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ALLELOPATHIC IMPACT OF *MELASTOMA MALABATHRICUM* L. ON THE SEED GERMINATION AND SEEDLING GROWTH OF THREE AGRICULTURAL CROPS

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An experiment was conducted to understand the growth effects (inhibitory or stimulatory) of aqueous extract obtained from *Melastoma malabathricum* L. on three economical important agricultural crops viz., *Oryza sativa* L. (Rice), *Cicer arietinum* L. (Chickpea) and *Vigna radiata* (L.) R.Wilczek (Mung bean). The experiment was carried out in sterilized petri dishes with time duration 4 days, 8 days and 12 days in room temperatures. The effect of different concentration on targets crops were observed and compared to control. Our results showed that *Melastoma malabathricum* L. aqueous leaf extracts caused significant suppression on seed germination, radical and plumule elongation of three selective receptor crops proportionally increases with the increase of percent of donor plant extract content. However, bioassay studies confirmed that the progression of inhibition of germinated seedling elongation (both radical and plumule) and decrease of biomass proportional to the time duration at the higher concentration. The higher concentration showed the strongest inhibitory effect whereas the lower concentration showed stimulatory effect in some cases. Among the three targeted crops, *Oryza sativa* was strongly affected by the higher concentration (T_5) of *Melastoma malabathricum* L. aqueous leaf extracts. The bioassay results remarkably suggest that allelopathic effect may be a possible mechanism controlling the inhibitory effect on seed germination and germinated seedling growths of agricultural crops.

Key word: Allelopathy, Germination, *Cicer arietinum, Oryza sativa, Vigna radiata, Melastoma malabathricum*

Allelopathy is an interference mechanism in which living or dead plant material, including litter, releases chemicals exerting an effect (mostly negative) on the associated plants (Wardle et al. 1998). The term 'allelopathy' was first coined by German plant physiologist Hans Molisch, which is derived from the Greek allelon = of each other, pathós = to suffer to define “the injurious effect of one plant upon other one” (Molisch 1937, Rizvi *et al*. 1992). The phenomenon of allelopathy, whereby a plant species chemically interferes with the germination, growth or development of other plant species has been known and documented for over 2000 years (Sodaeizadeh and Hosseini 2012). However in 1996, the International Allelopathy Society suggested the broadened definition of allelopathy to refer to any process involving the secondary metabolites produced by plants, microorganisms, viruses, and fungi that influence the growth and development of agricultural and biological system (excluding animals), including positive and negative effects (Torres *et al*. 1996, Olofsdotter *et al*. 2001, Xuan *et al*. 2005, Cheng and Cheng 2015, Amb and Ahluwalia 2016).

Allelopathy involves the synthesis of plant bioactive secondary compounds, known as allelochemicals, released into the environment are usually not a single substance, and released from one plant species into the environment by volatilization, leaching, root exudation, decomposition and can influence the growth of other species (Meissner *et al*. 1986, Cheng and Cheng 2015). An allelopathic compound is also thought to be one of the indirect causes of continuous cropping obstacles in agriculture. The fact that organic substances of many weed species have been studied *in vitro* for their allelopathic potential on various field crop species such as allelopathic effect of *Amaranthus spinosus* L., *A. tricolor* L. and *A viridis* L. on pearl millet sorghum, wheat, groundnut and sesame by inhibiting seed germination and seedling growth (Rao 1991) and *Hyptis sauveolens*, *Ricinus communis*,

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Alternanthera sessilis, *Ipomoea carnea*, *Malachra capitata* and *Cymbopogon citrutus* on seed germination of *Triticum aestivum* (Joshi and Joshi 2016).

M. malabathricum is a small shrub commonly found in previously cleared land, waste places, and road side throughout the Southeast Asian countries, including Malaysia. It is native to tropical and temperate Asia and the Pacific Islands. The plant is one of the most common weeds that grow wildly and abundantly throughout the tropics, especially in the moist areas, and can be found in the Indian Ocean Islands, throughout South and South-East Asia, China, Taiwan, Australia, and the South Pacific Ocean. Throughout Malaysia, particularly, the plant is very common in the lowland and mountain forests, chiefly in open places (Joffry *et al*. 2012, Wong 2008).

MATERIAL AND METHODS

The Receptor Plants: The receptor agricultural crops selected for allelopathic tests are *Oryza sativa* L. (Rice), *Cicer arietinum* L. (Chickpea) and *Vigna radiata* (L.) R.Wilczek.

Donor Plant and Preparation of Leaf Extracts: In the present experiment we have used *Melastoma malabathricum*, a widely available perennial shrub as the donor plant. The leaves were thoroughly washed and placed in the shade for drying. The fully shade dried leaves were chopped into small pieces. For preparation of aqueous leaves extracts, 10g leaves were soaked in 200 ml distilled water and kept in room temperature for 3 days. After 3 days plant leaves leachate was filtered by filter paper and stock at 4ºC for seed treatment experiments. The stored leaf leachate of *Melastoma malabathricum* L. considered as 100 % concentration (Stock extract). Using this stock extract, four different concentrations were prepared by subsequent dilution with sterile distilled water, in final concentrations of 20%, 40%, 60% and 80% w v^{-1}. To carry out the experiment distilled water was used as a positive control.

Treatments: Following treatments are allowed carrying out the experiments:

T_0: Seeds of receptor plants grown in Control only (Distilled water)

T_1: Seeds of receptor plants grown in 20% aqueous leave extracts of *M. malabathricum*.

