DISTRIBUTION OF *MIKANIA* AND ITS ECONOMIC IMPACT ON TEA ECOSYSTEM OF ASSAM

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Abstract: *Mikania micrantha* a gregarious perennial fast growing herbaceous creeping vine possess a serious threat to tea production. Negative impacts of the weed include labour cost, reduction in yield of crop, loss of native biodiversity etc. An ecological survey to study the seasonal distribution and economic impact in terms of cost and profitability of tea cultivation was carried out during 2004-2005 in two sites viz.,Cinnamora Tea Estate (CTE), Division: Hatigarh and Experimental garden for plantation crop (EGPC), Assam Agricultural University, Jorhat (Assam). The results of the present investigation showed highest population build up 2600 and 1000 numbers of *Mikania* stalks/ha during the month of September and August respectively in CTE and AAU. Study on economic impact of *Mikania* showed an adverse affects of it on tea cultivation in the surveyed area causing a loss of 41.8% and 18.90 % respectively in CTE and EGPC.

INTRODUCTION

Mikania micrantha Kunth in HBK (Asteraceae) mile-a-minute weed originating from the tropical and subtropical zones of North Central and South America, (Holm *et al.,* 1977) is a gregarious, perennial fast growing herbaceous creeping vine that possess a serious threat to tea production in North East India. *Mikania micrantha* is reported to be introduced into the North-Eastern part of India during the Second World War as a nonleguminous ground cover for tea plantation (Parker, 1972; Borthakur, 1977; Palit, 1981)

Weed competition in tea plantations may cause crop loss to the extent of 10-15 per cent and may remove up to 252 kg of soil nitrogen per hectare annually in young tea. Their control is implicit considering the phenomenal enhancement in yield by reducing the stress on moisture, nutrients and space. Weed control in tea using herbicides has been found to be advantageous with a cost - benefit ratio of 1:1 or more. Out of 5,600 Mt of herbicides applied annually in our country, about 112 M are used in tea plantations alone (Chakravartee *et al.*, 1998).

Out of 250 *Mikania* species reported identified so far, *Mikania micrantha* is the only species, which causes a significant weed problem in the old world (Sankaran *et al.,* 2003). High distribution to ecosystems and the resultant structural and functional modification of micro sites appear to have promoted spread of *Mikania* in India including Assam. The weed can propagate by means of wind-dispersed achenes and by stem fragments, which roots easily at nodes (Barreto and Evans, 1995) but cannot tolerate dense shade (Holm *et al.,* 1977). Seeds are dispersed long distances by wind and the plant can grow vegetatively from very small sections of the stem. Growth of young plants is extremely fast (8-9 cm in 24h) (Choudhury, 1972) and using trees as support, the weed rapidly forms a dense cover of entangled leafy stems (Holm *et al.*, 1977). Although growing tips of the weed dry out each year during summer (wherever soil moisture is low), underground suckers and main stalk may survive for a few years giving rise to new shoots after the onset of monsoons.

MIKANIA ON TEA

Mikania is capable of smothering tea plants by growing up the canopy. It seriously disrupts plucking by its growth among the new harvestable shoots. It deprives crop plants of soil nutrients and sunlight (Watson *et al.,* 1964) and has an allelopathic effect on their growth. Moreover the adverse effects of weeds on growth and productivity of tea are the problems generally faced by tea planters. Weed control is the second most expensive operation in tea cultivation. Harler (1958) estimated that in Assam about 20 percent of the workers in a plantation are in weeding. Plucking is conspicuously the single largest

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operation demanding maximum labour utilization (61.65%) followed by weed control (17.33%) (Bhuyan, 2005).

It is very difficult to kill this weed chemically by using herbicides when it comes over the plucking surface of tea. The common practice is to remove manually from the plucking surface (Dutta, 1977). Weed competition in tea plantation may cause crop loss to the extent of 10-15 per cent. There has been a rapid growth of *Mikania* in most of the tea growing areas, causing various ecological and economic problems to tea planters. Economically, the ill effect of *Mikania* is the cost escalation in various cultivation practices, which make them economically non viable. Thus the economic effect of *Mikania* in a tea plantation is also high as it enhances the cost of cultivation and reduces yield.

Mikania affects the production systems in a number of ways. In tea plantation, the most obvious of these is the negative effects on crop production, i.e., either increased cost of production due to cost of weeding or reduced yield (income) or both. If the growers undertake weeding effectively, there will not be much impact on total production and consequently the total estate income, otherwise the contrary; the production (income) will be reduced. These factors have been taken into account while analyzing the impact of *Mikania*.

