and winter seasons. ‘ Autumn’ is followed by winter season lasting from November to February and is characterized by low temperature negligible rains, occasional frost in the nights and short photo period.

**SOIL :**

The soil of the study site is made up largely of pre-Cambrian rocks, moderately undulated, acutely folded and steeping dipping with an overturned fringe of mesozoic and tertiary sediments( Poscoe, 1950-64). The soil of the study site is lateritic silty loam to clay loam, pale brown to deep brown in colour and acidic ( P<sup>H</sup>5.42) in reaction. The particle fractionation, organic matter content ( OMC ), water holding capacity ( WHC) and P<sup>H</sup> of the study site is given in Table 3.2.

The study site had more proportion silt than the sand particle in both weed free and un-weeded plots. As compared to proportion of sand, the un-weeded plot had a little higher proportion of course particle ( Table 3.2). The Organic matter content and water holding capacity. Similarly were higher in the un-weeded plot than those of the weed free plot. The P<sup>H</sup> of the soil in both the plots was more or less similar.

**VEGETATION :**

The natural vegetation of the study area is characterized by the preponderance of semi evergreen tree species which gives an indication that probably the entire area was once covered with this type of vegetation and it has now been considered degraded due to the prevailing slash and burn ( Shifting/Jhum) cultivation and other human activities. The site was raised for agroforestry practicing keeping two bamboo species viz 1) *Dendrocalamus longispathus* and *Melocana baccifera* as tree species and soybean as the crop and has been practice since the last three years to improve the site condition and both land and crop productivity.

The important weed species which grow luxuriantly in the site and which can make their visual appearance/ infestation are *Sida acuta*, *Cynodon dactycon* *Rubia spp*, *Bidens pilosa*, *Galinsoga ciliata*

**TABLE 3.1****AGRICULTURAL PRACTICES FOLLOWED IN WEEDED AND UN-WEEDED PLOTS:**

Cultural Operation	Weeded Plots	Un-weeded Plots
Cultivation	Manual spading	Manual pading
Depth of ploughing	Upto 15 cm	Upto 15 cm
Weeding operation	Hand weeding	Nil
Application of farmyard manure	Nil	Nil
Application of Chemical fertilizer	Nil	Nil
Herbicide application	Nil	Nil

**TABLE 3.2**

**PARTICLE FRACTIONATION, TEXTURAL CLASS AND IMPORTANT CHARACTERS OF SOILS UNDER WEED FREE AND UN-WEEDED PLOTS OF THE BAMBOO BASED AGROFORESTRY SYSTEM AT MIZORAM.**

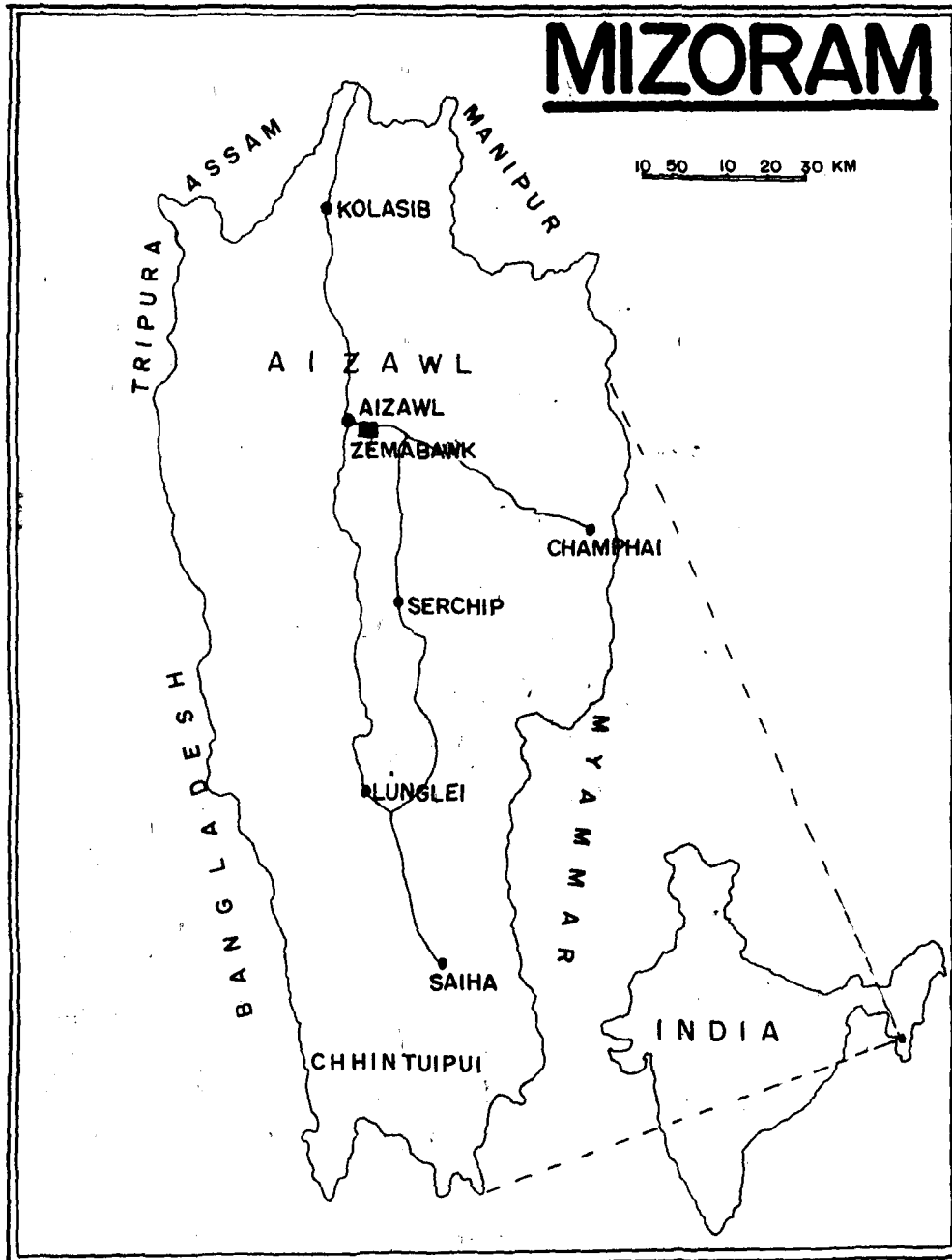
<b>Soil parameters</b>	<b>Weed free</b>	<b>Un-weeded plot</b>
<b><u>Coarse particles</u></b>		
Sand(%)	27.1 ± 0.9	22.6 ± 0.7
Silt (%)	32.3 ± 0.9	36.3 ± 0.7
Total ( Sand + Silt )	59.4 ± 1.1	58.9 ± 0.9
<b><u>Fine particles</u></b>	40.6 ± 0.6	41.1 ± 0.8
Textural class	Clay loam,	Clay loam
OMC (%)	2.6 ± 0.2	2.8.1 ± 0.2
WHC(%)	64.0 ± 3.1	66.7 ± 3.1
p <sup>H</sup>	5.42 ± 0.2	5.46 ± 0.1