T_2: Seeds of receptor plants grown in 40% aqueous leave extracts of *M. malabathricum.*

T_3: Seeds of receptor plants grown in 60% aqueous leave extracts of *M. malabathricum.*

T_4: Seeds of receptor plants grown in 80% aqueous leave extracts of *M. malabathricum.*

T_5: Seeds of receptor plants grown in 100% aqueous leave extracts of *M. malabathricum.*

Bioasaay Study: Healthy seeds of recipient plants seed *i.e.*, *Oryza sativa* (Rice), *Vigna radiata* and *Cicer arietinum* were washed thoroughly with distilled water. Then sufficient numbers of autoclaved petri dished were prepared; each containing cotton bed. Each petridish was wetted with 10 ml of test solutions of different concentrations ($T_1 – T_5$) and as control distilled water (T_0) used in the experimental set separately. In each petridishes, 20 surface sterilized target seeds were placed separately for each tested species. A total of 3 replications of all treatments were kept undisturbed at room temperature in the laboratory for 4 days, 8 days and 12 days.

Germination and Growth Records: A germinated seed was considered when radicle emerged. The seed germination was recorded after 4 days, 8 days and 12 days respectively and the outcome were determined by counting the number of germinated seeds. The length of radicle and plumule of each set were recorded for the different experimental set at different time intervals (4 days, 8 days, and 12 days). The emergence of a radicle and plumule approximately 1 mm in length was taken into considered as germination. Length of radicle and plumule were measure by using cm scale. To observe the effects of allelochemicals on

seedling biomass in aqueous solution of *Melastoma malabathricum* leaf extracts and root infested soils, the seedlings of each replicates were taken separately into trussing papers and freshly weighted by using electronic balance. After oven dry at 90-120°C for 60 minutes, it was again weighted and recorded.

The germination and root shoot elongation ratio were calculated following equations as suggested by Ahmed *et al*. 2007

$$R=G/Gr \times 100t \quad (1)$$

Where, R is the relative germination ratio, G the germination ratio of tested plant at different treatments, and Gr is the germination ratio of tested plant at control (T_0)

$$RS= MS/ MC\times 100 \quad (2)$$

where, RS is the relative elongation ratio of shoot, MS the mean shoot length of tested plant, MC the mean length of control.

$$RR=M/ Mc \times 100 \quad (3)$$

where, Rr is the relative elongation ratio of root and M the mean root length of tested plant.

For the calculation of percentage of inhibitory (or stimulatory) effect on germination and growth parameters of treatment plants to control, we used the following formula:

$$I=100-(T_n \times 100/T_o) \quad (4)$$

Where, I is the % inhibition or stimulation; T_n is the response of treatment plant at different treatments and T_0 the response of plant at control.

Seedling weight loss and relative weight loss was calculated by the following equations

$$SWL= FW-DW \quad (5)$$

Where FW is the average fresh weight of germinated seedlings and DW is the average dry weight of germinated seedlings

$$Wr= 100-(W_n \times 100/W_o) \quad (6)$$

Where W_r is the % reduction or increase of weight; W_n is the weight loss of germinated seedlings of receptor plant at different treatments and W_o is the weight loss in response of germinated seedlings of receptor plant at control.

[5 and 6 formulation was used to understand the comparatively changes between the control and treatments (either stimulation or reduction).

RESULTS

The results indicated that growth of three test crops viz., *Oryza sativa* (Rice), *Cicer arietinum* and *Vigna radiata* were severely inhibited when grow in different treatments (T_1-T_5) compared to control.

Germination: The germination percentages of 3 target plants were recorded in Table 1. The germination percentage varied significantly in different treatments. With the increase of concentration, the inhibitory effect was

Table 1. Germination percentage of three target agricultural crops to Control (T0) and different concentrations of *M. malabathricum* leaf aqueous extracts (T_1-T_5)

Germination of seeds			
Treatments	***Oryza sativa***	***Cicer arietinum***	***Vigna radiata***
T_0	100[a]	98	100
T_1	93.33 (-6.66)	90[a] (-10)	98 (-1.66)
T_2	88.33[b] (-11.66)	100 (+2)	96.66 (-3.33)
T_3	83.33[c] (-16.66)	88.33 (-11.66)	91.66 (-8.33)
T_4	25[abcd] (-75)	81.66 (-18.33)	88.33 (-11.66)
T_5	00[abcd] (0)	66.66[a] (-33.33)	75 (-25)

[Notes: Values in the columns followed by the same letter (s) are significantly different ($P \leq 0.05$) according to Duncan's Multiple Range Test (DMRT). Values in the parenthesis indicate the inhibitory (-) or stimulatory (+) effects in comparison to control (T_0) treatments.]