The financial cost-benefit analysis using discounted cash flow technique is one of the methods identified to study the effect of *Mikania* on the profitability of perennial crop production. However, the farmers do not maintain reliable long-term data on many aspects of raising plantations. Further *Mikania* invariably affects both young and mature plantations, which results in reduced yield. Again in most of the tea estates a mixture of different varieties of seeds, clones and biclonal seed stocks of different age groups are present. This makes a financial cost benefit analysis difficult. Keeping this in view, the present investigation was carried out to study the distribution of *Mikania* and its economic impact on Tea ecosystem of Assam. In this study the annual cost of cultivation and income received by the grower's from their *Mikania* infested and uninfested tea sections were compared, assuming that the difference would indicate the impact of this obnoxious weed.

STUDY SITE

The present study was carried out in Jorhat, Assam at two different locations *viz.*, Cinnamora Tea Estate (CTE), Hatigarh Division and Experimental Garden for plantation Crops (EGPC), Assam Agricultural University. Jorhat is located at approximately 26"46' latitude, 94"12' longitude and 86.5m above mean sea level.

MATERIALS AND METHODS

To assess the distribution, abundance and economic significance of *Mikania micrantha* on tea, a survey was conducted during 2004 and 2005 in two study areas as mentioned elsewhere. An experimental area of 1.0 ha and 0.2 ha respectively in the first (CTE) and second (EGPC) sites were considered. The plots were purposively selected in a highly *Mikania* prone sections in consultation with the concerned Tea Estate Managers.

Observation plots were made initially weed free in the first week of January in both the years (2004 and 2005). The total area allotted in the estate was divided into two blocks, one was kept completely weed free while in the other only *Mikania* was retained. Since the on set of pre monsoon starts during the month of April the annual outbreaks of *Mikania* infestation was initiated from the mid of the month upto the period of complete maturity (flowering) of *Mikania* plant (December). The abundance of *Mikania* was assessed by selecting at random, fifty 1m x 1m quadrates. The number of *Mikania* stalks (individual plant) in the quadrate was counted. The mean number was counted and the total number per hectare was estimated. These were assigned by grade number (Table -1) to assess some measure of abundance / out breaks. These grades were arbitrary but were assigned to enable a ranking on the basis of abundance of *Mikania*.

Keeping all other management practices similar to that of a well-managed commercial tea estate, weeding was made by sickling (using a sickle), cheeling (using a cheel hoe) or forking (using a fork hoe). The total cost of weeding per ha, taking four rounds in a season was calculated out. Yield data of tea was taken as total green leaves plucked during the year. Made tea (kg / ha) was calculated out by dividing the total yield of green leaf

Table -1: Severity scale for quantification of level of infestation with *Mikania* under tea ecosystem

Level (Grade)	Nos. of stalks of plants per ha
Absent (-)	0
Negligible (0)	1 – 200
Scattered (1)	201 – 400
Low (2)	401 – 600
Moderate (3)	601 – 800
Medium (4)	801 – 1000
High (5)	Above 1000

Sankaran *et al.*, 1999 (modified)

with a conversion factor 4.77 assuming an average recovery of 21 per cent.

The Data on weather parameters as temperature, relative humidity, rainfall, bright sun shine hours were also recorded during the crop season and correlated with number of stalks/plot.

RESULTS AND DISCUSSION

The annual out breaks of *Mikania* infestation in CTE and EGPC shows that first out break of recorded in mid of April with 500 stalks/ha and 100 stalks/ha, respectively during 2004 (Fig. 1) and 450 stalks/ha and 150 stalks/ha during 2005 (Fig. 2). During 2004, a temperatures range of 19-26 °C, relative humidity (RH) of 76-92 % and rainfall (RF) of 336.6 mm was recorded during the month, and temperature range, RH and RF of 19-27°C, 76-92% and 187.9 mm, respectively were recorded during 2005 in the month of April. Thereby a gradual increase of *Mikania* population was recorded in the following months and reached to a maximum population of 2550 stalks/ha in CTE in the mid of September and 1000 stalks/ha in EGPC in last part of August during 2004. During 2005, a maximum population of 2200 and 1050 stalks/ha in CTE and EGPC, respectively were recorded in last part of August. A temperature range of 25-32°C and 24-30°C, RH of 78-89% and 83-92% and RF of 194.6 mm and 378.8 mm in the month of August and September, respectively was recorded during 2004, and a temperature range of 25-32°C, RH of 81-93% and RF of 320.2 mm in the month of August was recorded during 2005. After that in December population was found to decrease and reach to a minimum population of 1100 stalks/ha and 100 stalks/ha respectively in CTE and EGPC during 2004, and a minimum population of 1000 stalks/ha and 150 stalks/ha was found in CTE and EGPC, respectively during 2005. During this month a temperature range of 11-24°C and 10-25°C, RH of 72-95% and 65-96%, and RF of 2.5mm and 0.0 mm were recorded during 2004 and 2005, respectively. Weather parameters are presented in Figs. 3 and 4 for the year 2004 and 2005, respectively.