± S.e.m, n = 4, OMC – Organic matter content,

WHC – Water holding capacity.

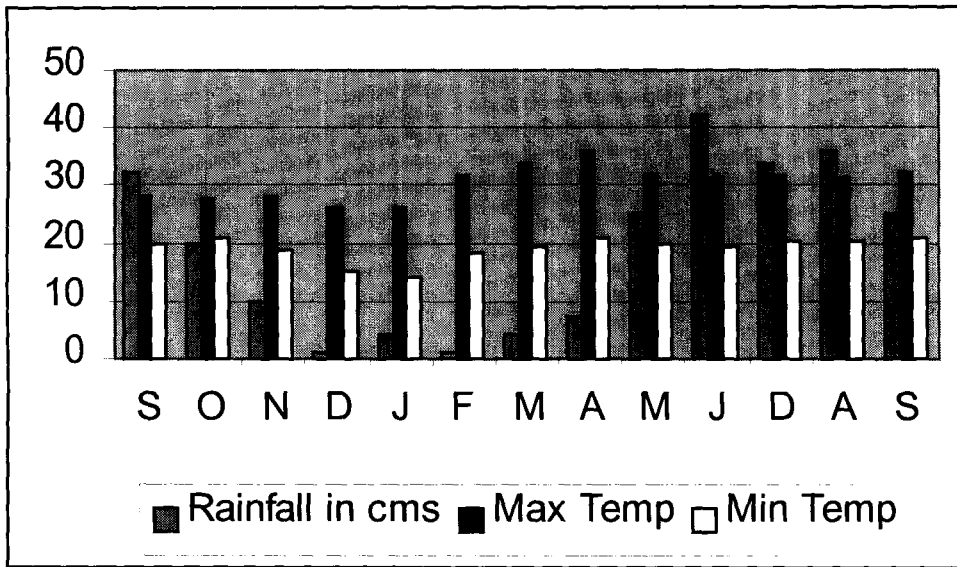
**FIGURE 1**

**LOCATION MAP OF MIZORAM SHOWING THE EXPERIMENTAL SITE AT PAITE VENG**



**Figure - 2**

**Monthly variation in mean maximum and mean minimum temperature and monthly mean rainfall from September 2000 to September 2001**



## CHAPTER – IV

### PHYTOSOCIOLOGICAL ANALYSIS OF WEEDS IN THE AGROFORESTRY SYSTEM

Phytosociological refers to the structure and classification of plant community in a given ecosystem and the analytical characters are those features of the community which can be observed or measured directly in each stand. These include all kinds and number of species, distribution of individual species, vigour, form, number of individuals, height of plants, area, volume growth rate and periodicity etc.

Floristic composition is a qualitative analysis of plant community and is studied by periodic collection and identification of plant species. These are valuable for characterization because each species has its own range of ecological amplitude.

#### MATERIALS AND METHODS :

The study on phytosociological analysis of weeds was carried out from April to September at Paite Veng. For this purpose, twenty quadrates ( Size 50x50 cm) were laid randomly immediately after the crop sowing. The size and number of quadrates were determined according to Misra ( 1968 ). The weed count was made and each species was identified the relative density, relative frequency, relative elominance and importance value index of individual weeds was calculated. The analysis was done by using the following formula as described by Shukla and Chandel ( 1998).