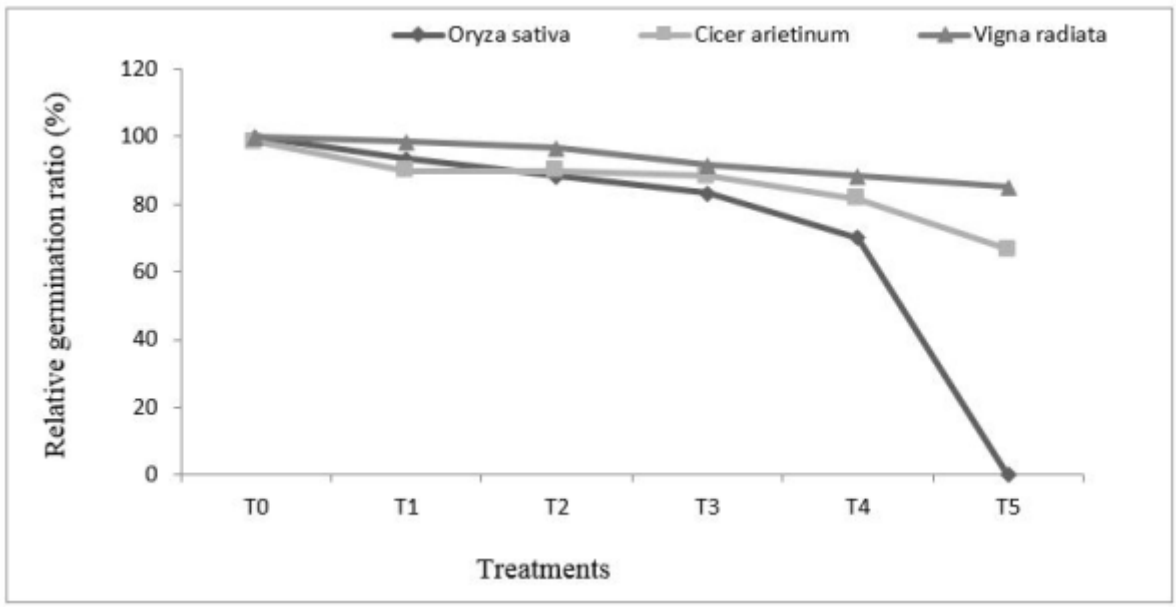

Figure 1: Relative germination ratio of bioassay species grown in petridishes at different concentrations of *Melastoma malabathricum* aqueous leaf extracts

progressively increases. In all cases, maximum germination inhibitory effect was found in T_5 treatment. The highest relative germination ratio (-75.00%) was found on *Oryza sativa* at T_5 treatment followed by (-33.33%) in *Cicer arietinum* and *Vigna radiata* (-15%) at the same treatment. Stimulatory effect (+2.00%) was found on C. arietinum at the T_2 treatmen which also shows the maximum relative germination ratio. Among the receptors, *Vigna radiata* shows the less sensation to the exposure of different concentrated extracts. The experimental findings indicate that aqueous leaf extracts of *Malastoma malabathricum* delayed the germination significantly in all the receptor crops compared to the control treatment. The experimental results suggested that germination of *Oryza sativa* was significantly inhibited at T_5 treatment compared to others treatments (T_0-T_4).

GROWTH BEHAVIOURS:

Roots Elongation: The average radicle (roots) lengths (mm) of the germinated seedlings of agricultural crops of the three receptor agricultural crops are shown in Table 2. Our experimental results showed that all treatments inhibit radicle growth of tested plants more or less except some cases which showed growth stimulatory activity of *Oryza sativa* when treated with T_1 treatment in 8 days and 12 days with stimulation ratio of (+28.35) and (+2.92) respectively compare to the control (T_0). Our experimental results revealed that the radicle elongation inhibition effect was progressively increased with the increase of concentration. Among all the treatments, T_5 treatment followed profoundly inhibits (-100%) the radicle elongation in 4 days, 8 days and 12 days experiments. At T_4 treatment more than -90% inhibitions was found in all days treatment significantly varies from control. Maximum inhibition of relative radicle elongation (-91.73 %) of *Cicer arietinum* was occurred in 12 days at T_5 treatment and in 4 days (-85.39%) and 8 days treatment (-84.61%) significantly varies compare to Control (T_0). T_4 treatment progressively inhibits radicle growths in 4 days, 8 days and 12 days of treatments with percentage inhibition ratio -83.24%, -84.99% and -87.35% respectively. At T_2 treatment in 4 days and T_3 treatments in all experimental days inhibits relative radicle elongation more than >50%.In case of *Vigna radiata* highest

Table 2: Root elongation (cm) of receptor agricultural crops to control (T_0) and different concentrations of *Melastoma malabathricum* leaf extracts (T_1-T_5)

Radicle growth in different time intervals in three crops									
Treatments	***Oryza sativa***			***Cicer arietinum***			***Vigna radiata***		
	4 days	**8 days**	**12 days**	**4 days**	**8 days**	**12 days**	**4 days**	**8 days**	**12 days**
T_0	7.96^{a}	16.08^{abc}	30.75^{a}	22.8	26.33^{a}	38.12^{a}	20.05^{a}	24.22	27.61^{a}
T_1	5.43^{ax} (-31.78)	20.64^{ab} (+28.35)	31.65^{ax} (+2.92)	6.8^{ax} (-69.87)	22.58^{a} (-16.40)	28.6^{abx} (-24.97)	19.48^{ab} (-2.84)	18.01^{a} (-25.64)	22.7^{ab} (-17.78)
T_2	2.32^{ax} (-70.85)	10.45^{acy} (-35.01)	30.12^{axy} (-2.04)	6.39^{ax} (-71.97)	12.27^{ab} (-53.39)	25.71^{abx} (-32.55)	14.05^{abc} (-30.32)	16.83^{a} (-36.41)	18.45^{b} (-33.21)
T_3	1.5^{ax} (-81.15)	7.41^{abc} (-53.92)	22.77^{ax} (-25.95)	4.87^{a} (-78.64)	9.32^{ab} (-64.60)	17.1^{bc} (-55.14)	13.97^{bc} (-30.32)	15.4^{ac} (-36.41)	16.17^{bc} (-41.43)
T_4	0.33^{a} (-95.85)	1.32^{c} (-91.79)	2.46^{b} (-92)	3.82^{a} (-83.24)	3.95^{b} (-84.99)	4.82^{c} (-87.35)	13.23^{bc} (-34.01)	9.66^{cd} (-60.11)	10.5^{c} (-61.97)
T_5	0.00^{a} (-100)	0.00^{c} (-100)	0.00^{b} (-100)	3.33^{a} (-85.39)	3.21^{b} (-87.80)	3.15^{c} (-91.73)	9.24^{c} (-53.91)	9.06^{d} (-64.90)	10.6^{c} (-63.56)

