International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 12 Issue 9 ǁ September 2024 ǁ PP. 18-26

The Effect of Weed Plants Leaf Extracts on Seed Germination of Vegetable Crops

Ms. Anu K. Johnson
**1Department of Botany, Mar Thoma College, Thiruvalla, Mahatma Gandhi University, Kottayam,*

Abstract
Invasive weed plants are a significant concern in many parts of the world due to their ability to spread rapidly and outcompete native vegetation. This study aims to investigate the allelopathic effects of leaf extracts from two weed plants—Mikania micrantha and Sauropus androgynus—on the germination, growth, and development of two vegetable seeds: Vigna unguiculata and Solanum lycopersicum. This project aims to treat the seeds with various concentrations of leaf extracts and to determine the most effective leaf extract concentration promoting seed germination and plant growth. The study provides insights into the allelopathic potential of these weed plants and their possible applications.

Keywords: *Invasive, Mikania, Sauropus, Vigna, Solanum, allelopathic effect.*

Date of Submission: 26-08-2024 Date of acceptance: 05-09-2024

I. INTRODUCTION

Vigna unguiculata, also known as cowpea, is an herbaceous annual in the Fabaceae family. They can be germinated by soaking in water for 4 hours of the daytime light and keeping them in the dark for the rest of the day. *Solanum lycopersicum* is an herbaceous annual in the family Solanaceae grown for its edible fruit. The tomato plant typically grows to a height of 0.7-2 m and is harvested after a single growing season.[1]

Mikania micrantha H.B.K. is a perennial creeping climber from the Asteraceae family known for its vigorous. It thrives in high fertility, organic matter, soil moisture and humidity. It damages or kills other plants by blocking light and smothering them.[2] It produces allelochemicals such as phenolics, flavonoids, alkaloids, terpenes, which are released through volatilization, leaching and decomposition of plant debris. *M. micrantha* exhibits allelopathic effects on crops, weeds, other plant species, insects and pathogens.[3] *Sauropus androgynus* L., known as leaf asparagus or sweet leaf, is a fast-growing perennial shrub up to 3 m tall. The plant produces various chemicals including flavonoids, alkaloids and is listed as a weed in some references.[4]

The impact of allelochemicals from *Mikania micrantha* on the germination and growth of *Melia azedarach* seedlings was investigated. Solutions with varying ratios of chemicals and water (specifically control, 75:25, 50:50 and 25:75) were prepared and used to treat the seeds. The results indicated that the germination rate was approximately 43.34%, the highest cumulative base diameter of *M. azedarach* reaching around 1.55 ±0.03 cm and cumulative height of approximately 14.44±0.40 cm when the 75:25 solution was applied. However, the highest number of leaves on the seedlings was observed with the 25:75 solution. These findings suggest that using chemical extracts from *M. micrantha* could be an effective management strategy.[5]

The effects of leachate from *Sauropus androgynus* L. stem sections on the germination of *Chrysanthemum coronarium* L. and *Brassica chinensis* L. were studied using an indoor Petri dish filter bed method. This research aimed to address issues related to continuous cropping. The study found that leachate concentrations of 10, 50 and 90g/L from *Sauropus androgynus* L. significantly reduced seed germination rates. It was recommended that while *Sauropus androgynus* L. could be used in intercrop systems with *Chrysanthemum coronarium* L., it should not be intercropped with *Brassica chinensis* L.[6]

The study investigated the allelopathic effects of aqueous extracts from *Mikania* leaves and roots on the seed germination and seedling growth of two co-occurring woody plants in southern China, *Lagerstroemia indica* L. and *Robinia pseudoacacia* L. The findings indicated showed that both leaf and root extracts from *Mikania* had inhibitory effects on these woody species. The study suggests that the impact of root extracts on belowground biomass may be more pronounced for some species compared to leaf extracts. Conversely, for the other species, leaf extracts might have a greater effect on belowground biomass than root extracts particularly regarding root growth.[7]

Germination is the process by which seeds develop into new plants. Environmental conditions must trigger this process, with key factors including water availability, temperature and sunlight. Seeds undergo imbibition to activate root growth, though excess water can be detrimental. Temperature affects cellular metabolic and growth rates, while light or darkness can serve as environmental trigger for germination,

influencing physiological dormancy [8]. The criteria used to determine a seed's lots of viability is termed standard germination. Standard germination is the percentage of seeds in a seed lot that produce a normal seedling under optimal germination conditions.

