

Evaluation of Herbicidal Properties of Mikania (*Mikania Micrantha* H.B.K) and Rain Tree (*Samanea Saman* Jacq Merr) Leaf Extract

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Abstract

Background: Uses of synthetic herbicides to control weeds have negative impacts on soil health. But botanical herbicides have little or no impacts on soil health in addition to control weeds. **Aim and Objectives:** The aim of the research is to develop botanical herbicides for controlling selected weeds. A pot experiment has been done to evaluate the herbicidal properties of fresh *Mikania micrantha* H. B. K and *Samanea saman* Jacq. Merr. leaf extract on two commonly grown weeds *Physalis heterophylla* and *Chenopodium album*. Four weed seedlings were transplanted in each pot and three replications were maintained for pots and twelve for each weed. Eighty percentage methanolic extract (1:1) of *M. micrantha* and *S. saman* were applied at 0, 10, and 15 mL per pot after 35 days of transplanting. **Materials and Methods:** Data were collected for agronomic parameters, chlorophyll contents, weed control efficiency by number and weight, and pH and Electrical conductivity (EC) of postharvest soils. About 92% *C. album* by number was controlled by application of 10 mL *M. micrantha* extract and which was 36% by weight. Maximum 58% *C. album* and *P. heterophylla* by number and 12%–16% by weight was controlled by application of 15 mL *S. saman* leaf extract. Chlorophyll contents (a+b) were significantly decreases in treated leaves compared to control as these plant extract causes chlorosis of weed leaves. **Results:** Hence, number of yellow leaves significantly increases and green leaves decreases in treated leaves. pH (7.08–7.34) and EC (0.62–0.89 dS m⁻¹) of postharvest soil indicated that these values were not significantly change after and before application of herbicidal extract and thus no adverse effect was found on soil environment. **Conclusion:** Considering the weed control efficiency, it is concluded that *M. micrantha* leaf extract has high potentiality as botanical herbicide to control both *C. album* and *P. heterophylla*.

Keywords: Botanical herbicide, weed, weed control efficiency

INTRODUCTION

Weeds cause tremendous loss in crop yield and quality. In crop fields, weeds are one of the main pests reducing crop yield from 15% to 96%.^[1] In Bangladesh, weeds in crop fields are mainly controlled using labor. However, scarcity of agricultural laborers increases due to rapid industrialization. Hence, it is necessary to find out alternative ways to control weeds. One alternative is to use chemical herbicides which give rise to environmental hazards. Another option is to use of instrument to uproot weeds, but this is also difficult due to small size of land to apply different farm mechanization technology. Botanical herbicides have also been found to control weeds through utilizing the allelopathic potentials of these materials.^[2] These natural botanical herbicides are

friendly both to environment and human health and also less costly due to the availability of raw materials. There are some plant extracts were examined as botanical fungicides and/or pesticides such as mehagani leaf, seed, pitraj seed, neem, tobacco, bishkataly, ginger, and garlic.^[3-4] If such type of botanical herbicides could be innovated, these would help to not only control the weeds but also improve soil physical

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properties after its proper decomposition along with maintain the environmental sustainability.

Rain tree (*Samanea saman* Jacq. Merr.) and herbaceous vine known as Mikania (*Mikania micrantha* H. B. K.) are commonly grown in Bangladesh. These plants can grow vigorously in adverse environment. Rain tree leaf and bark extract is used traditionally in diarrhea, intestinal diseases, stomach ache, colds, and headache.^[5] The leaves were reported to contain tannins, flavonoids, steroids, saponins, cardiac glycosides, and terpenoids.^[5] The leaves possess antimicrobial activity and the plant is also reported to have anticancer property.^[6] A previous study examined by applying Mikania vine beneath the soil and it can significantly reduce the *Cyperous* weeds over control treatment. These plants have low phytotoxicity to specific crop plants.^[7-9] The latest research has reported that seed germination, radical elongation, and biomass production of *Lycopersicon esculentum* and *Brassica chinensis* were inhibited by aqueous extract of Mikania, but *Zea mays* and *Vigna sesquipedalis* seedlings were not affected.^[10] The leaf leachate of Rain tree was applied to seed at germination stage of *Brassica campestris*, *Amaranthus viridis*, and *Oryza sativa* and found the inhibitory effect on *Brassica campestris* and *Amaranthus viridis*, while rice plant (*Oryza sativa*) is opposed to the effect of leaf leachate.^[11,12] So, we hypothesized that these plants contain allelopathic compounds and have potential herbicidal properties, which can be used as selective organic herbicides. So we hypothesized that these plants contain allelopathic compounds and have potential herbicidal properties which can be used as selective organic herbicides. So, it is essential to find out responsive weeds to Mikania and Rain tree leaf extract application. The proposed research was conducted to examine the potentiality of botanical herbicide through organic extraction from Mikania (*Mikania micrantha* H.B.K.) and rain tree (*Samanea saman* Jacq. Merr.) leaves on two commonly grown weeds in rice and maize field, namely, Foska begun (English name: Clammy ground cherry, Scientific name: *Physalis heterophylla*, Family: Solanaceae) and Bathua (English name: Lamb's quarter, Scientific name: *Chenopodium album*, Family: Amaranthaceae).