[Notes: Values in the columns followed by the same letter (s) are not significantly different and the values in the row followed by the same letter (s) are significantly differ ($P \leq 0.05$) according to Duncan's Multiple Range Test (DMRT). Values in the parenthesis indicate the inhibitory (-) or stimulatory (+) effects in comparison to control (T0) treatments.]

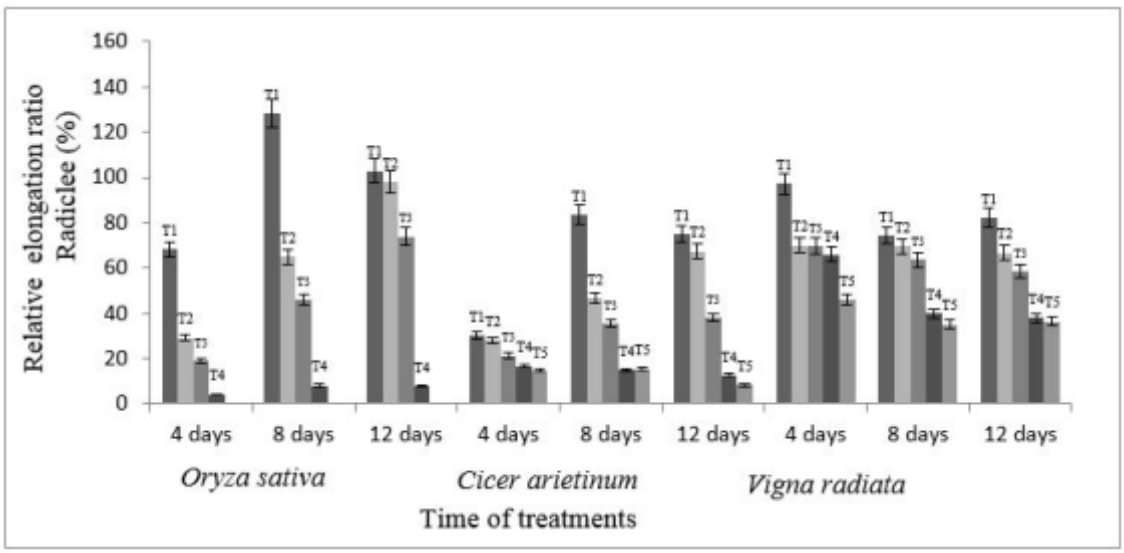

Figure 2: Relative radicle elongation ratio (%) of bioassay species grown in petridishes at different concentrations of *Melastoma malabathricum* aqueous leaf extracts

inhibition of radicle elongation was recorded at T_5 treatment in 8 days followed by 12 days and 4 days treatments with the inhibition ratio -64.90%, -63.56% and -53.91% respectively. T_4 treatments also significantly inhibit radicle growth compared to control (T_0), maximum inhibition (-61.97%) was found in 12 days treatments and in 8 days and 4 days with inhibition of elongation ratio was -60.11% and -34.01% respectively.

When all three targeted agricultural crops were treated with aqueous *Melastoma malabathricum* leaf extracts, it is observed that T_5 treatments i.e., 100% concentration inhibits -100% *radicle* elongation of *Oryza sativa* seedlings elongation but it is recorded >-80% in *Cicer arietinum* whereas in case of *Vigna radiata* it is less (>-50%) compare to two other crops.

Table 3: Shoot elongation (mm) of receptor agricultural crops to control (T_0) and different concentrations of *Melastoma malabathricum* leaf extracts (T_1-T_5)

Plumule growth in different time intervals in three crops									
Treatments	***Oryza sativa***			***Cicer arietinum***			***Vigna radiata***		
	4 days	**8 days**	**12 days**	**4 days**	**8 days**	**12 days**	**4 days**	**8 days**	**12 days**
T_0	4.08^{ax}	16.28^{a}	35.57^{ax}	8.86^{ax}	31.42^{a}	48.23^{ax}	27.81^{ax}	44.56^{ay}	63.03^{axy}
T_1	2.7^{ax} (-50.27)	16.08^{a} (-22.09)	33.87^{abx} (+7.01)	1.5^{ax} (-82.84)	14.54^{ab} (-53.72)	36.87^{ax} (-23.55)	26.76^{ax} (-3.77)	37.98^{ac} (-14.76)	48.78^{abx} (-22.60)
T_2	0.98^{ax} (-81.95)	8.55^{a} (-58.57)	29.38^{abx} (-7.17)	0.9^{ax} (-89.84)	9.71^{ab} (-69.09)	27.05^{ax} (-43.91)	26.17^{a} (-6.79)	31.4^{c} (-31.64)	38.2^{bc} (-39.39)
T_3	1.16^{ax} (-78.63)	7.46^{a} (-63.85)	27.6^{bx} (-12.79)	0.85^{ax} (-90.40)	5.71^{ab} (-81.82)	29.11^{ax} (-39.64)	25.93^{a} (-6.79)	30.46^{c} (-31.64)	36.37^{cb} (-42.29)
T_4	0^{a} (-100)	0.52^{a} (-97.48)	2.4^{c} (-92.41)	0.48^{ax} (-94.58)	1.48^{b} (-95.28)	2.12^{bx} (-95.60)	21.84^{a} (-21.46)	32.16^{c} (-27.82)	33.77^{cb} (-46.42)
T_5	0.00^{a} (-100)	0.00^{a} (-100)	0.00^{c} (-100)	0.37^{a} (-95.82)	1.61^{b} (-96.01)	1.78^{b} (-96.66)	20.6^{a} (-25.92)	26.18^{c} (-41.24)	25.46^{cb} (-59.60)