Correlation studies for the year 2004 (Table-2) revealed that *Mikania* population (No of stalks/ha) was positively correlated with maximum and minimum temperature, evening RH and RF while a negative correlation was found with morning RH and bright sunshine hours (BSSH) in both the fixed surveyed plots. Maximum and minimum temperature, evening RH in EGPC and only evening RH in CTE showed significant effect on *Mikania* population. No other climatic factors have found significant for *Mikania* population build up in year of observations.

For the year 2005, correlation analysis (Table-2) also showed similar trend of relationship of *Mikania* population (stalks/ha) with the weather parameters with that of 2004 except the relationship of its population with morning and evening RH in CTE. Morning RH was found to be negatively correlated while evening RH was found to be positive with non-significant effect.

Table -2: Correlation coefficient among numbers of *Mikania* stalks, temperature, relative humidity, rainfall, bright sunshine hours for the year 2004 and 2005

Fixed Surveyed Plot	X_1	X_2	X_3	X_4	X_5	X_6
CTE (2004)	0.5831	0.4947	-0.2192	0.6956*	0.1659	-0.1709
EGPC (2004)	0.8603*	0.7905*	-0.5477	0.7227*	0.3520	-0.0666
CTE (2005)	0.6447	0.5261	0.0931	0.4609	0.2982	-0.0765
EGPC (2005)	0.8374*	0.7835*	-0.1940	0.7127*	0.6439	-0.4251

* Significant at 5% level

Where CTE: Cinnamora Tea Estate, Jorhat, EGPC: Experimental Garden for Plantation Crops, AAU, X_1: Temperature (Max.), X_2: Temperature (Min.), X_3: Relative Humidity (Morning), X_4: Relative Humidity (Evening), X_5: Rainfall, X_6: Bright Sunshine Hours.

Impact of *Mikania* on cost of cultivation was calculated out from two-selected fixed plots. Table - 3 shows that there is significant difference in the cost

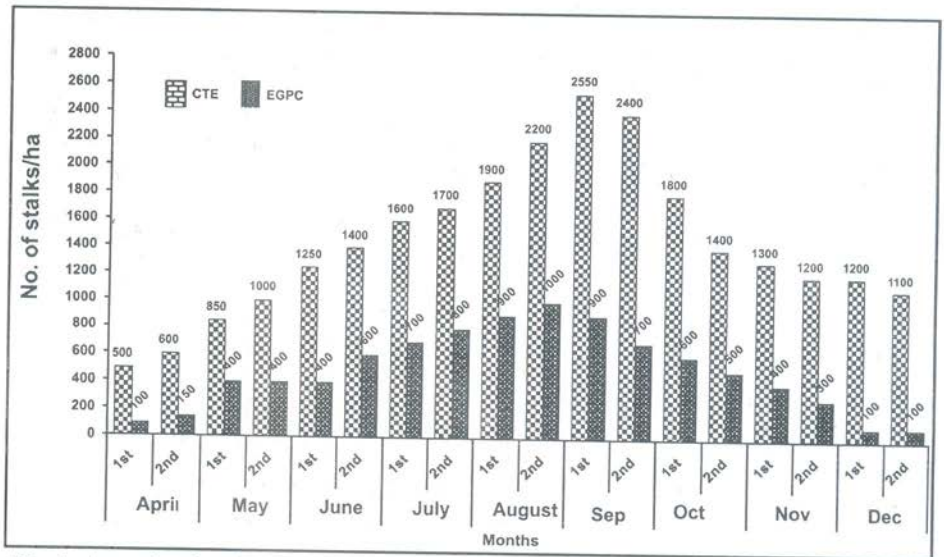

Fig. 1: Annual outbreak of *Mikania* infestation (fixed plot) at CTE and EGPC for the year 2004.