METHODOLOGY

Pot preparation

Soil was collected from the Patuakhali Science and Technology University (PSTU) Farm and air dried. All kinds of dirt, trash, and plant parts were removed. Then, it was grinded and sieved carefully. After sieving, 10 kg of this soil was filled in a series of plastic pot (0.25 m²) and labeled properly.

Weed collection and cultivation

The two most commonly grown weeds in Bangladesh, namely, Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) seedlings, were also collected from the PSTU farm area with similar size and age. Each of four seedlings was transplanted in previously prepared pot. After transplanting, the pots were watered to assure field capacity and put in a net

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Mikania and rain tree leaf extract preparation

Fresh Mikania (*Mikania micrantha* H. B. K.) and rain tree (*Samanea saman* Jacq. Merr.) leaves were collected and washed with distilled water and then air-dried. The air-dried leaves were macerated and making paste by mixing 80% methanol (1:1) using a grinder machine at room temperature. Then, the extracts were centrifuged at 7000 rpm for 3 min in a centrifuge machine. The supernatant were used as botanical herbicides to control the Foska begun and Bathua. Freshly prepared extracts were used for the treatments.

Treatments

After 35 days of transplanting, the extract was sprayed in the morning (at 8:30 am) at 0 (control), 10, and 15 mL in each pot. Three replications were maintained for pots and twelve for each weed. The experiment was arranged following completely randomized design.

Data collection and postharvest soil sampling

Three days after spraying, living plants and dead plants number and numbers of total leaves along with green and yellow leaves were counted for each plant and per pot. Some fresh leaves were collected from each pot for chlorophyll a and b analysis. After harvesting, all plants were dried and dry weight per pot was recorded. The postharvest soil sampling was done and processed to determine pH and electrical conductivity (EC).

Weed control efficiency

Weed control efficiency of these extracts was determined in terms of both number and by weight using the following formula.^[9,13,14]

Weed control efficiency by weight (%) = $\left(\frac{\text{Dry weight of weeds in untreated pot} - \text{dry weight of weeds in treated pots}}{\text{dry weight of weeds in untreated pot}} \right) \times 100 \dots\dots\dots(i)$

Weed control efficiency by number (%) = $\left(\frac{\text{Number of living weeds in untreated pot} - \text{number of living weeds in treated pots}}{\text{Total number of weeds in untreated pot}} \right) \times 100 \dots\dots\dots(ii)$

Chemical analysis

pH and EC of soil (1:2.5 = soil: water for pH and 1:5 = soil: water for EC) samples were determined with a glass electrode pH meter (pH Meter, Hanna) and conductivity meter (EC Meter, Hanna), respectively.^[15,16]

Leaf sampling was done from each pot after 3 days of spraying and immediately used for the estimation of chlorophyll a and chlorophyll b contents. Chlorophyll concentrations in leaves were extracted using 80% chilled acetone; contents of these were estimated with the help of a UV-VIS spectrophotometer using the following equation given.^[17]

$$\text{Chlorophyll a} = 12.21A_{663} - 2.81A_{646} \dots\dots\dots(iii)$$

$$\text{Chlorophyll b} = 20.13A_{646} - 5.03A_{663} \dots\dots\dots(iv)$$

Statistical analysis

The data were statistically analyzed. Results were expressed as the means \pm standard error of means of three replicates for pots and twelve for plants. Significance degree was calculated using a *t*-test and curve fitting was done using the computer package Microsoft Excel program (Microsoft Office 2007 Professional).