[Notes: Values in the columns followed by the same letter (s) are not significantly different and the values in the row followed by the same letter (s) are significantly differ ($P \leq 0.05$) according to Duncan's Multiple Range Test (DMRT). Values in the parenthesis indicate the inhibitory (-) or stimulatory (+) effects in comparison to control (T_0) treatments.]

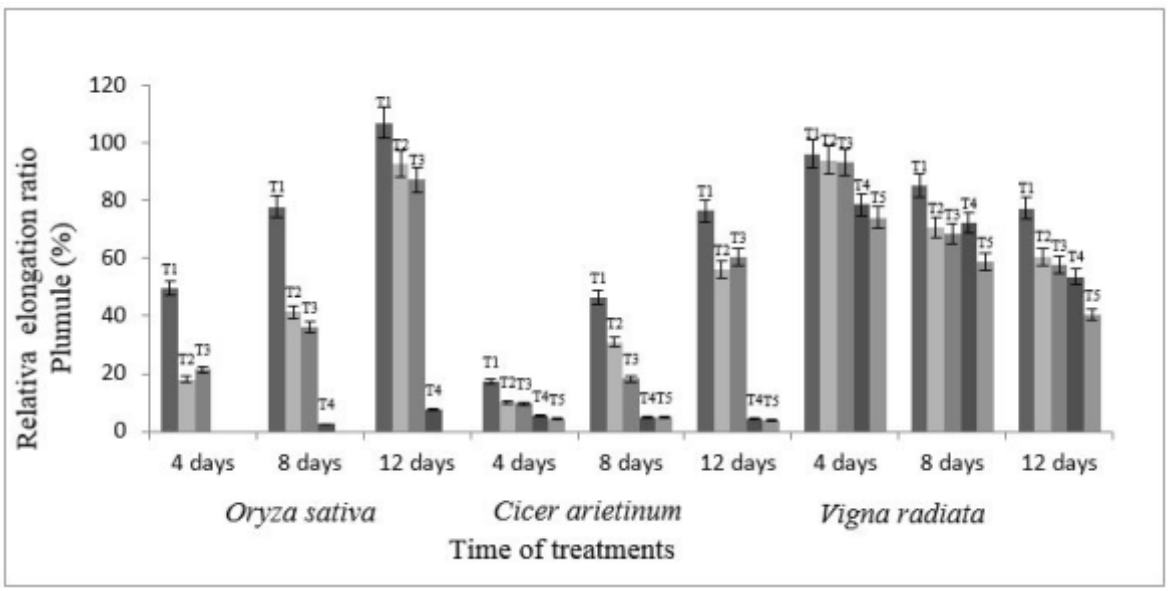

Figure 3: Relative plumule elongation ratio (%) of bioassay species grown in petridishes at different concentrations of *Melastoma malabathricum* aqueous leaf extracts

Shoot Elongation: The average plumule (shoots) lengths (mm) of the germinated seedlings of agricultural crops of the three receptor agricultural crops are shown in Table 3. The experimental results showed that the average plumule elongation inhibition effect was progressively increased with the increase of concentration compare to T_0 treatment. Among all the treatments, T_5 treatment significantly inhibits the plumule elongation in 4 days, 8 days and 12 days treatments followed by the T_4 treatments compare to the control treatment in three receptor crops viz., *Oryza sativa*, *Cicer arietinum* and *Vigna radiata*. The