Allelochemicals are chemicals synthesized by one species that influence the behaviour and growth of another species (Putnam and Tang, 1986). These chemicals can have beneficial or detrimental effects, a phenomenon known as Allelopathy.

Besides the allelochemicals this study also initiates an investigation whether the leaf extracts of the weed plants can promote the growth and development of the vegetable crops. So, this initiative can bring more insights into the field of organic farming. The chemical compounds in *Mikania* and *Sauropus* may inhibit or promote seed germination. This project aims to study the effect of leaf extract from these weed plants on the germination and growth of vegetable seeds. Specifically, it investigates the potential allelopathic effects of *Mikania* and *Sauropus* leaf extracts on the germination and growth of *Vigna unguiculata* and *Solanum lycopersicum*.

II. MATERIALS AND METHODS

2.1 Seed Germination test

For testing the viability of seeds of *Vigna unguiculata* the rolled towel test was used, in several sheets of germination paper a precise number of seeds (10) were placed in each. The seeds are rolled in the paper and placed upright in the growth chamber. The number of normal seedlings will be determined after the first and second counts.

For testing the viability of *Solanum lycopersicum* L. the Petri dish germination test is used which are usually used for small seeds or those which require light like Solanum. Seeds are placed on a vacuum template to get the correct number of seeds for insertion into the Petri dish. The Petri dish contains a moistened paper substrate (blue blotter). Dishes are placed in an incubator and normal germination is counted[10].

2.2 Preparation of Pure leaf extracts of weeds (*M. micrantha* and *S. androgynus*)

After sterilizing the glass wares like measuring cylinder, beakers, working area, mortar & pestle and hands with ethyl alcohol. Then freshly collected leaves of *M. micrantha*, and *S. androgynus* were taken. The leaves were washed and ground using mortar and pestle separately. With the cheese cloth filtered off the leaves extracted to different beaker and measured. 75ml of each leaf extracts were extracted.

2.3 Preparation of different concentrations

Three different concentrations were prepared from each leaf extract. Using distilled water and pure leaf extracts were used to prepare different concentrations. The different concentrations were 10%, 25% and 40% from each leaf extracts.

The concentrations were prepared according to the tables given below.

Sl. No.	Concentration needed	Volume of Pure leaf extract (ml)	Volume of Distilled water (ml)	Total volume (ml)
1.	10%	10 ml	90 ml	100 ml
2.	25%	25 ml	75 ml	100 ml
3.	40%	40 ml	60 ml	100 ml

Table 2.1Preparation of concentrations.

2.4 Preparation of Potting trays

The potting mixture was prepared by mixing peat moss and perlite. Seven spoons of dolomite per 1kg were mixed. Using the measuring cylinder the required concentrations of each leaf extract were made in beakers and a total of 100 ml was prepared for each concentration. Different solutions were prepared in beakers accordingly. Ten seeds were counted and placed in each beaker for concentrations of each leaf extracts for pre-treatment. The seeds were pre-treated with different concentrations of leaf extracts. The seeds of *V. unguiculata* were soaked in the concentrations for 4 hours. The seeds of *S. lycopersicum* were soaked in concentrations for 15 hours. Then the seeds were sowed in potting trays with potting mixture. There was also set a control i.e. the seeds were soaked in distilled water at the same time as pre-treatment of seeds. After sowing water, it properly and continuously observed the changes and was recorded. The length of shoot and root was measured using a thread and ruler. The results of *V. unguiculata* were taken after 10 days. The results of *S. lycopersicum* were taken after 22 days. For taking measurements randomly five seedlings were taken from each treatment. Measurements were recorded and tabulated. Photographs were also taken.

Average length of shoot / root = Sum of the lengths of shoot / root of seeds for each treatment
5

III. RESULT AND DISCUSSION

3.1 Observations and results of *Vigna unguiculata* L.

During the seed germination test, a total of 100 seeds were rolled in the germination paper 10 in each. The first reading was recorded after three days, the second reading was recorded after five days. From the first reading recorded 71 percent of the seeds were germinated in whole and in last reading it increased to 87 percent.