RESULTS

Effect of Mikania (*Mikania micrantha* H. B. K) and rain tree (*Samanea saman* Jacq. Merr.) leaf extract on agronomic parameters of Foska begun (*Physalis heterophylla*) weed

Numbers of Foska begun dead plants were increased with the increasing of Mikania and rain tree leaf extract [Table 1]. The highest numbers (3.67 ± 0.33 out of 4.0 ± 0.00) of Foska begun dead plants were found at 15 mL Mikania leaf extract treatment and the lowest (1.67 ± 0.33 out of 4.0 ± 0.00) was found at 10 mL rain tree leaf extract treatment, while no weed was died at control (0). The numbers of yellow leaves significantly ($P < 0.01, 0.005$) increased and inversely green leaves decreased within 3 days of application of Mikania and rain tree leaf extract at an increasing rate [Table 1].

Effect of Mikania (*Mikania micrantha* H. B. K) and rain tree (*Samanea saman* Jacq. Merr.) leaf extract on agronomic parameters of Bathua (*Chenopodium album*) weed

The distinct effect of Mikania leaf extract was found on Bathua weed. The maximum and same number (3.67 ± 0.33) of Bathua weed was died at both 10 and 15 mL of Mikania extract application [Table 2].

Rain tree leaf extract has lower effects on Bathua compared to Mikania extract. There was a strong significant ($P < 0.01$) relation between the treated and untreated (control) Bathu leaves in respect to yellowing and greening condition. The maximum number of yellow leaves (117.67) was found at 15 mL Mikania extract application, whereas the lowest (7.33) was found in control (0) treatment. The increasing number of yellow leaves and the decreasing of green leaves were also found with increasing of rain tree leaf extract application [Table 2]. Mikania leaf extract has a strong phytotoxic effect on Bathau weed.

Impact of Mikania (*Mikania micrantha* H. B. K) leaf extract on dry weight of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) weeds

Data illustrated in Figure 1 explained that Mikania extract significantly reduced the dry weight of Foska begun ($P < 0.05$) and Bathua ($P < 0.01$) weed compared to control treatment. There was a strong correlation between yellow leaves and dry

Table 1: Number of living and dead plants, green and yellow leaves, and dry weight of Foska begun (*Physalis heterophylla*) weed after spraying of different doses of Mikania (*Mikania micrantha* H.B.K) and Rain tree (*Samanea saman* Jacq. Merr.) leaf extract at 40 days after transplanting [data indicates mean ($n=12$) \pm SEM; ** and *denotes significant difference at $P < 0.001$ and 0.05, respectively, among the treatments compare to the respective control]

Extract	Treatments (mL)	Number of living plants/pot	Number of dead plants/pot	Total leaves/plants	Green leaves/plants	Yellow leaves/plants	Dry weight (g)/pot
Mikania	0	4.00 \pm 0.00	0.00 \pm 0.00	13 \pm 1.15	11.33 \pm 0.33	1.67 \pm 0.87	86.33 \pm 5.24
	10	0.67 \pm 0.33	3.33 \pm 0.33	9.67 \pm 0.67	3.33 \pm 1.67*	6.33 \pm 1.45*	62.67 \pm 2.40*
	15	0.33 \pm 0.33	3.67 \pm 0.33	8.67 \pm 0.67	1.00 \pm 1.00**	7.67 \pm 1.45*	59.33 \pm 2.60*
Rain tree	0	4.00 \pm 0.00	0.00 \pm 0.00	13 \pm 1.15	11.33 \pm 0.33	1.67 \pm 0.87	86.33 \pm 5.24
	10	2.33 \pm 0.33	1.67 \pm 0.33	11.33 \pm 0.33	6.67 \pm 0.33	4.67 \pm 0.33	76.33 \pm 9.50
	15	1.67 \pm 0.33	2.33 \pm 0.33	11.00 \pm 0.58	5.67 \pm 0.88*	5.33 \pm 0.33*	75.67 \pm 3.38

*Significant difference at $P < 0.05$ among the treatments compare to the respective control, Data indicates mean ($n=12$) \pm SEM. SEM: Standard error of mean

Table 2: Number of living and dead plants, green and yellow leaves, and dry weight of Bathua (*Chenopodium album*) weed after spraying of different doses of Mikania (*Mikania micrantha* H.B.K) and Rain tree (*Samanea saman* Jacq. Merr.) leaf extract at 40 days after transplanting [data indicates mean ($n=12$) \pm SEM, ** and *denotes significant difference at $P < 0.001$ and 0.05, respectively, among the treatments compare to the respective control]