Table 4: Relative Seedling weight loss (SWL) compare to control

Seedling weight loss (SWL) rate of tested crops in different concentration									
Treatments	***Oryza sativa***			***Cicer arietinum***			***Vigna radiata***		
	4 days	**8 days**	**12 days**	**4 days**	**8 days**	**12 days**	**4 days**	**8 days**	**12 days**
T_0	1.85^{a}	1.93^{a}	2.14^{a}	19.72^{ax}	24.72^{y}	35.79^{xy}	7.19^{axy}	11.08^{ay}	13.85^{ax}
T_1	1.66^{abxy} (-10.27)	2.08^{ay} (+7.77)	2.46^{ax} (+14.95)	12.1^{ab} (-38.64)	16.57^{a} (-32.96)	18.48^{a} (-48.36)	6.08^{axy} (-15.43)	9.83^{aby} (-11.28)	12.18^{abx} (-12.06)
T_2	1.33^{bc} (-28.10)	1.42 (+26.42)	1.45^{b} (-32.24)	11.77^{ab} (-40.31)	14.27^{ab} (-42.27)	17.59^{a} (-50.85)	5.89^{axy} (-70.13)	9.3^{aby} (-16.06)	11.8^{abx} (-14.80)
T_3	1.19^{c} (-35.67)	1.24 (-35.75)	1.36^{b} (-36.45)	11.27^{b} (-42.85)	12.01^{ab} (-51.41)	17.7^{a} (-50.54)	5.56^{axy} (-71.80)	9.59^{aby} (-13.45)	11.12^{abcx} (-19.71)
T_4	0.61^{d} (-67.03)	0.72^{b} (-62.7)	0.8^{d} (-62.617)	11.32^{b} (-42.59)	10.68^{ab} (-56.79)	15.76^{a} (-55.96)	4.83^{axy} (-75.50)	9.71^{aby} (-14.17)	8.78^{bcx} (-36.60)
T_5	0.31^{d} (-83.24)	0.35^{b} (-81.86)	0.37^{d} (-82.71)	10.48^{b} (-46.85)	10.92^{b} (-55.82)	13.21^{a} (-63.09)	4.59^{ax} (-76.72)	5.08 (-54.15)	8.27^{cx} (-40.29)

[Notes: Values in the columns followed by the same letter (s) are not significantly different and the values in the row followed by the same letter (s) are significantly differ ($P \leq 0.05$) according to Duncan's Multiple Range Test (DMRT). Values in the parenthesis indicate the inhibitory (-) or stimulatory (+) effects of dry weight in comparison to control (T_0) treatments.]

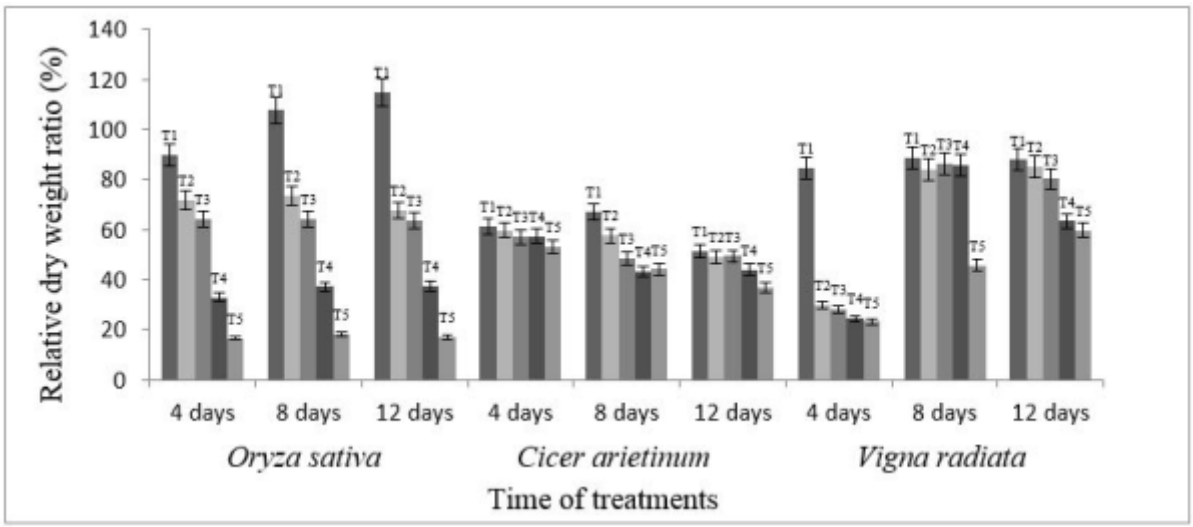

Figure 4: Relative dry weight ratio (%) of bioassay species grown in petridishes at different concentrations of Melastoma malabathricum aqueous leaf extracts

highest inhibition of plumule elongation was occurred in T_5 treatment (-100%) in 4 days, 8 days and 12 days treatments on *Oryza sativa*. At T_4 treatment in 4 days showed -100% inhibition and 8 days and 12 days treatments showed >90% inhibition of plumule elongation on *Oryza sativa*. Time interval of treatments also significantly varied between 4 days treatment and 12 days treatments which influence the growth elongation of *Oryza sativa* at the treatments of T_1, T_2 and T_3. Maximum relative plumule elongation inhibition -96.30 % of *Cicer arietinum* was occurred in 12 days at T_5 treatment followed by 4 days and 8 days treatment and T_4 treatment significantly inhibits plumule growths in 12 days followed by 8 days of treatments compare to Control (T_0). At T_4 and T_5 treatments significantly inhibits relative plumule

elongation >90% in all days treatments and in 12 days inhibition % differs significantly compare to T_0. Even, significant inhibition of average plumule elongation was found in between 4 days and 12 days after treatment at T_1 T_2, T_3 and T_4 concentrations.In case of *Vigna radiata*, highest inhibition of radicle elongation was recorded at T_5 treatment in 12 days was -59.60% and in 8 days and 4 days treatments which was -41.24 % and -25.92% respectively

Dry Weight: The average dry weights of germinated seedlings of three receptor agricultural crops are shown in Table 3. With the increase of concentration, the dry weight was progressively reduced compare to the control. The highest reduction of dry weight was recorded at T_5 treatment followed by T_4 treatment compared to T_0 treatment in all crops compare to control. In *Oryza sativa* dry weight is increases in 8 days and 12 days at T_1treatment and at T_2 treatment in 8 days compare to control because the stimulation of radicle and plumule growths in the same days treatments. Significant reduction weight of germinated seedlings was observed at T_5 and T_4 treatments in all days (4 days,8 days and 12 days) with >-80% and >-60% respectively. *Cicer arietinum* showed the highest reduction of dry weight (-63.09 %) of at T_5 treatment in 12 days. T_3, T_4 and T_5 treatments in 8 days and 12 days reduced the relative dry weight >-50%. But in *Vigna radiata* significant reduction of relative dry weight was observed in T_2 to T_5 treatments in 4 days which showed >70% relative weight loss compare to T_0. It was observed that reduction of relative dry was highest in *Oryza sativa* than other two crops.