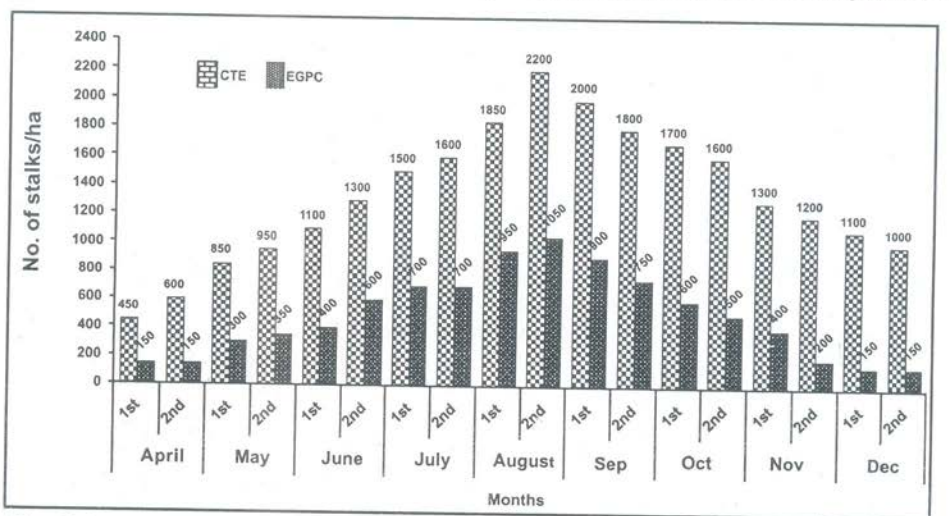

Fig. 2: Annual outbreak of *Mikania* infestation (fixed plot) at CTE and EGPC for the year 2005.

of maintenance of tea plantations with and without *Mikania*. Costs incurred by the estates in the plots with it were Rs.1872.00 per ha in CTE and Rs.3500/- per ha in EGPC and without it Rs. 2304/- per ha in CTE and Rs. 4200/- per ha in EGPC during the study period. It is also evident from Table - 2 that when the cost of labour involved and income was compared in plots with and without *Mikania* a loss of 41.83 % and 18.93 % was recorded due to its respectively in CTE and EGPC. This variation of loss in percent due to *Mikania* probably because of plot size, being 1ha in CTE while 0.2ha in EGPC and the former is under corporate sector while the later is in under university.

The problem of *Mikania* is invariably severe both in young and old tea plantations where *Mikania* overgrows covering the canopy upto the plucking table. This affects the growth and productivity of tea. Efficient weeding is one of the solutions to solve this problem. Manual (hand weeding), mechanical (sickling, cheeling and forking) and chemical (herbicide application) are generally advocated for management of *Mikania*. Weed management practices carried out by the tea estate workers are mostly inefficient, partly due to lack of adequate funds and partly due to labour shortage. The peak *Mikania* out break is from June to November, which coincides with