During the process of germination radicle emerges first and all set of leaf extracts of different extracts showed the result. Of totally, 70 seeds were pre-treated with different concentrations of each leaf extract and in each 10 seeds were treated. The table 3.1.1 explains the number of seeds germinated i.e. emergence of plumule which were visible. The first reading was recorded after seven days, the second reading was recorded after 9 days, and the final results were taken after 10 days. From the first reading recorded 74 percent of the seeds were germinated in whole and in last reading it increased to 88 percent. From table 3.1.1 100 percent germination were shown in 10 % concentration of *Mikania* extract and 40% of *Sauropus* extract. Then 5 seedlings were taken randomly from each set measured the length of shoot, root and crown and recorded (Table 3.1.2). The average lengths were calculated. Then each set of leaf extracts were compared with the measures of control using graphs. Table 3.1.3 shows the average lengths.

Leaf extract used	Conc. Of leaf extract	No of germinated seeds		
		First reading	Second reading	Final reading
Mikania leaf extract	10%	10	10	10
	25%	8	9	9
	40%	7	7	7
Sauropus leaf extract	10%	8	10	10
	25%	5	9	9
	40%	8	10	10
Control	-	6	7	7
Total		**52**	**62**	**62**

Table 3.1.1 No of germinated seeds

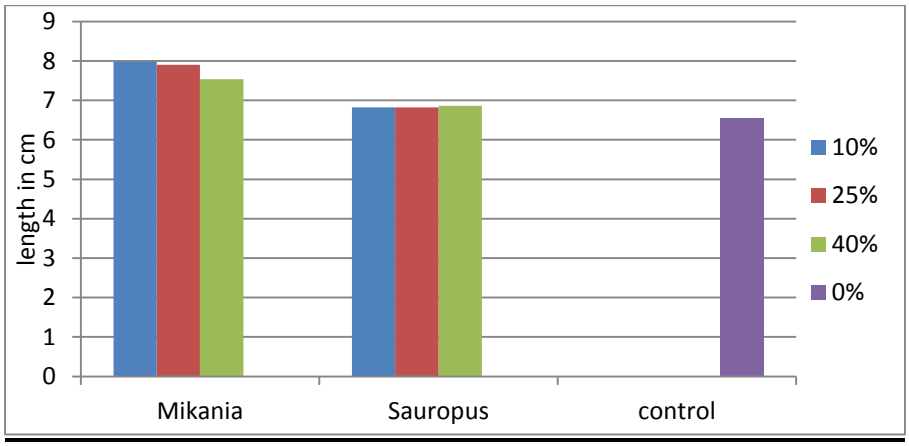
Concentration of leaf extracts	Sl. no.	Shoot length	Root length	Crown length
10 % concentration of *Mikania* leaf extract	1	8	8.7	10.1
	2	7.5	5.6	9.9
	3	8.7	7	10.9
	4	7.5	7	11.3
	5	8.2	7.3	10
Average length		**7.98**	**7.12**	**10.44**
25% concentration of *Mikania* leaf extract	1	7.5	8.5	10.5
	2	7.7	8.1	10.9
	3	7.9	8.4	10.9
	4	8.2	8.9	9.2
	5	8.2	4	9.6
Average length		**7.9**	**7.58**	**10.22**
40% concentration of *Mikania* leaf extract	1	7.5	7	9.8
	2	7.2	6.8	8.4
	3	8.2	6.4	6.4
	4	7.2	6	7.9
	5	7.6	11.5	9.8
Average length		**7.54**	**7.54**	**8.52**
10% concentration of *Sauropus* leaf extract	1	6	9.1	6.8
	2	6.5	6.1	8
	3	6.6	1.9	7.3
	4	7.9	5.9	8.8
	5	7.1	4.3	8.2

Average length		**6.82**	**5.46**	**7.82**
25% concentration of *Sauropus* leaf extract	1	7.3	6.6	9.2
	2	6.7	5.5	8.9
	3	6.7	6.1	8.6
	4	6.9	6.1	7.2
	5	6.5	7.3	7.9
Average length		**6.82**	**6.32**	**8.36**
40% concentration of *Sauropus* leaf extract	1	6.5	5.5	9.4
	2	7.4	6	10.6
	3	6.4	6.1	8.3
	4	7.3	6.9	6.2
	5	6.7	9.5	8.7
Average length		**6.86**	**6.8**	**8.64**
Control	1	5.5	4	9.4
	2	7.4	5.9	5.5
	3	6.4	6	8.5
	4	7.3	3	7.9
	5	6.7	5.5	6.1
Average length		**6.56**	**4.88**	**7.48**