DISCUSSION AND CONCLUSIONS

Our observation suggested that *Melastoma malabathricum* aqueous leaf extracts is more potent to inhibit the elongation of roots and shoots growths. Suppressive effect both root and shoot elongation was highest on *Oryza sativa* (-100%), *Cicer arietinum* (>-90%) but less inhibitory effect was observed in *Vigna radiate* (-60%) along with the rate of percentage germination of *Oryza sativa* (100%), *Cicer arietinum* (66%) and *Vigna radiata* (75%). The observation of our study confirms the findings of Faravani *et al*. 2008, who reported that the suppressive effects of root-shoot growths, rate of germination in the Barnyard grass (*Echinochloacrus-galli*) and Radish (*Raphanus sativus* L.) seeds increased with an increase in concentration increasing of *M. malabathricum* aqueous and methanol extracts.

Our results indicate that *Melastoma malabathricum* aqueous leaf extracts has also the long term inhibitory effects against agricultural crops. In our study it shows the complete inhibitory effects on rice from 4 days to 12 days of treatments. Some cases inhibitory effects was more in 4 days or 8 days treatments but increasing with an increase of treatment percent content concentration the suppressive effect was highest in 12 days than 4 days and 8 days of treatments. Besides these observations, at lower concentration of these treatments some stimulatory effect was also observed, this phenomenon may be the particular concentration of allelochemicals which provide the stimulation of germinated seedlings elongation through cell division. The findings also accordance with the results of Alam 1990, Chou *et al.* 1986, Ahmed et al. 2007 in which root growth behaviour was more susceptible and responds more strongly to the increasing concentration of the aqueous extract. The suppressive effect of *M. malabathricum* aqueous extracts on three agricultural crops may be caused by allelopathy. *M. malabathricum* aqueous extracts might have appeared to inhibit or to stimulate the growth of roots and shoots of germinates by some reasonable mechanisms. The first reason is the presence of phenolic compounds which have been previously identified and separated from *M.*

malabathricum extracts (Dafaalla 2004) and possibility at higher concentration they inhibited mitosis cell division completely, induced mitotic abnormalities by damaging chromatin organization and the mitotic spindle in roots exposed root elongation as resulting the growth elongation is suppressed. (Cai and Mu 2012, Teerarak *et al.* 2012). The allelopathic phenomenon on target agricultural crops (*viz*., *Oryza sativa*, *Cicer arietinum* and *Vigna radiata*) may be the results of the interaction of the allelochemicals with these basic targets, such as inhibit amino acid absorption, affect the integrity of DNA and RNA protein biosynthesis and related processes (Abenavoli *et al.* 2003, Baziramakenga *et al*. 1997, Zeng *et al.* 2001, Cheng and Cheng 2015).

The findings of our studies are also supportive with others reported verities of plants namely *Lantana camara* L. (Verbenaceae), *Hyptis suaveolens* (L.) poit., *Echinochloa colona* L. (Poaceae) *Cyperus iria* L. (Cyperaceae) those shows their allelopathic effects on different agricultural crops namely wheat, rice, soyabean, cucumber, radish etc. (Kohli *et al*. 2006, Ahmed *et al*. 2007, Chopra *et al.* 2017, Islam and Kato-Noguchi 2013).

Faravani *et al.* 2008 suggested that *Melastoma malabathricum* plant extracts significantly affected root growth of susceptible plants, that result with growing the plant will be a reduction of plant biomass in the presence of allelopathic compound which is most similar with our study. Allelochemicals may directly play the key action to prevent or promote germination when environmental conditions are conducive to growth and establishment, therefore, influencing the contributing to species distribution and abundance within plant communities and can be important in the success of invasive plants (Inderjit *et al*. 2006, Field *et al.* 2006, Zheng *et al.* 2015). Thus allelochemicals from *Melastoma malabathricum* may, however, be different and need to be identified though laboratory bioassay studies.

REFERENCES

Abenavoli M R, Lupini A, Oliva S and Sorgona A 2010 Allelochemical effects on net nitrate uptake and plasma membrane H+-ATPase activity in maize seedlings. *Biologia Plantarum* **54** 149-153.

Ahmed R, Uddin M B, Khan M A S A, Mukul S A and Hossain M K 2007 Allelopathic effects of *Lantana camara* on germination and growth behavior of some agricultural crops in Bangladesh. *Journal of Forestry Research* **18** 301-304.

Alam S M 1990 Effect of wild plant extract on germination and seedling growth of wheat. *Rachis* **9** 12- 13.

Amb M K and Ahluwalia A S 2013 Allelopathy: Potential Role to Achieve New Milestones in Rice Cultivation. *Rice Science* **23** 165-183.

Baziramakenga R, Leroux G D, Simard R R, Nadeau P 1997 Allelopathic effects of phenolic acids on nucleic acid and protein levels in soybean seedlings. *Can J Bot* **75** 445-450.