#### DENSITY :

The numerical strength of a species in relation to a definite unit space is called its density. The crude density refers to the number of individual of a particular species per unit area. Each organism occupies only the area that can adequately meet its requirements. Thus the density of an organism refers to the amount of area available.

$$\text{Density of a species per unit area} = \frac{\text{Total no. of individual of a species in all sample plots}}{\text{Total no. of sample plots studied}}$$

The proportion of density of a species to that of a stand as a whole is referred to as relative density.

$$\text{Relative density of a species} = \frac{\text{Total number of individuals of a species}}{\text{Total number of individuals of all species}} \times 100$$

### **FREQUENCY:**

In the community, the individuals of all the species are not evenly distributed. Individuals of some species are widely spaced while those of some other species are found in clumps or mats. The distribution patterns of individuals of different species indicate their reproductive capacity as well as their adaptability to the environment. Frequency refers to the degree of dispersion in terms of percentage occurrence.

$$\text{Frequency} = \frac{\text{Total no. of quadrates in which the species occur}}{\text{Total no. of quadrates studied}} \times 100$$

The dispersion of species in relation to that of all the species is termed as relative frequency of a species. Relative frequency is determined by the following formula.

$$\text{Relative frequency of a species} = \frac{\text{Frequency of the species in stand } x}{\text{Sum of the frequencies for all species in stand } x} \times 100$$

### **ABUNDANCE:**

The estimated number of individuals of a species per unit area is referred to as abundance. The abundance is determined by the following formula.

$$\text{Abundance of a species} = \frac{\text{Total number of individuals of the Sp. In all quadrates}}{\text{Total number of quadrates in which the species occur.}}$$

**DOMINANCE :**

Species which exert controlling influence on the community by virtue of their size, numbers, production or other activities are called dominant. A relatively few species or species group exert the major controlling influence on the entire community such as species or species groups which control the physical habitat and the community are known as two ecological dominants.

$$\text{Relative dominance of a species} = \frac{\text{Total basal area of the species in all the quadrates}}{\text{Total basal area of all the species in all the quadrates}} \times 100$$

**IMPORTANCE VALUE INDEX :**

It was first proposed by Curtis and McIntosh ( 1950 ) which is the sum of the relative values of the three quantitative characters. In any heterogenous plant community data of frequency, density, abundance and cover of species do not yield total picture of ecological importance of a species in relation to the community structure can be obtained by adding the values of relative frequency density, relative dominance and relative frequency.

**RESULTS AND DISCUSSION :****FLORISTIC COMPOSITION OF THE WEED FLORA :**

The weed flora of the experimental site composed of a total of twenty one species belonging to 13 families ( Table 4.1), out of which 10 belongs to annual and 11 belongs to perennials.

The weed species composing the flora varied to a great extent with respect to their distribution in different quadrates ( Table 4.2). The number of weed species varied from 08 to 17. Similarly, there was a wide variation in the distribution of annuals and perennials between the quadrates ( Table 4.2 ).

The weeds which were found in the crop fields too represented in the follow land thus there was a total of 21 weed species common to both crop and follow period ( Table 4.4. ). The density of weeds were higher during the fallow period than that of corresponding value of cropping period.

The ecological analysis of the weed flora revealed that *Sida acuta* had the highest density ( 116.8) followed by *Bidens pilosa* ( 70 ), *Cyperus rotundus* ( 26.6 ). *Gynuria auriculata* ( 25 ) and *Ageratum conyzoides* ( 24.8 ).

The data on weed count as revealed from their number/ density and life from in the different quadrates indicated that , the field is more heterogenous. The composition of weed flora in a particular crop field is intricately linked to the soil seed bank of the weeds ( Sahoo, 1994, Sahoo, 1997), besides, the history of the crop fields and to the various managerial practices ( Sagar and Mortiner, 1976). Many workers have attributed the variation in weed composition to other factors, such as type of crop, method of crop planting, period to which the crop is exposed to rigorous tilling practice. Crop rotation and to the amount of rainfall a site receive ( Misra *et al* ,1992; Moss, 1988; Fryer and Makepeace, 1977, Moore and Wein, 1977; Menges, 1987, Roberts 1981 ). The various agronomic practices which are followed in the experimental site have been described in Table 3.1 which reveals that other than weeding, the practices followed are same.

Our results had some similarity with the findings of earlier workers who argue that weed composition is largely associated with the crop and the crop types. The higher number of weeds and their relative densities during the follow period, obviously were due to availability of more natural resources for the growth of the weeds in the absence of crop and any agricultural disturbance. On the contrary, weed diversity was less during cropping period which may be attributed to less availability of the resources and more weed – crop competition and / or may be attributed to crop - weed compatibility.

The importance value index was highest in *Sida acuta*, thus this species was ranked as the most dominant weed species in the agroforestry system ( Table 4.4. ). The co-dominant species were *Bidens pilosa*, *Gynuria auriculata*. These three weeds combining have a major share in the weed flora of the cropping system. Incidentally these species too are annuals/ prennials and are considered among the troublesome weeds as classified by many agronomists . Thus, they can be easily knocked down by using suitable herbicides and the crop can be improved for its productivity.