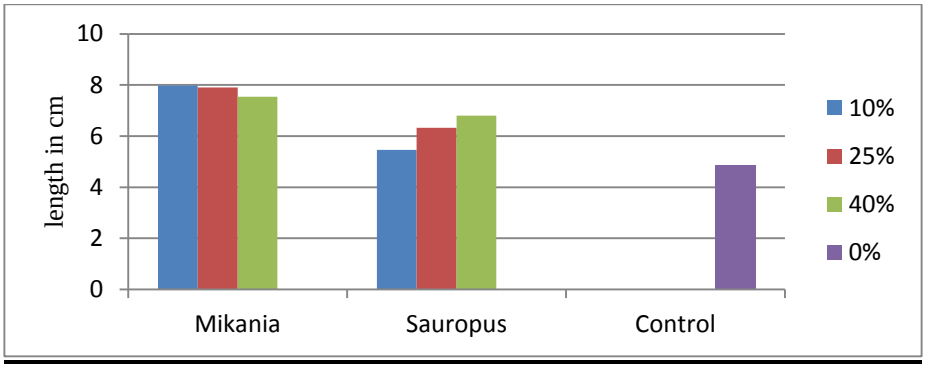
Table 3.1.2 Lengths of Shoots, Roots and Crown in different concentrations of Leaf extracts

Table 3.1.3 Average tables

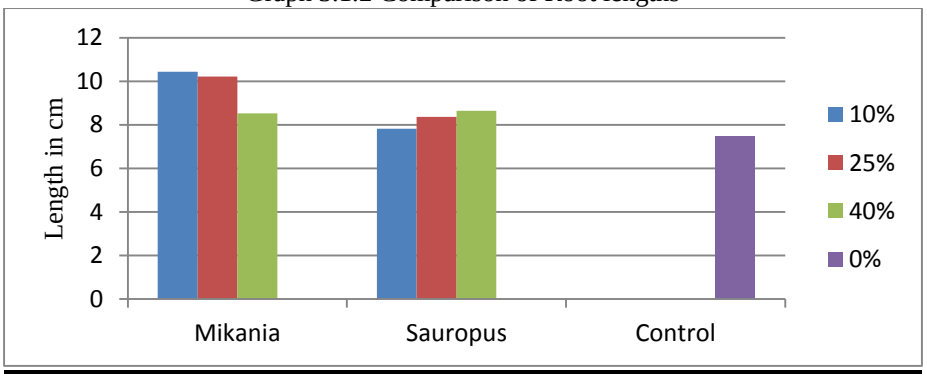
Leaf extract used	Conc. Of leaf extract	Average length		
		Shoot length	Root length	Crown
Mikania leaf extract	10%	7.98	7.12	10.44
	25%	7.90	7.58	10.22
	40%	7.54	7.54	8.52
Sauropus leaf extract	10%	6.82	5.46	7.82
	25%	6.82	6.32	8.36
	40%	6.86	6.80	8.64
Control		6.56	4.88	7.48



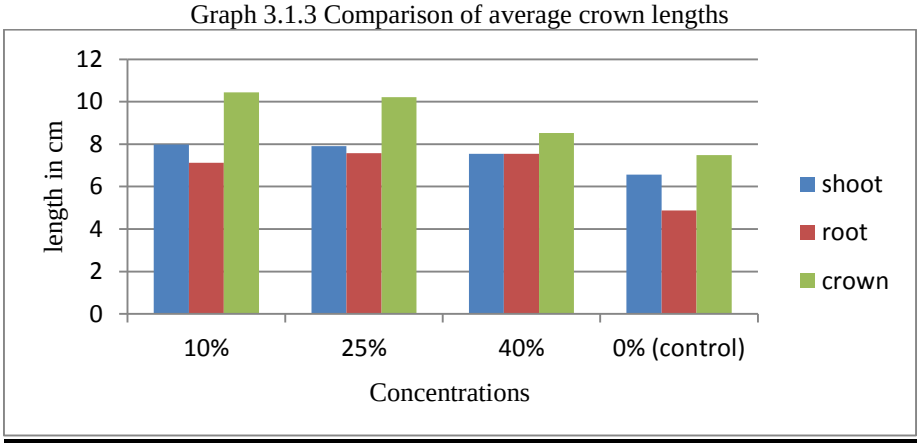
Graph 3.1.1 Comparison of average shoot lengths