Cai S L, Mu XQ 2012 Allelopathic potential of aqueous leaf extracts of *Datura stramonium* L. on seed germination, seedling growth and root anatomy of *Glycine max* (L.) Merrill. *Allelopathy J* **30** 235–245.

Cheng F, Cheng Z 2015 Research Progress on the use of Plant Allelopathy in Agriculture and the Physiological and Ecological Mechanisms of Allelopathy. *Frontiers in Plant Science* doi: 10.3389/fpls.2015.01020

Chopra N, Tewari G, Tewari L M, Upreti B and Pandey N 2017 Allelopathic Effect of Echinochloa colona L. and Cyperus iria L. Weed Extracts on the Seed Germination and Seedling Growth of Rice and Soyabean.

Advances in Agriculture https://doi.org/10.1155/2017/5748524.

Chou C H, Kuo Y L 1986 Allelopathic exclusion of understory by *Leucaena leucocephala* (Lam.) dwit. *J Chem Ecol* **12** 1431-1448

Dafaalla M H A 2004 *Phytochemical and biological studies on Melastoma malabathricum,* Chemistry Penang. Universiti Sains Malaysia, The degree of Doctor of Philosophy.

Faravani M, Baki H B, Khalijah A 2008 Assessment of Allelopathic Potential of *Melastoma malabathricum* L. on Radish (*Raphanus sativus* L.) and Barnyard Grass (*Echinochloacrus-galli*). *Not Bot Hort Agrobot Cluj* 36 54-60

Field B, Jordan F, Osbourn A 2006 First encounters–deployment of defence-related natural products by plants. *New Phytol* **172** 193–207

Inderjit, Callaway R M, Vivanco J M 2006 Can plant biochemistry contribute to understanding of invasion ecology? *Trends Plant Sci* **11**: 574–580

Islam A K M M, and ato-Noguchi H 2013 Plant growth inhibitory activity of medicinal plant *Hyptis suaveolens*: could allelopathy be a cause? *Emir J Food Agric* **25** 692-701.

Joffry S M, Yob N J, Rofiee M S, Mohd. Affandi M M R M, Suhaili Z, Othman F, Akim AMd, Desa M N M and Zakaria Z A 2012 *Melastoma malabathricum* (L.) Smith Ethnomedicinal Uses, Chemical Constituents, and Pharmacological Properties: A Review. *Evidence-Based Complementary and Alternative Medicine* doi:10.1155/2012/258434.

Joshi N, Joshi A 2016 Allelopathic effects of weed extracts on germination of wheat. *Annals of Plant Sciences* **5** 1330-1334

Kohli R K, Batish D R, Singh H P, Dogra K S 2006 Status, invasiveness and environmental threats of three tropical American invasive weeds (*Parthenium hysterophorus* L., *Ageratum conyzoides* L., *Lantana camara* L.) in India. *Biological Invasions* **8** 1501–1510.

Meissner R, Nel PC, Beyers EA 1986 Allelopatlric influence of Tagetes- and Bidens-infested soils on seedling growth of certain crop species. *South African Journal of Plant and Soil* 3 176 -180

Molisch H 1937 The effect of plants on each other. Fischer Jena **31** 12–16

Olofsdotter M 2001 Getting closer to breeding for competitive ability and the role of allelopathy—An example from rice (*Oryza sativa*). Weed Technology **15** 798-806

Rao V V 1991 *Studies on Interference between Certain crops and weeds.* Ph.D. Dissertation, Rajkot: Saurashtra University Pp 210

Rizvi S J H, Rizvi V 1992 Exploitation of allelochemicals in improving crop productivity. In: Rizvi SJH, Rizvi V. *Allelopathy Basic and Applied Aspects*. London: Chapman and Hall. Pp 443–472.

Sodaeizadeh H, Hosseini Z (2012) Allelopathy an Environmentally Friendly Method for Weed Control. *International Conference on Applied Life Sciences (ICALS) Turkey* 387-392.

Teerarak, M, Charoenying P, Laosinwattana C 2012 Physiological and cellular mechanisms of natural herbicide resource from *Aglaia odorata* Lour. On bioassay plants. *Acta Physiol Plant* **34** 1277–1285.

Torres A, Olivia R M, Castellano D, Cross P 1996 A science of the future. In: Proceedings of the 1st World Congress on Allelopathy. Cadiz, Spain: University of Cadiz Pp 278.

Wardle DA, Nilsson MC, Gallet C, Zackrisson O 1998 An ecosystem-level perspective of allelopathy. *Biol Res* **73** 305—319.

Wong W 2008 *Melastoma malabathricum*: Too Beautiful to Be Called a Weed, Green Culture, Singapore.

Xuan T D, Shinkichi T, Khanh T D and Min C I 2005 Biological control of weeds and plant pathogens in paddy rice by exploiting plant allelopathy: an overview. *Crop Prot* **24** 197-206

Zeng R S, Luo S M, Shi Y H, Shi M B, Tu C Y 2001 Physiological and biochemical mechanism of allelopathy of secalonic acid F on higher plants. *Agron J* **93** 72–79.

Zheng Y L, Feng Y L, Zhang L K, Callaway R M, Valiente-Banuet A, Luo D Q et al. 2015 Integrating novel chemical weapons and evolutionarily increased competitive ability in success of a tropical invader. *New Phytol* **205** 1350–1359.