**TABLE 4.1 :**

**LIST OF WEEDS COMPOSING THE FLORA IN THE BAMBOO BASED SOYBEAN  
AGROFORESTRY SYSTEM IN MIZORAM.**

Sl.No.	Name of the weeds	Family	Life form
1.	<i>Ageratum conyzoides</i> ( L )	Asteraceae	A
2.	<i>Bidens . pilosa</i> ( L )	Asteraceae	A
3.	<i>Cyperus rotundus</i> (Rottb )	Cyperaceae	P
4.	<i>Centella asiatica</i> ( L )	Apiaceae	P
5.	<i>Cyperus iria</i> ( Rottb )	Cyperaceae	P
6.	<i>Cynodon dactylon</i> ( Linn )	Peaceae	P
7.	<i>Commelina benghalensis</i> ( L )	Commelinaceae	A
8.	<i>Desmodium heterophyllum</i> D.C	Papilionaceae	P
9.	<i>Drymaria cordata</i> ( Linn )	Caryophyllaceae	A
10.	<i>Digitaria ciliaris</i> ( HBR ) Hern	Poaceae	A
11.	<i>Eupatorium odoratum</i> ( L )	Asteraceae	P
12.	<i>Eclipta.. alba</i>		A
13.	<i>Galinsoga ciliata</i> ( Rafin )	Asteraceae	A
14.	<i>Gynuria auriculata</i>		P
15.	<i>Imperata cylindrica</i> Beauv	Poaceae	P
16.	<i>Lantana camara</i> ( L )	Verbenaceae	A
17.	<i>Mikania scandense</i> ( L )	Asteraceae	P
18.	<i>Oxalis corniculata</i>	Onalidaceae	P
19.	<i>Rubia Spp</i>	Rosaceae	A
20.	<i>Sida acuta</i>	Malvaceae	A
21.	<i>Setaria glauca</i>	Poaceae	P

**TABLE 4.2**  
**VARIATION IN WEED COMPOSITION AND NUMBER IN DIFFERENT QUADRATS ( 50 X 50 Cm ) IN THE SPP FIELD DURING**  
**PEAK GROWTH PERIOD AT THE STUDY SITE.**

Sl. No.	Species	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12	Q 13	Q 14	Q 15	Q 16	Q 17	Q 18	Q 19	Q 20
1.	<i>Ageratum conyzoides</i> ( L )	9	4	2	-	2	-	-	3	-	-	-	-	2	-	-	-	-	8	3	-
2.	<i>Bidens pilosa</i> ( L )	45	-	40	10	-	15	-	50	-	-	10	20	56	-	-	35	50	17	-	-
3.	<i>Cyperus rotundus</i> ( Rottb )	29	-	-	7	-	4	-	14	-	-	-	50	7	-	-	-	-	-	12	2
4.	<i>Centella asiatica</i> ( L )	10	-	1	3	7	2	2	-	3	-	-	-	3	2	2	5	-	-	4	2
5.	<i>Cyperus iria</i> ( Rottb )	-	-	4	-	-	-	-	-	-	2	-	-	3	-	2	1	1	1	2	2
6.	<i>Cynodon dactylon</i> ( Linn )	4	-	12	3	6	-	-	5	2	1	-	-	-	2	5	7	-	1	1	3
7.	<i>Commelina benghalensis</i>	5	2	2	3	-	-	1	1	1	4	-	2	-	-	5	-	-	2	1	2
8.	<i>Desmodium heterophyllum</i> D.C	7	3	-	-	-	-	2	-	-	4	-	-	-	1	-	-	2	5	1	10
9.	<i>Drymaria cordata</i> (Linn )	6	9	14	3	9	4	-	-	2	3	-	-	1	1	1	2	1	5	-	-
10.	<i>Digitaria ciliaris</i> (HBK)Hern	14	11	9	25	-	13	2	-	-	5	10	5	7	17	13	-	-	-	-	2
11.	<i>Eupatorium odoratum</i> (L)	15	3	9	-	5	11	-	1	20	6	17	13	1	-	-	4	4	5	7	3
12.	<i>Solanum tuberosum</i>	-	-	-	-	-	1	1	2	-	-	2	2	4	-	-	-	3	-	9	-
13.	<i>Galinsaga ciliata</i> ( Rafin )	2	2	1	1	5	2	-	3	-	10	-	-	5	-	-	13	11	5	9	8
14.	<i>Gynuria auriculata</i>	45	-	40	10	-	15	-	-	50	-	10	20	50	-	-	35	50	19	-	-
15.	<i>Imperata cylindrica</i> beaur	14	7	-	-	-	12	-	3	5	3	6	-	-	-	2	2	25	4	-	-
16.	<i>Lantana camera</i> ( L )	-	2	2	3	11	-	4	7	3	-	-	-	-	-	4	9	7	3	-	-
17.	<i>Mikania scandense</i>	-	-	-	5	-	1	-	-	2	-	-	1	1	1	1	-	-	-	1	2
18.	<i>Oxalis corniculata</i>	10	-	-	-	6	-	-	9	5	2	13	-	-	-	7	-	-	2	-	12
19.	<i>Rubia spp</i>	-	-	4	5	2	12	2	8	15	-	4	-	-	10	14	-	-	3	2	31
20.	<i>Sida . acuta</i>	60	-	75	29	54	-	-	-	-	66	-	-	-	-	90	45	-	70	95	-
21.	<i>Setaria glauca</i>	15	9	-	-	-	3	-	2	5	-	-	1	1	2	-	-	-	5	6	-
No of Weeds.		17	11	14	14	11	14	8	12	13	12	9	10	14	9	13	12	10	16	14	12

**TABLE 4.3 :**

**LIST OF WEEDS COMPOSING THE WEED FLORA AND THEIR DENSITIES  
(NUMBER m<sup>-2</sup>) DURING THE PEAK GROWHT PERIOD AT THE STUDY SITE.**