Extract	Treatments (mL)	Living plants/pot	Dead plants/pot	Total leaves/plants	Green leaves/plants	Yellow leaves/plants	Dry weight (g)/pot
Mikania	0	4.00 \pm 0.00	0.00 \pm 0.00	128 \pm 2.03	121 \pm 2.08	7.33 \pm 0.67	128 \pm 4.73
	10	0.33 \pm 0.33	3.67 \pm 0.33	118.67 \pm 5.93	8.33 \pm 8.33**	110.33 \pm 3.18**	82 \pm 4.04**
	15	0.33 \pm 0.33	3.67 \pm 0.33	124 \pm 3.00	6.33 \pm 6.33**	117.67 \pm 5.49**	83 \pm 4.04**
Rain tree	0	4.00 \pm 0.00	0.00 \pm 0.00	128 \pm 2.03	121 \pm 2.08	7.33 \pm 0.67	128 \pm 4.73
	10	2.33 \pm 0.33	1.67 \pm 0.33	117.33 \pm 6.89	55.33 \pm 2.6**	62.00 \pm 4.51**	113 \pm 4.73
	15	1.67 \pm 0.33	2.33 \pm 0.33	120 \pm 3.79	48.67 \pm 9.00*	71.33 \pm 10.73*	107.33 \pm 6.49

**Significant difference at $P < 0.01$ among the treatments compare to the respective control, Data indicates mean ($n=12$) \pm SEM. SEM: Standard error of mean

weight. After application of Mikania extract, yellow leaves become fall down and weeds were died and hence dry weight was significantly reduced [Tables 1 and 2].

Impact of rain tree (*Samanea saman* Jacq. Merr.) leaf extract on dry weight of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) weeds

Dry weight data of Foska begun and Bathua weeds were also collected after application of rain tree leaf extract and presented in Figure 2. Although there was no statistically significant change of dry weight after application of rain tree leaf extract, it was lower than the control treatment. The dry weight become decreases with increasing the rate of rain tree leaf extract application on both weeds [Tables 1 and 2]

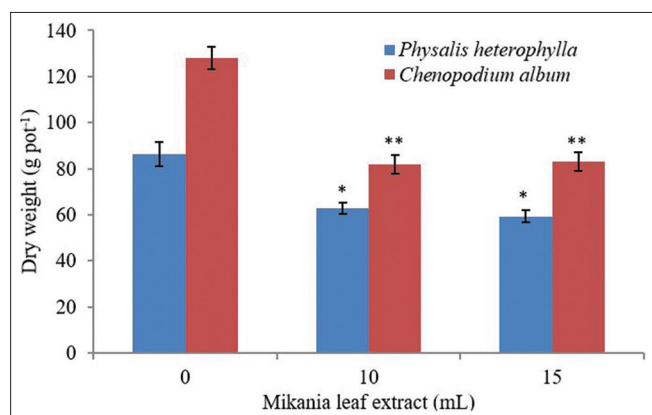


Figure 1: Dry weight (g pot⁻¹) of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) weed after spraying of different doses of Mikania (*Mikania micrantha* H. B. K) leaf extract at 40 days after transplanting (Error bar indicates mean [$n = 3$] \pm standard error of means; ** and *denotes significant difference at $P < 0.001$ and 0.05 , respectively, among the treatments compare to the respective control [0])

Chlorophyll contents of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) leaves after application of Mikania (*Mikania micrantha* H. B. K) and rain tree (*Samanea saman* Jacq. Merr.) leaf extract

Chlorophyll is essential for photosynthesis and two types of chlorophyll are exist in the photosystem of green plant, namely, chlorophyll a and b.^[18] Hence, both chlorophyll a and b for all treated and nontreated weed leaves were determined and the data are depicted in Figures 3 and 4.

