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Weed Management Potentials of Identified Invasive Weed Species

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ABSTRACT

Synthetic herbicide, the most popular weed control, causes environmental hazards. The use of allelopathy in controlling weeds is a possible alternative for sustainable weed management. The study was conducted to determine the allelopathic potentials of identified invasive weed species in terms of percent and rate of germination, plant height, length of leaves and roots and percent mortality of grasses, sedges, and broadleaves. The treatments were: T0-Pre/Post-emergence Herbicide, T1Tap Water, T2-Mimosa pudica extract,T3-*Lantana camara* extract,T4-Chromolaena odorata extract. These were compared according to their effects on *Cenchrus spinifex*, *Conyza canadensis, Impatiens wallerana* and *Cyperus rotundus*. Data were analyzed using Analysis of Variance

(ANOVA) for Completely Randomized Design. A further test was done using Duncans Multiple Range Test (DMRT). For germination, *Lantana camara* is effective in reducing the percent germination and prolonging germination rate of most common weed species. On the other hand, Chromolaena odorata is effective in reducing the percent germination and prolonging the germination rate of *Impatiens wallerana*, while *Mimosa pudica* was effective against *Cenchrus spinifex* and *Cyperus rotundus*. For growth and development, *Mimosa pudica* was found to be the most effective in all common weed species, except for *Cyperus rotundus* where *Chromolaena odorata* was most effective on reducing the length of leaves and roots, and above ground fresh weight. Furthermore, *Chromolaena odorata* was found effective against both *Cyperus rotundus* and *Conyza canadensis* while *Mimosa pudica* was effective against *Cenchrus spinifex* in terms of percent mortality. Thus, such potential of invasive weed species for weed management should be utilized.

Keywords **–** weed management, organic herbicide, allelopathy, experimental research, Cebu Philippines

INTRODUCTION

Along with the various technological achievements in agriculture, severe outbreaks of insect pests, diseases, and weeds in crops have also occurred. Weeds pose a threat to agricultural productivity. They alone are held responsible for nearly 34% of the total reduction in crop yield (Oerke, 2006). Weeds are unwanted plants that compete with crops for nutrients and space resulting to physiological malfunctioning of the crop that makes it susceptible to diseases. Thus, eventually reduces its yield. It further harbors some pathogens that consequently infect the crops at various stages of its growth.

The most popular way to reduce weed population is through herbicide, a chemical designed to kill weeds by disrupting some important metabolic reactions at the cellular level. However, its excessive use leads to several environmental and health hazards. To combat this, efforts are being made all over the world to replace these synthetic chemicals with alternatives that are safer and do not cause any toxic effects on the environment (An, Pratley & Haig, 1991).Thus, these future problems on weeds will have to be tackled in an environmentally benign manner as part of sustainable crop production technology (Dhaliwal & Heinrichs; 1998, Koul, Multani, Goomber, Daniewski & Berlozecki, 2004; & Koul, 2008).

The use of allelopathy in controlling weeds has been suggested to be one of the possible alternatives for achieving sustainable weed management. Allelochemicals are released by plants that can suppress the growth of other neighboring plants of different species. The readily visible effects of allelochemicals on the growth and development of plants include inhibited or retarded germination rate; seeds darkened and swollen; reduced root or radicle and shoot or coleoptile extension; swelling or necrosis of root tips; curling of the root axis; discoloration, lack of root hairs; increased number of seminal roots; reduced dry weight accumulation; and lowered reproductive capacity. Invasive plant species, including some species of weeds, usually use allelochemicals for successful colonization of lands. *Makahiya*, scientifically known as *Mimosa pudica* has been found to contain some allelochemicals like alkaloid which has a microbial effect and flavonoids and glycosides (also alkaloids) that exhibited significant hypolipidemic activity. Similarly, allelochemicals acyclic terpenoids, lantadene A and B from coronet (*Lantana camara*) have been reported to be effective against aquatic weeds *Eichornia crassipes* and *Microcystis aeruginosa*.

On the other hand, through allelopathy, *Chromolaena odorata* reduces vegetation in grasslands and forests (Dev & Koul, 1997). Such reports suggest that further study can be done on their effects to control common terrestrial weeds. However, as indicated in some literature, extracts of some weeds were found to have allelopathic effects over certain crops. Interaction between weeds and crops is simultaneously and/or sequentially, with direct or indirect effect of one plant species to another, through the synthesis of various chemical compounds – allelochemicals, that are released into the environment and affect (inhibit and/or stimulate) the germination of seeds and the development of a number of weeds and crop (Reigosa, Souto & Gonzales, 1999; Kostadinova, Ahmed & Kuzmova, 2002; Kadioglui, Yanar & Asav, 2005).

Thus, a study was conducted to determine the potential allelopathic effects of these weed species to control the establishment, growth, and development of some common weed species in the Philippines.

MATERIALS AND METHODS

Collection of Invasive Weeds for Allelochemical Extraction

Composite samples of each Makahiya (*Mimosa pudica*), Coronet (*Lantana camara*) and Hagonoy (*Chromolaena odorata*) plants were collected at Laray, Consolacion, Cebu, Philippines and Cebu Technological University – Barili

Campus, Barili, Cebu, Philippines. Only vigorously growing weeds at their reproductive stage were collected for allelochemical extraction. All plant parts (roots, stems, leaves and flowers) were considered for extraction.