Sl.No.	Weeds	Cropping period	Fallow period
1.	<i>Ageratum conyzoides</i>	24.8	30.6
2.	<i>Agremone mexicara</i>	(P) -	35
3.	<i>Bidens pilosa</i>	70.	-
4.	<i>Cyperus rotundus</i>	26.0	37
5.	<i>Cyntella asiatica</i>	10.4	24
6.	<i>Cynoda dactylon</i>	15.4	18.4
7.	<i>Cyperus iria</i>	12.2	16.6
8.	<i>Commelina benghalensis</i>	4.8	24.6
9.	<i>Dicanthium annulatum</i>	-	94.6
10.	<i>Desmodium heterophyllum</i>	3.6	11.2
11.	<i>Drymaria cordata</i>	13.2	27.6
12.	<i>Digitaria ciliarie</i>	9.8	118.6
13.	<i>Eupatorium odoratum</i>	7.0	13.6
14.	<i>Eclipta alba</i>	3.8	13.2
15.	<i>Galinsaga ciliata</i>	16.4	53.2
16.	<i>Gynuria auriculata</i>	25.0	23.6
17.	<i>Imperata cylindrica</i>	6.6	105.6
18.	<i>Indigafera latifolia</i>	-	36.6
19.	<i>Lantana canara</i>	9.0	23.6
20.	<i>Mikenia sea dense</i>	3.0	5.8
21.	<i>Oxalis corniculata</i>	9.2	15.2
22.	<i>Paspalidium flauatum</i>	-	24.6
23.	<i>Rubia spp</i>	22.4	37.8
24.	<i>Saccharum spontancum</i>	-	94.6
25.	<i>Sida acuta</i>	116.8	-
26.	<i>Setaria glauca</i>	6.2	16.6
<b>Total</b>		<b>409.2</b>	<b>683.4</b>
No. of species present =		21 (10)	25 (9)
- Species absent			
Values in Parenthesis indicate the number of annuals.			

**TABLE 4.4 :****FLORISTIC COMPOSITION AND IMPORTANT VALUE INDEX OF WEEDS.**

Sl. No.	SPECIES	Relative density (%)	Relative Frequency (%)	Relative Dominance (%)	Important Value Index	Species Rank
1.	<i>Ageratum conyzoides</i>	5.92	6.89	5.23	18.04	(5)
2.	<i>Bidens pilosa</i>	16.72	4.47	1.13	22.58	(2)
3.	<i>Cyperus rotundus</i>	6.35	5.60	3.14	15.09	(8)
4.	<i>Centella asiatica</i>	2.48	5.60	5.23	13.31	(10)
5.	<i>Cyperus iria</i>	2.91	4.74	0.43	8.08	(20)
6.	<i>Cynodon dactylon</i>	3.67	6.03	8.72	18.42	(4)
7.	<i>Commelina benghalensis</i>	1.14	3.44	7.42	12.00	(13)
8.	<i>Desmodium heterophyllum</i>	0.86	3.87	3.49	8.22	(18)
9.	<i>Drymaria cordata</i>	3.15	3.87	2.18	9.20	(16)
10.	<i>Digitaria ciliaris</i>	2.34	4.31	2.61	9.26	(15)
11.	<i>Eupatorium odoratum</i>	1.67	3.87	4.80	10.34	(14)
12.	<i>Eclipta alba</i>	0.90	6.03	0.41	7.36	(21)
13.	<i>Galinsoga ciliata</i>	4.01	4.77	6.54	15.26	(7)
14.	<i>Gynuria auriculata</i>	5.97	3.44	9.16	18.57	(3)
15.	<i>Imperata cylindrica</i>	1.56	3.44	7.85	12.86	(12)
16.	<i>Lantana camara</i>	2.63	4.74	8.29	15.65	(6)
17.	<i>Mikania scandense</i>	0.71	3.87	4.36	8.94	(17)
18.	<i>Oxalis corniculata</i>	2.19	5.60	5.23	13.02	(11)
19.	<i>Rubia Spp</i>	5.60	5.60	2.18	13.38	(9)
20.	<i>Sida acuta</i>	27.90	3.87	9.60	41.37	(1)
21.	<i>Setaria glauca</i>	1.48	5.60	1.52	8.60	(19)

\*\*\*\*\*

## **CHAPTER – V**

### **EFFECT OF WEEDS INFESTATION ON CROP GROWTH AND PRODUCTIVITY IN THE AGROFORESTRY SYSTEM.**

Weeds are an integral part of any agroforestry or agroecosystem. They take an upper hand by virtue of their aggressiveness and higher ecological amplitude thereby having more competitive in crop-weed interaction for various natural resources. In Soybean weed control is of utmost important because the crop has a very slow growth compared to its weeds associates.

The crop productivity in a given field determines site quality which in turn is inter linked to the competition between crop and weed, nutrient uptake, dry matter allocation in both weeds and crops and to the management practices followed in the field. The density of weed population or the degree of weed infestation and its composition has a large bearing on crop productivity ( Troy *et al* , 1991)

#### **MATERIALS AND METHODS :**

The effect of weeds on the growth behavior and crop yields was studied from May to September. Various growth parameters of the crop (*Glycine max*) such as height, number of leaves, collar thickness, biomass etc was measured using appropriate tool and following standard methodologies at a monthly interval. However, the crop productivity was assessed only once i.e. at the end of cropping period.