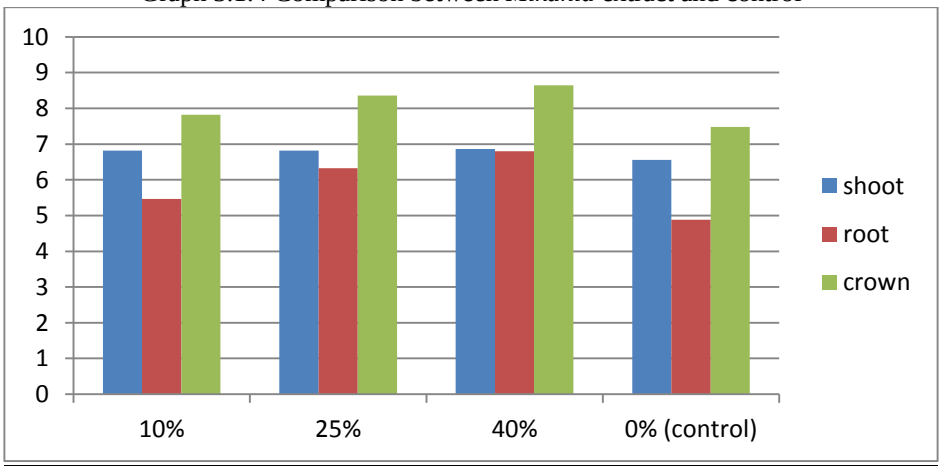
Graph 3.1.2 Comparison of Root lengths



Graph 3.1.3 Comparison of average crown lengths



Graph 3.1.4 Comparison between *Mikania* extract and control



Graph 3.1.5 Comparison between *Sauropus* extract and Control

In graph 3.1.1 the average shoot lengths of all were compared. From the graph the highest average length of shoot is in 10% of *Mikania* leaf extract and the lowest is in Control (distilled water). The graph 3.1.2 the average root lengths were compared. From the graph the highest average length of root is in 25% *Mikania* leaf extract and the lowest is in Control. The graph 3.1.3 the average crown lengths were compared. From the graph the highest average length of crown is in 10% *Mikania* leaf extract and the lowest is in Control. When compared the measures of *Mikania* leaf extract with control (Graph 3.1.4), the highest average germination is in 10 % of concentration and lowest in the control. When compared the measures of *Sauropus* leaf extract with control (Graph 3.1.5), the highest average germination is in 40% of concentration and lowest in the control.

3.2 Analysis of Data-*Vigna unguiculata* L.

The *V. unguiculata* seed showed vigorous germination in all sets of concentrations of leaf extract than germination in control. In Mikania leaf extract as the concentration increases, the germination and growth rate decreases. As the concentration of Sauropus leaf extract increased, the growth rate also increased. But from overall information the leaf extract treated with Mikania promotes greater germination than in Sauropus extract. In Mikania leaf extract lower concentrations promote germination than in higher concentration. In Sauropus higher concentration promotes germination than in lower concentration.

3.3 Observations and results of *Solanum lycopersicum* L.

During the Petri dish germination test, a total of 100 seeds, 10 in each dish, were placed and observed for 15 days. The first reading was taken in 9 days and 32 percent of seeds were germinated. And the second set of reading was taken after 15 days, and 51 percent of seeds were germinated.

During the process of germination radicals emerge first and all sets of leaf extracts of different concentrations show the result. A total of 70 seeds were pre-treated with different concentrations of each leaf extract and ten in each. Table 3.3.1 explains the number of seeds germinated i.e. those in which the emergence of plumule were visible. The first reading was recorded after 9 days, and 22 seeds germinated among 70 seeds. The second reading was recorded after 15 days, and 44 seeds germinated. The final results were taken after 22 days, and no. of germinated seeds decreased to 29. From table 3.3.1 100 percent germination was not observed in all sets. Noticeable was that in 10% of *Sauropus* extract only 1 seed germinated among ten. Then five seedlings were taken randomly from each set, measured and recorded the length of shoot, root and crown (Table 3.3.2). The average lengths were calculated. Then each set of leaf extracts was compared with the measures of control using graphs. Table 3.3.3 shows the average lengths.