Chlorophyll (a + b) were significantly ($P < 0.01, 0.005$) decreased in treated leaves compared to control. The lowest amount (0.26 mg g^{-1}) of chlorophyll (a + b) was found in 15 mL Mikania leaf extract application to Foska begun. The degree of reduction of chlorophyll was higher in Mikania treated

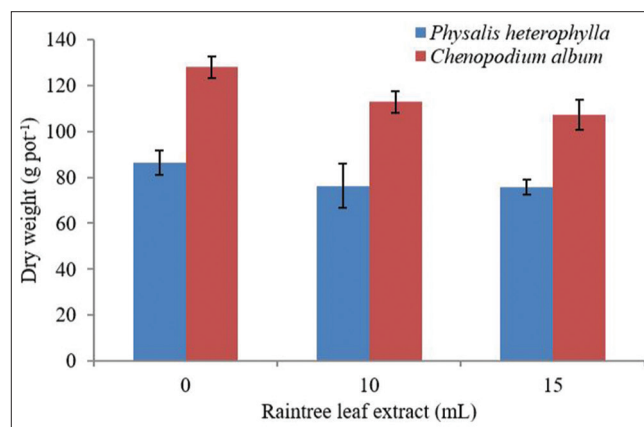


Figure 2: Dry weight (g pot⁻¹) of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) weed after spraying of different doses of Rain tree (*Samanea saman* Jacq. Merr.) leaf extract at 40 days after transplanting (Error bar indicates mean [$n = 3$] \pm standard error of means)

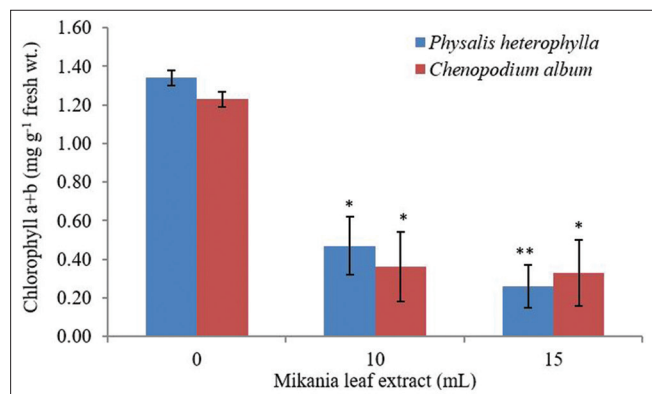


Figure 3: Chlorophyll (a + b) content (mg g^{-1} fresh weight) of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) weed after spraying of different doses of Mikania (*Mikania micrantha* H. B. K) leaf extract at 40 days after transplanting (Error bar indicates mean [$n = 3$] \pm standard error of means; ** and *denotes significant difference at $P < 0.001$ and 0.05 , respectively, among the treatments compare to the respective control [0])

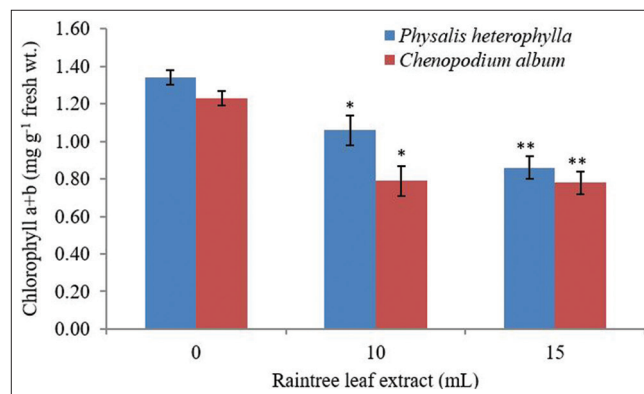


Figure 4: Chlorophyll (a + b) content (mg g^{-1} fresh weight) of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) weed after spraying of different doses of Rain tree (*Samanea saman* Jacq. Merr.) leaf extract at 40 days after transplanting (Error bar indicates mean [$n = 3$] \pm standard error of means; ** and *denotes significant difference at $P < 0.001$ and 0.05 , respectively, among the treatments compare to the respective control [0])

both Foska begun and Bathua leaves compared to rain tree leaves [Tables 3 and 4]. The chlorophyll content was decreased due to the increasing of yellowing of leaves after application of both Mikania and rain tree leaf extract [Tables 1 and 2].

Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) weeds control efficiency

Mikania and rain tree leaf extract application increased weed control efficiency both by number and weight of Foska begun and Bathua over the control [Tables 3 and 4]. Mikania extract has excellent Bathua control efficiency compared to Foska begun and rain tree leaf extract application. About 92% Bathua by number was efficiently controlled by application of 10 mL Mikania extract and which was 36% by weight [Table 4]. Maximum 58% Bathua and Foska begun by number and 12%–16% by weight was controlled by application of 15 mL Rain tree leaf extract [Table 3 and 4]. Foska begun control efficiency was increased with the progressive rate of Mikania application from 83% to 91.67% (by number) and 27.41 to 31.27% (by weight, Table 3), whereas almost similar result was found at both doses (10 mL and 15 mL) for Bathua weed [Table 4]. Bathua weed is sensitive to methanolic extract of Mikania leaf at 10 mL application but after that if spraying rate is increased from 10 to 15 mL, no significant change was found in weed control efficiency.

pH and electrical conductivity of postharvest soil

pH and EC of post-harvest soils were determined and the data are tabulated in Table 5 to examine whether any change of soil

pH and EC was happened after application of both Mikania and rain tree leaf extract. pH and EC data pointed out that the both Mikania and rain tree leaf extract have no adverse effect on soil environment. pH of post harvest soil was ranged from 7.04 to 7.44 indicated that the soil were in neutral condition which was similar to initial soil (pH 7.08 to 7.34, data not shown here) and no structural change was occurred. EC value ranges from 0.62 to 0.89 dS m⁻¹ in post harvest soil [Table 5] specified that soil were in non-saline condition and almost similar to initial soil (0.54 to 0.79 dS m⁻¹, data not shown here).

DISCUSSION

Mikania leaf has mikanolide,^[19] deoxymekanolide, caffeic

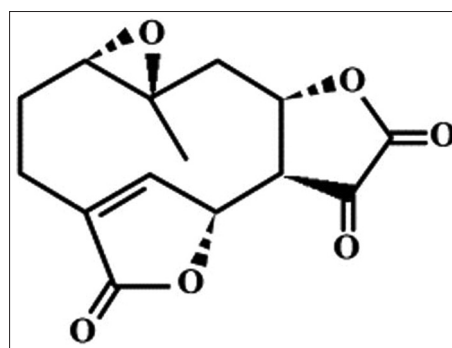


Figure 5: Chemical structure of bioactive compounds Mikanolide present in Mikania (*Mikania micrantha* H. B. K) leaves extract^[19]

Table 3: Chlorophyll a + b contents (mg/g fresh weight), control efficiency (by number and weight (%)) of Foska begun (*Physalis heterophylla*) weed after spraying of different doses of Mikania (*Mikania micrantha* H.B.K) and Rain tree (*Samanea saman* Jacq. Merr.) leaf extract at 40 days after transplanting

Extract	Treatments (mL)	Chlorophyll a + b (mg/g fresh weight)	Weed control efficiency by number (%)	Weed control efficiency by weight (%)
Mikania	0	1.34±0.04	0.00±0.00	0.00
	10	0.47±0.15*	83.33±8.33	27.41
	15	0.26±0.11**	91.67±8.33	31.27
Rain tree	0	1.34±0.04	0.00±0.00	0.00
	10	1.06±0.08*	41.67±8.33	11.58
	15	0.86±0.06**	58.33±8.33	12.35

** and *Significant difference at $P < 0.001$ and 0.05, respectively, among the treatments compare to the respective control, Data indicates mean ($n=12$)±SEM. SEM: Standard error of mean

Table 4: Chlorophyll a + b contents (mg/g fresh weight), control efficiency (by number and weight (%)) of Bathua (*Chenopodium album*) weed after spraying of different doses of Mikania (*Mikania micrantha* H.B.K) and Rain tree (*Samanea saman* Jacq. Merr.) leaf extract at 40 days after transplanting

Extract	Treatments (mL)	Chlorophyll a + b (mg/g fresh weight)	Weed control efficiency by number (%)	Weed control efficiency by weight (%)
Mikania	0	1.23±0.04	0.00±0.00	0.00
	10	0.36±0.18*	91.67±8.33	35.94
	15	0.33±0.17*	91.67±8.33	35.16
Rain tree	0	1.23±0.04	0.00±0.00	0.00
	10	0.79±0.08*	41.67±8.33	11.72
	15	0.78±0.06**	58.33±8.33	16.15

** and *Significant difference at $P < 0.001$ and 0.05, respectively, among the treatments compare to the respective control, data indicates mean ($n=12$)±SEM. SEM: Standard error of mean

Table 5: pH and electrical conductivity (electrical conductivity, dS/m) of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) cultivated postharvest soil after spraying of different doses of Mikania (*Mikania micrantha* H.B.K) and Rain tree (*Samanea saman* Jacq. Merr.) leaf extract at 40 days after transplanting