The height of crop plants usually indicated their vigour and a measure of the environmental conditions. It is sometimes difficult to secure accurate measurements because the height attained by the stem and leaves varies with individual plants of the same species growing under similar conditions.

To determine the differences in height between plants under weed free and un-weeded plots, the crop were measured at monthly interval and then the data are subjected to analysis of Variance to see the difference.

The various growth parameters such as plant height collar thickness, number of leaves were measured from the eight permanent quadrates laid randomly for the purpose. For the purpose, eight crop plants were randomly selected from different quadrates and worked with water proof paints on their first eophyll leaves. These crop plants were assessed for their growth behavior at a monthly interval.

## **DRY MATTER PRODUCTION OF WEEDS.**

For the growth studies, 10 quadrates of 1mx1m size were randomly laid at the time of crop sowing in each field selected for the study. The weed biomass in different crop field was determined by collecting plants in each sampling date from the quadrates distributed in three replicated fields laid for the purpose. The weed plants were extracted by digging monoliths of size 25cm x 25 cm x 25 cm from each quadrates and separated from soil by washing. Dry weight was determined by oven drying the shoot and washed root samples at 80°C to a constant weight.

## **CROP PRODUCTIVITY :**

The crop productivity was assessed through a weed density gradient. For the purpose, four different weed densities viz 0 ( weed-free ) 54 plants/m<sup>2</sup> (low), 268 plants/m<sup>2</sup> (medium) and 409 plants/m<sup>2</sup> (high ) were choosen and maintained by regular weeding and keeping the number of weed plant to these level. These have been named as weed free plot, low density weed plot moderate density weed plot and high density weed plot respectively. In these plots these quadrates were maintained for the purpose. In weed free plot, regular weeding was done in the quadrates at a 15 days interval and in other plots, regular weed count was made in the respective quadrates, if there was any more weed than the initial number, weeding was done.

The crop productivity was determined by weighing the pods after harvesting from different quadrates. Analysis of variance was done to see the difference in crop yield along a weed density/infestation gradient.

## **RESULTS AND DISCUSSION**

### **GROWTH BEHAVIOR OF SOYBEAN :**

The different growth attribute of soybean such as height, collor thickness, number of leaves varied widely between the quadrates and stands. These can be observed from higher degree of standard error. This may be due to heterogeneity in the nutrient content of the soil of the study site between the sample plots and sampled quadrates. In general the growth on these attributes were significantly (  $P < 0.001$  ) higher in the weed free plot than the corresponding unweeded plots. However, in the case of number of soybean leaves, no significant variation was found between the plots.

The data shown that the highest crop height (cm) was attained in weed free plot during 90 days from the date of crop sowing. In general, the rate of crop growth at the first one month was very slow, then the crop peaked up growth and then they reached 120 days, the growth was almost steady. Therefore, the crop exhibited a signified curve growth with respect to the time in the crop field ( Table 5.1). Similar variation in the rate of growth in collar thickness and number of leaves was also observed in both weed free and un-weeded plot.

### **DRY MATTER PRODUCTION OF WEEDS :**

Dry matter production/ weed biomass increase with increase in time and attained a peak of 1087.5 gm<sup>-</sup> ( Table 5.7). Major portion of this biomass was due to *Sida acuta* *Bidens pilosa* and *Cyperus rotundus* \_which form the dominant and co dominant species in the agroforestry system.

High dry matter production by the weeds was due to higher weed density/ infestation and the competitive ability of the weeds. Further more there was a negative linear relationship between crop yield and weed density i.e. higher the weed biomass, lower is the crop yield and vice-versa. This finding is in confirmity with the works of Cousens *et al*, ( 1985).

### **CROP YIELD/ PRODUCTIVITY :**

Crop productivity varied significantly (  $P < 0.05$ ) between the level of weed infestations in the crop field ( Table 5.8). In the absence of weed competition ( weed free plot ), the crop production was 1.28 gm<sup>2</sup> while at the highest weed density ( highest weed infestation) the crop production was low at 0.56 gm<sup>2</sup>. There was a gradual decrease in crop productivity with the increase in the level of weed infestation in the crop filed ( Table 5.8). This is obviously due to high weed crop interaction. At higher weed density plots, weeds shared major portion of the nutrients and other natural resources available to the crop plants and thereby did not allow them to fully grow and resulted in reduced crop yield. There was more than two fold increase in the crop yield between the weed free and higher weed infested plots in the system. This depicts that weed control is very essential in order to improve crop productivity. According to Troy *et al* (1991), in soybean weeds alone share 25% of the variable cost associated with soybean production. Similar finding have been reported for other crops .

Table 5.9 reports the agronomic calendar of the site. The peak crop growth took place between June to July while peak weed growth took place a month before weed were very fast growing and aggressive therefore did not allow the crop to grow at par and after they decline to growth or attained a steady state, the crop attained peak growth.

Though the study on weed crop, biomass allocation to weed and crop in the agroforestry system are very interesting, the present study was of a very short duration. There have been some indication on the pattern of weed crop competition, growth of the crop as affected by the weeds and weed growth with respect to time and also, the crop yield along a weed density competitive gradient, however, further studies are required to confirm these findings and to pin point exactly the best time of weeding to improve crop production in the system.