Leaf extract used	Conc. Of leaf extract	No of germinated seeds		
		First reading	Second reading	Final reading
Mikania leaf extract	10%	2	5	5
	25%	4	5	4
	40%	2	6	4
Sauropus leaf extract	10%	1	1	1
	25%	3	6	5
	40%	5	6	5
Control	-	5	5	5
Total		22	44	29

Table 3.3.1 No. of Germinated seeds

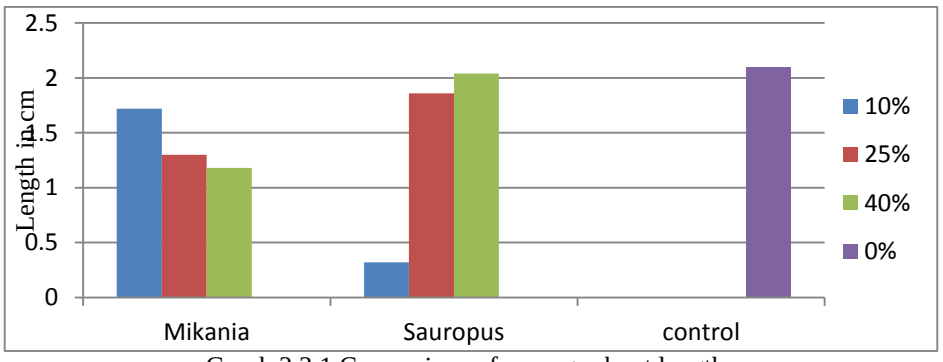
Concentration of leaf extracts	Sl. no.	Shoot length	Root length	Crown length
10 % concentration of *Mikania* leaf extract	1	1.5	1.9	2.2
	2	2.5	6	3.2
	3	1	1.4	1.3
	4	1.8	2.2	2.5
	5	1.8	2.2	1.2
Average length		**1.72**	**2.74**	**2.08**
25% concentration of *Mikania* leaf extract	1	1.8	3.4	3
	2	2.1	1.9	2.7
	3	1.5	1.7	2.5
	4	1.1	1.1	1.1
	5	-	-	-
Average length		**1.3**	**1.62**	**1.86**
	1	1.1	1.1	1

40% concentration of *Mikania* leaf extract	2	1.2	2.2	2
	3	1.5	1.9	2.1
	4	2.1	0.9	1.5
	5	-	-	-
Average length		**1.18**	**1.22**	**1.32**
10% concentration of *Sauropus* leaf extract	1	1.6	2.9	1.9
	2	-	-	-
	3	-	-	-
	4	-	-	-
	5	-	-	-
Average length		**0.32**	**0.58**	**0.38**
25% concentration of *Sauropus* leaf extract	1	1.6	1.8	2.5
	2	2.8	3.7	3.8
	3	1.5	1.4	1.5
	4	1.5	2.9	1.9
	5	1.9	2.1	2.5
Average length		**1.86**	**2.38**	**2.44**
40% concentration of *Sauropus* leaf extract	1	1.9	1.6	2
	2	1.9	2.1	2.2
	3	1.9	1.2	2.2
	4	2.2	2.8	2.9
	5	2.3	2.7	2.3
Average length		**2.04**	**2.08**	**2.32**
Control	1	2.4	2.8	2.8
	2	2	2	2
	3	1.4	1.5	1.5
	4	2.5	5.2	2.9
	5	2.2	7.2	2.2
Average length		**2.1**	**7.02**	**2.28**

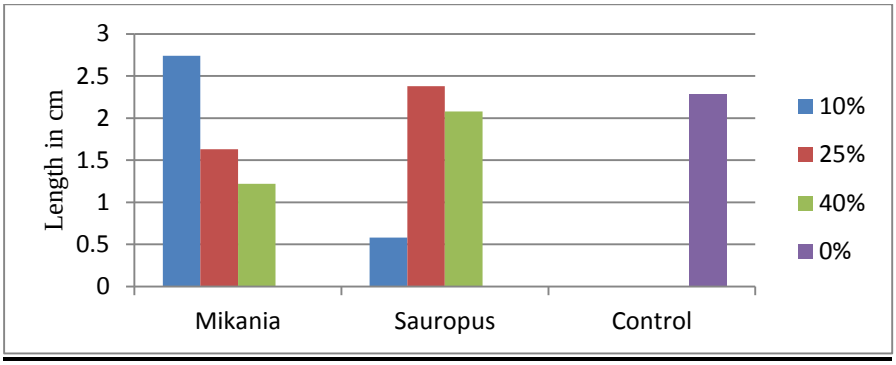
Table 3.3.2 Lengths of Shoots, Roots and Crown in different concentrations of Leaf extracts

Leaf extract used	Conc. Of leaf extract	Average length		
		Shoot length	Root length	Crown
Mikania leaf extract	10%	1.72	1.72	1.72
	25%	1.3	1.3	1.3
	40%	1.18	1.18	1.18
Sauropus leaf extract	10%	0.32	0.32	0.32
	25%	1.86	1.86	1.86
	40%	2.04	2.04	2.04
Control		2.1	2.1	2.1