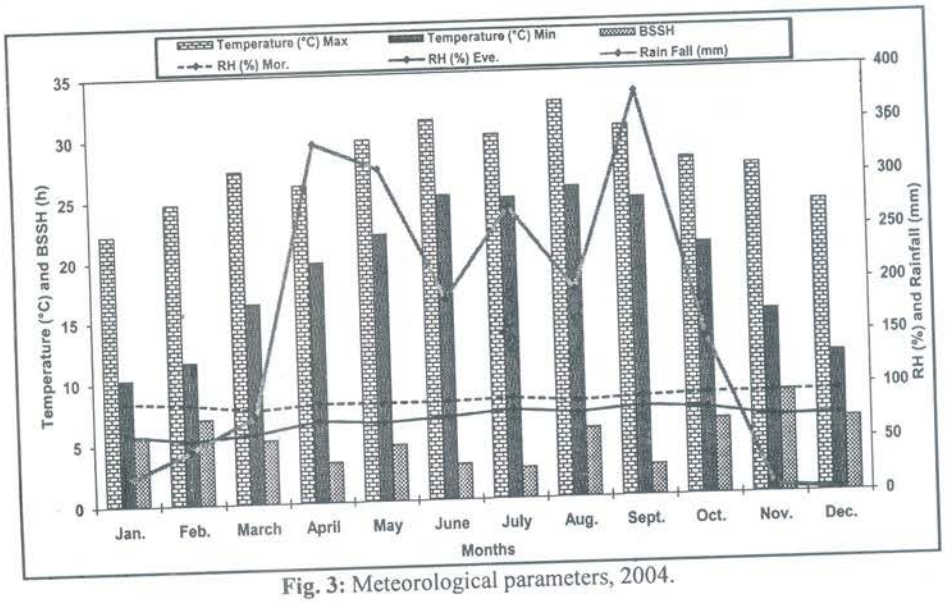

Fig. 3: Meteorological parameters, 2004.

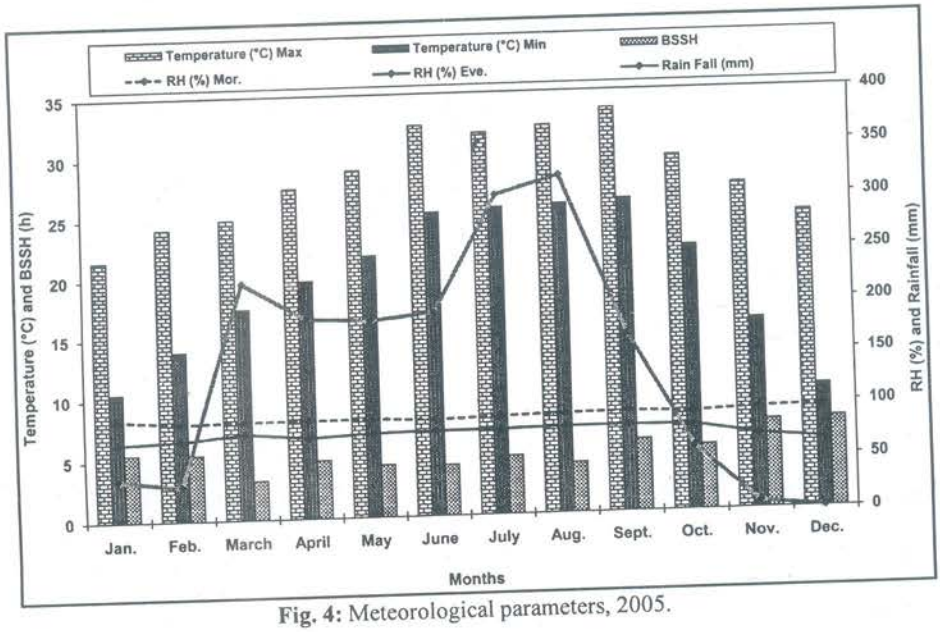

Fig. 4: Meteorological parameters, 2005.

the peak-plucking season and also the peak cultivation period of paddy, the most important crop of the state results labour shortage common during this season. Generally about 55-60 unskilled workers are required for weeding one hectare of area at wage rates varying from Rs. 72 to Rs 85 per man-day. Since the workers can earn an amount of Rs. 100 to 120 per day in other sectors out side the estate they prefer the latter. In order to complete the work with the limited funds allocated, the management employs only 25-30 workers to weed an area of 1 ha, which often leads to unsatisfactory results.

CONCLUSION

The wide distribution of *Mikania* in Assam possesses a serious threat to the tea growers. Intensive weeding of *Mikania* has become necessary to reduce its effect on productivity of tea plantations.

Table -3: Cost of cultivation in two different fixed plot surveyed area

Particulars	Cinnamora Tea Estate (Divn. Hatigarh)			EGPC (AAU)		
	Without Mikania	With Mikania	Loss due to Mikania (%)	Without Mikania	With Mikania	Loss due to Mikania (%)
Labour (unit) used/ha	32	26		60	50	
Cost involved (Rs/ha)	2304.00 (@ 72 per unit	1872.00 (@ 72 per unit		4200.00 (@ 72 per unit	3500.00 (@ 72 per unit	
% increase of cost		23.07			20	
Yield of made tea (kg / ha)	1725.90	1003.90		1686.30	1367.00	
Amount (Rs)	146701.50 (@Rs. 85 per kg	85331.50 (@Rs. 85 per kg	41.83	168630.00 (@Rs.100 per kg	136700.00 (@Rs.100 per kg	18.93

The results of this investigation shows that in tea plantations where weeding is not carried out intensively and regularly, the productivity and profitability are reduced drastically.

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