**TABLE 5.1:**

**MONTHLY VARIATION IN HEIGHT (C.M) OF THE SOYBEAN PLANT IN THE  
AGROFORESTRY SYSTEM IN WEED-FREE AND UN-WEEDED STANDS.**

Month	Stand I ( Un-weeded)	Stand -II ( Weed-free)
May	13.23	17.35
June	22.30	47.35
July	45.68	87.41
August	75.07	118.10
September	101.08	149.50

The values represent the mean value of eight crop plants

**TABLE 5.2:****ANOVA ON VARIATION OF IN HEIGHT OF SOYBEAN BETWEEN WEED FREE AND UN-WEEDED PLOTS IN THE AGROFORESTRY SYSTEM.**

SV	Df	SS	MSS	F ratio	F Value
Plot	1	10262.26	10262.26		
Month	4	53109.18	13277.29	11.138	7.70
Error	4	4768.04	1192.02		
Total	9				

\*\* Significant at 0.05 % level

**TABLE 5.3:**

**MONTHLY VARIATION IN NUMBER OF LEAVES OF THE SOYBEAN PLANT IN  
THE AGROFORESTRY SYSTEM IN WEED-FREE AND UN-WEEDED STANDS.**

<b>Month</b>	<b>Stand I ( Un-weeded)</b>	<b>Stand -II ( Weed-free)</b>
May	4.12	7.50
June	10.13	16.50
July	12.00	24.37
August	16.13	31.16
September	27.00	54.62

The values represent the mean value of eight crop plants

**TABLE 5.4 :**

**ANOVA ON VARIATION OF NUMBER OF LEAVES OF SOYBEAN BETWEEN WEED  
FREE AND IN WEEDED PLOTS IN THE AGROFORESTRY SYSTEM.**

SV	Df	SS	MSS	F ratio	F Value
Plot	1	2564.29	2564.29		
Month	4	1593.6	398.4	** 59.55	7.70
Error	4	26.76	6.69		
Total	9				

\*\* Significant at 0.05 % level

**TABLE 5.5:**

**MONTHLY VARIATION IN COLLAR DIAMETER (Cm) OF THE SOYBEAN PLANT  
IN THE AGROFORESTRY SYSTEM IN WEED-FREE AND UN-WEEDED STANDS.**

Month	Stand I ( Un-weeded)	Stand -II ( Weed-free)
May	0.51	0.50
June	1.17	1.18
July	1.55	1.78
August	1.91	2.35
September	2.21	3.16

The values represent the mean value of eight crop plants

**TABLE 5.6 :**

**ANOVA ON COLLAR DIAMETER OF SOYBEAN BETWEEN WEED FREE AND  
UNWEEDED PLOTS IN THE AGROFORESTRY SYSTEM.**

SV	Df	SS	MSS	F ratio	F Value
Plot	1	0.81	0.81		
Month	4	5.67	1.41	3.93 <sup>NS</sup>	7.70
Error	4	1.44	0.36		
Total	9				

NS - Non Significant

**TABLE 5.7 :**

**VARIATION IN DRY MATTER PRODUCTION ( gm<sup>2</sup>) OF TOTAL WEEDS IN THE  
AGROFORESTRY SYSTEM.**

<b>DAYS</b>	<b>DRY WEIGHT ( gm<sup>2</sup>)</b>
0	10.10
15	72.20
30	4000.00
45	730.60
60	980.20
75	1087.50
90	968.20

10/10/2018

**TABLE 5.8 :**

**CROP PRODUCTIVITY ( $\text{gm}^{-2}$ ) OF SOYBEAN ALONG A WEED DENSITY GRADIENT/  
INFESTATION IN THE AGROFORESTRY SYSTEM.**

<b>Level of infestation</b>	<b>Density of weed plant ( number <math>\text{m}^{-2}</math>)</b>	<b>Crop productivity (<math>\text{gm}^{-2}</math>)</b>
O ( Weed free )	Nil	1.28±0.01
Low	54±05	0.92±0.01
Moderate	268±15	0.68±0.1
High	409±11	0.56±0.0

± S.E.M, n = 3

**TABLE 5.9 :****AGRONOMIC CALENDAR FOLLOWED IN THE STUDY SITE.**

<b>Operation</b>	<b>Weed free plot</b>	<b>Un-weeded plot</b>
Clearing of site	February – March	February- March
Ploughing	1 <sup>st</sup> week of April	1 <sup>st</sup> week of April
Sowing of Crop	last week of April	last week of April
First dressing	2 <sup>nd</sup> week May	2 <sup>nd</sup> week May
Weeding	15 – 20 days interval	Nil
Peak crop growth	June – July	Nil
Peak weed growth	May – June	May – July
Flowering of Crop	July – August	July – August
Fruiting of crop	August – September	August – September
Crop harvest	Last week September	Last week September

\*\*\*\*\*



**Plate-1:** One month old soybean plant on un-weeded plot



**Plate-2:** One month old soybean plant on weed free plot



**Plate-3:** Soybean plant at harvest time on weed free plot.



**Plate-4:** Soybean plant at harvest time on un-weeded plot.



**Plate-5:** Weed infestation during fallow period.

## **CHAPTER -VI**

### **GENERAL DISCUSSION AND CONCLUSION.**

Unlike any agroecosystem agroforestry systems are more complicated, in the former, there is composition between weed and crop while in the latter, there is another tree components, sometimes, there may be many more component depending on the agroforestry system. So, the weeds in the agroforestry system not only compete with the crop plant but also compete with the tree species growing there. Similarly, the response of the crop plant and its growth and dynamics are largely influenced by the tree component of the system. Since the crop in the present study ( i.e. Soybean ) is very slow growing ( Santharam, 1981 ) it was at a very receiving end as far as the competition is concerned and had almost no resistance to both tree and weed species.