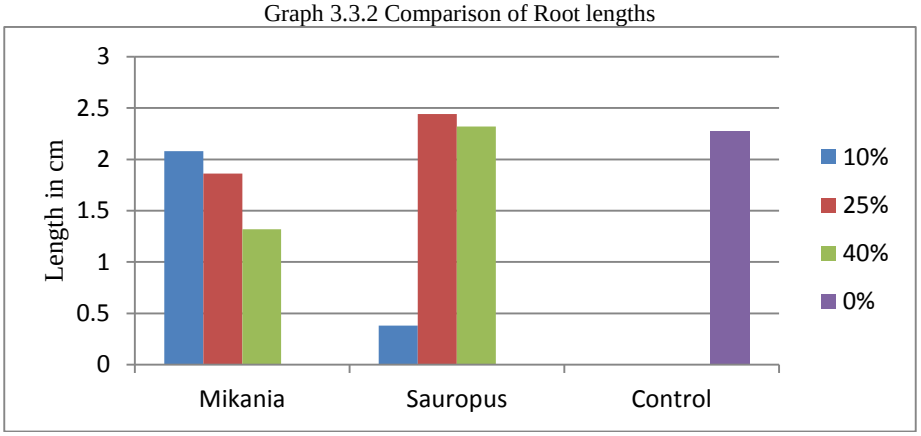
Table 3.3.3 Average tables



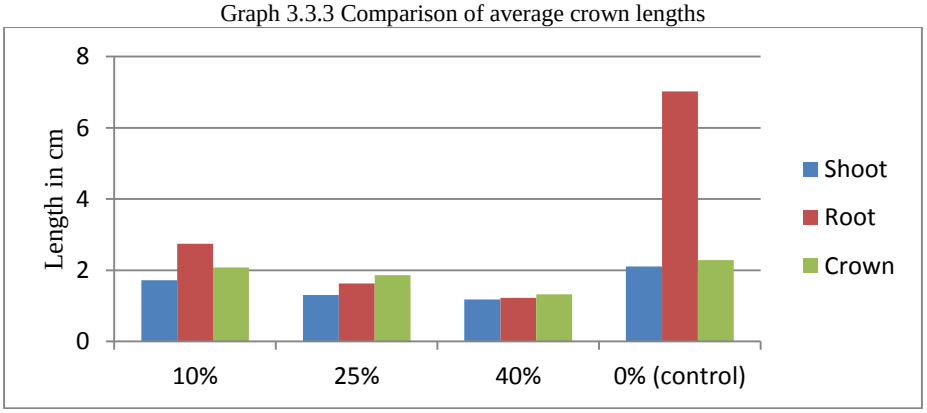
Graph 3.3.1 Comparison of average shoot lengths



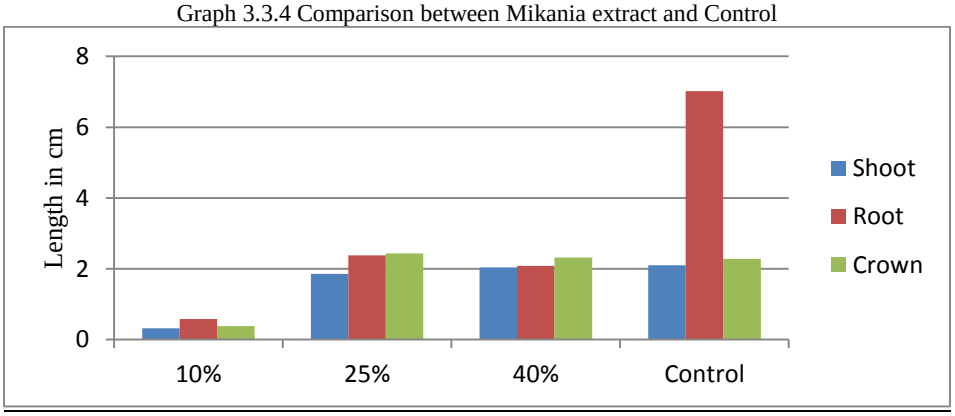
Graph 3.3.2 Comparison of Root lengths



Graph 3.3.3 Comparison of average crown lengths



Graph 3.3.4 Comparison between Mikania extract and Control



Graph 3.3.5 Comparison between Sauropus extract and Control

In graph 3.3.1 the average shoot lengths of all were compared. From the graph the average length of shoot was found highest in the control and the lowest was in 10% *Sauropus* extract. The graph 3.3.2 the average root lengths were compared. From the graph the highest average length of root was observed in 10% of *Mikania* extract and the lowest was in 10% of *Sauropus* extract. The graph 3.3.3 the average crown lengths were compared. From the graph the highest average length of crown was in 25% of *Sauropus* leaf extract and the

lowest was in 10 % of *Sauropus* extract. When compared the measures of Mikania leaf extract with control (Graph 3.3.4), the highest average germination was in control and lowest in the 40%. When compared the results of Sauropus leaf extract with control (Graph 3.3.5), the highest average germination was in control and lowest in 10%.