Extract	Treatments (mL)	Foska begun (<i>Physalis heterophylla</i>)		Bathua (<i>Chenopodium album</i>)	
		Postharvest soil pH	Postharvest soil EC (dS/m)	Postharvest soil pH	Postharvest soil EC (dS/m)
Mikania	0	7.13±0.04	0.78±0.06	7.06±0.08	0.62±0.02
	10	7.04±0.03	0.89±0.08	7.34±0.05	0.65±0.11
	15	7.09±0.05	0.77±0.09	7.42±0.06	0.77±0.09
Rain tree	0	7.13±0.04	0.78±0.06	7.06±0.08	0.62±0.02
	10	7.17±0.13	0.87±0.09	7.39±0.06	0.70±0.08
	15	7.44±0.10	0.84±0.09	7.42±0.04	0.84±0.04

Data indicates mean ($n=6$)±SEM. SEM: Standard error of mean, EC: Electrical conductivity

acid, p-hydroxybenzaldehyde, resorcinol, and vanilic acid allelochemicals, which have strong phytotoxicity and hence enhancing the yellowing of Foska begun (*Physalis heterophylla*) and Bathua (*Chenopodium album*) leaves and plants become died [Tables 1 and 2].^[10,20,21] Due to presence of different allelopathic chemicals especially mikanolide [Figure 5], it is rapidly develop cytotoxicity and chlorosis is occurred in both weed leaves which is supported by chlorophyll data presented in Figures 3 and 4. Chlorophyll contents were significantly decreased in treated weed leaves compared to control (0). *M. micrantha* leaf extract can control 92% Bathua and Foska begun by number, might be due to the presence of strong bioactive compounds, mikanolide. It has the highest potentiality to use as botanical herbicides to control these weeds. A previous research was applied the 1-5 cm pieces of *M. micrantha* 5 cm below the soil and then *Cyperous* weed were cultivated on this soil.^[9] They also found that *M. micrantha* application increased the weed control efficiency at 14.45%–56.32% by number over the control. Here, in this experiment, direct organic extract was sprayed to leaves and which can be more efficient to control weed than the soil application.

Rain tree leaves extract has also been reported for different insecticidal, cytotoxic, and allelopathic activity.^[22] Here methanolic extract is used as botanical herbicides for controlling Foska begun and Bathua and found that it can controlled 41-58% by number and 11-16% by weight of these two weed species [Tables 3 and 4]. A recent study has isolated two macrocyclic spermine alkaloids: Pithecolobine-1 and 2 [Figure 6] from 80% methanolic extract of *S. saman* leaves and clarified by spectral analysis.^[22,23] These two compounds were reported to exhibit good cytotoxic activity, and the range of concentration is 0.019–0.625 mg/mL. The current study used 10–15 mL doses for controlling weeds and this amount also significantly decreases the chlorophyll contents in leaves and reduces the dry weight [Figures 3 and 4]. Previously it was clearly indicated the cytotoxicity occurred at 757.3672µg/mL of methanol extract in brine shrimp bioassay, with the LD50 value of 757.3672µg/mL.^[24] Although weed control efficiency of rain tree leaf extract was not strong enough like Mikania, it still has potentiality to use as herbicides at high doses.

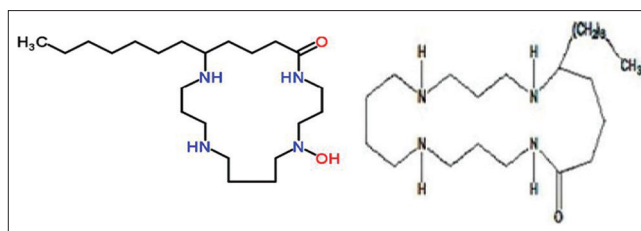


Figure 6: Chemical structure of bioactive compounds Pithecolobine-1 and Pithecolobine-2 present in Rain tree (*Samanea saman* Jacq. Merr.) leaves^[22-23]

CONCLUSIONS

M. micrantha leaf extract has high potentiality to control both *C. album* and *P. heterophylla* over *S. saman* leaf extract. From this study, it is revealed that *M. micrantha* leaf extract can reduce the total number of *P. heterophylla* and *C. album* weed at lower doses. Further field-based research should be conducted to other weed species and crops involving the *M. micrantha* and *S. saman* leaf extract application and monitoring the population density of both crops and weeds.

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Conflicts of interest

There are no conflicts of interest.

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