The population growth of any species whether a herb, shrub or tree is determined by availability of all natural resources to the plant including growing space. It was possible to include the tree species ( i.e. bamboo ) for the present study to monitor various growth parameters, therefore the results depicted in the study are considered as the effect of crop- weed interactions. A majority of the weed species found in the system were of perennials. The perennials are generally difficult to control than the annuals, therefore, they are most nuisance in the system.

The weed composition which again depended on crop type, crop duration, prevailing climatic condition and other disturbances indicated that the system had a higher degree of weed infestation. As compared to the cropping and fallow period, there might have been intense competition between the natural resources in the crop field, which could be resulted in lower weed diversity and lower weed density. During the fallow period, on the other hand no agronomic disturbances were followed, thereby the weeds had a very luxuriant growth. A number of workers have found out that weed infestation can be drastically reduced/ minimized by adopting suitable crop rotation ( Gummerson, 1971; Burnside, 1978, Khingman, 1961, Dowler *et al*, 1974 ) Similar crop rotations can also be introduced in the hill farming system to tackle with the ongoing weed problem.

Dry matter production is a quantitative measure of weed growth. The higher the weed biomass mean a luxuriant weed growth and higher weed density. This is inversely related to the crop productivity obviously for the reason already stated in the preceding paragraphs. Similar findings have been reported by a number of workers ( Crowley *et al*, 1972; Gomes *et al*, 1978 )

The composition of weeds in the flora at a given time is the resultant of the natality And intra and inter specific competition and availability of the seed pool in the soil ( Sahoo *et al* , 1994, Sahoo *et al*, 1999, Sahoo *et al*, 1997). The sigmoid curve growth pattern of both crops and weeds are also related to the above factors. Besides, the weed composition in a given field relates to its history, management practices, in the present study, the system was bamboo- based. Since no other multipurpose tree based system was compared, it cannot be depicted how the variation in weed composition will be, but as has been observed by a number of workers, weed composition vary with respect to the soil type, topography, altitudinal range.

The population dynamics of individual weeds, their half- life, cohort-wise distribution, survivorship, fecundity and the proportion of contributing to the soil, fate of the seed population in soil, pattern of emergence, dormancy etc play vital role in the weed regulating weed crop competition and predicting future infestation. Tillage and other agronomic practices do contribute to the severity of weed infestation in the crop fields. Higher the tillage and other form of disturbances such as hoeing, the field subject to more weed emergence as has been found out by Misra *et al* (1992 ), Sahoo *et al* (1994), Sahoo *et al* (1997). These studies report that before adopting any weed control measures, the burried seed bank be disturbed so as to enhance emergence of weeds and then using suitable herbicides can be knocked down ( Sahoo *et al* , 1995). A knowledge on viable soil seed bank and its status in the agroforestry therefore is essential to propose any suitable weed control measure in the present study.

The present study was only for a very short duration. Therefore, a detailed study on different aspects of weed stated above could not be undertaken so as to make any concrete conclusion. However,, there have been sufficient indication that (1) the crop field has intense weed growth (2) more perennials (3) higher dry matter allocation. Weeds and the crop productivity is adversely affected with the degree of weed infestation. Further, studies are required to confirm these. Some studies can also be undertaken to compare the variation in weeds and their densities in different cropping season and with different crops and different agroforestry models so as to know the pattern of weed-crop association, weed-crop dry matter allocation and related yield issues.

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## **CHAPTER VII**

### **SUMMARY.**

The study on weed infestation in a bamboo-based soybean agroforestry system was carried out from April to September 2001 at Paite Veng, located about 6 KM east of Aizawl, the capita city of Mizoram. The experiment was done by studying the weed composition and the growth attributes of the plant. The results are subjected to analysis of variance ( ANOVA ) to find the effect of weeds on growth and yield of plants on weed-free and un-weeded plots. The growth parameters were recorded at monthly interval while the yield was recorded only once that is on their harvest.

The major findings of the present investigation were as follows :

- i) The weed flora of the experimental site composed of a total of twenty one species belonging to thirteen families. Ten belongs to annuals and eleven belongs to perennial.
- ii) The weed species composing the flora varied to a great extent with respect to their distribution. The number of weed species varied from 8 to 17.
- iii) The number of weed species was more during the fallow period than during the cropping period and their density too was higher during fallow period than that of the cropping period.
- iv) The different growth attributes of soybean such as height, collar thickness, number of leaves were significantly (  $P < 0.01$  ) higher in weed free plot than the un-weeded plots. There was no significant variation in the number of soybean leaves between the plots.
- v) Dry matter production increased with increase in time and attained a peak of  $1087.5 \text{ gm}^{-2}$ .
- vi) The crop productivity varied significantly (  $P < 0.05$  ) between the level of weed infestations in the crop field. In the absence of weed competition the crop production was  $1.28 \text{ gm}^{-2}$  while at the highest weed density the crop production was low at  $0.50 \text{ gm}^{-2}$ .

From our present investigation, it can be depicted that weed can cause considerable Decrease to crop growth and yield. Therefore a detailed study on weed-crop competition effects of crop growth by weeds and also the effects on crop yield by weeds are required to improve crop production in the system.

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