3.4 Analysis of Data – *Solanum Lycopersicum* L.

In this seed study, the no. of germinated seeds increased after 15 days but then seeding gets destroyed gradually in various concentration of extract. In this set the seedlings germinated in control show vigorous growth than leaf extracts. The concentration of *Mikania* extract increased the growth rate decreased, but in *Sauropus* extract as the concentration increases, the growth rate also increases. Here also similar trend to Vigna showed, overall growth rate is higher for *Mikania* than Sauropus.

IV. CONCLUSION

In this study the effect of weed plants leaf extract in various concentrations on vegetable crops were tested. There are a wide variety of allelochemicals produced by different species, and so there are many effects that they can have on crop. These effects can either affect crops directly or indirectly. Direct effects affect the growth and metabolism processes of the plant, slowing or preventing germination, or increasing or decreasing root and shoot growth. Indirect effects include changing soil properties or nutritional status, or by influencing the population or activity of soil microorganisms and nematodes [11]. According to the collected data and analysis reached conclusions.

Each of the leaf extracts influence the growth and germination of various vegetable crops in different ways. Some have negatively effects, and some have positive effects on vegetable crops. The seeds of *S. lycopersicum* showed vigorous germination and growth in control than in leaf extracts. So, the leaf extracts negatively effects on them. Seeds of *V. unguiculata* the leaf extracts to some extend promoted the germination than in control. The concentrations of *Mikania micrantha* leaf extract have allelopathic effect. As the concentration increased the germination gets inhibit the lower concentration promotes the growth than higher concentration. But the contradictory part is that the growth rate is higher than in *Sauropus* concentrations and control. But in case of *Sauropus androgynu*s leaf extract, as the concentration increases the growth rate also increases. So, the higher concentrations promote the growth than the lower concentrations. So, it has a lesser allelopathic effect. From this study concluded that, lower concentrations of *Mikania* (10%) and higher concentration of *Sauropus* (40%) can be used as a component in bio manure. Because as per the study these concentrations promote germination and growth with lesser allelopathic effect

REFERENCES

[1]. OECD (2016), "Cowpea (Vigna unguiculata)", in Safety Assessment of Transgenic Organisms in the Environment, Volume 6: OECD Consensus Documents, OECD Publishing, Paris.
[2]. Pacific Island Ecosystems at Risk PIER, 2003.
[3]. Guangyan, Ni., Fenglan, Li., Baoming, Chen., Liying, Song., and Shaolin, Peng., (2007). Allelopathic plants 21. Mikania micrantha H.B.K. Allelopathy Journal. Vol. 19(2). P. 287-295
[4]. Iplants.org. Okra. Mussori Botanical Garden.
[5]. Liza, K.C., and Mandal, R.A., (2017). Allelopathic Effect of Extract of Mikania micrantha on Seed Germination and Seedling Growth of Melia azedarach. Pearl Research Journals. pp. 52-57.
[6]. Mengleiao, Lv. (2015). Effect of Extracts from Sauropus androgynus L. stem on two kinds of Vegetable Seed Germination. Anhui Agricultural Science Bulletin.
[7]. AiPing, Wu., Hua, Yu., ShuQuin, Gao., ZhenYing, Huang., (2009). Differential belowground Allelopathic Effects of Leaf and Roots of Mikania micrantha. Trees: Structure and Function. Vol. 23 (1). pp. 11-17.
[8]. Raven, Peter, H., Ray, F. Evert., Susan, E. Eichhorn. (2005). Biology of Plants. 7 th Edition. p. 504-508.
[9]. Putnam, A.R. and Tang, C.S. (1986). The Science of Allelopathy. Experimental Agriculture. Vol. 23 (4). pp. 473-443.
[10]. Seednet.ap.nic.in/germination testing: principles and procedure
[11]. Ingesta.org. Allelopathy. Farming for Future.