Collection of Seeds of Some Common Weeds

Seeds of pioneer grass (*Cenchrus spinifex*), Impatiens broadleaf weed (*Impatiens wallerana*) and purple nut sedge (*Cyperus rotundus*) were collected at Laray, Consolacion, Cebu. These seeds were used for testing the bioassay of the different crude extracts regarding to seed establishment (seed germination). For the seedlings, uniform weed seedlings (number of leaves, height, and overall appearance) of pioneer grass (*Cenchrus spinifex*), horseweed (*Conyza canadensis*) and purple nut sedge (*Cyperus rotundus*) *w*ere collected at Cebu Technological University – Barili Campus, Barili, Cebu.

Preparation of Crude Extracts

Crude plant extracts were prepared following the procedure described by Guevara and Recio (1985) with some modifications.

Each composite sample of invasive weed species were chopped and pounded to increase surface area for contact with water. Five hundred grams of each of the different invasive weed were added with 500 ml of water and blended and allowed to stand for 24 hrs. The mixture was then filtered, and the filtrate was collected for bio-assay.

Experimental Design and Treatments

The study was arranged in Completely Randomized Design (CRD) with 10 samples per treatment and three replications.

The treatments were as follows:

T_0 – Herbicide (post/pre-emergence herbicide at 1% concentration based on its recommended rate)

T_1 – Tap Water

T_2 – Makahiya (*Mimosa pudica*) Crude Extract at 2% concentration taken from the 1:1 ratio in crude extract preparation

T_3 – Coronet (*Lantana camara*) Crude Extractat2% concentration taken from the 1:1 ratio in crude extract preparation

T_4 – Hagonoy (*Chromolaena odorata*) Crude Extract at 2% concentration taken from the 1:1 ratio in crude extract preparation

Bioassay of Crude Extracts

Bioactivity of the different treatments was done following the procedure of Morallo-Rejesus and Decena (1982) and was investigated against three classes of weeds:

- Grass (*Cenchrus spinifex*),
- Broadleaf weed (*Conyza canadensis*) seedlings and (*Impatienswallerana*) seeds, and
- Sedge (*Cyperus rotundus*).

The treatments were tested on two stages of weed development to determine its pre and post-emergence herbicidal potentials:

- Seed germination (percentage germination and germination rate), and
- Seedling stage (growth and development).

For weed establishment, seeds were laid in a petri dish lined with tissue paper and impregnated with the different treatments at 20 ml per petri dish. Impregnation of the extract was done every three days during the whole incubation period (15 days). During the preliminary study, horseweed and purple nut sedge seeds did not germinate. Thus they were replaced with impatiens seeds and purple nut sedge rhizomes.

For growth and development, uniform weed seedlings (number of leaves, height, and overall appearance) were transplanted in uniform size polyethylene bags (10 cm x 12 cm) and were watered daily according to the different treatments for one week at 20 ml per polyethylene bag. Data on growth, development and mortality were gathered one week after application of treatments (14 days from first application) and a week after that (21 days after first application).

Data to be gathered

A. Pre-emergence (establishment)

1. Percentage Germination – This was computed using the formula:

$$\% \text{ Germination} = \frac{\text{Number of Seeds Germinated}}{\text{Number of Seeds Sown}} \times 100$$

2. Germination Rate – This was computed using the formula:

$$\text{Germination Rate} = \frac{(N_1)(T_1) + (N_2)(T_2) + (N_3)(T_3) + (N_4)(T_4) \ldots}{\text{Total Number of Seeds Germinated}}$$

Where: N – number of seeds germinated

T_n – number of days from sowing to germination

B. Post-emergence (growth and development)

Growth

1. Average Plant Height (cm) – This was measured from the base of the plant immediately just above the origin of the top most root up to the terminal end of the longest shoot during the termination of the study (21 days after first application of treatments) and 2 cm above the soil surface up to the tip of the longest leaf, held vertically, on 14th day after the first application of treatments.
2. Average Length of Leaves (cm) – This was measured from the terminal end of the leaf up to its base just before the petiole. Measurements of the longest and shortest fully opened leaves were used. This was done on the 14th and 21st day after first application of treatments.
3. Average Width of the Leaves (cm) - This was measured on the broadest portion of the leaves. Measurements of the widest and narrowest fully opened leaves were used. This was done on the 14th and 21st day after first application of treatments.
4. Average Length of Roots (cm) - This was measured from the origin of topmost root up to the tip of the longest root. This was done during the termination of the study.

5. Above Ground Fresh Weight (g) – This is the fresh weight of the weeds immediately just above the origin of the top most root. This was done during the termination of the study.
6. Below Ground Fresh Weight (g) - This is the fresh weight of the weeds from the origin of the top most roots and below. This was done during the termination of the study.

Development

1. Average Number of Leaves – This was determined by counting only the number of fully opened leaves on each plant per treatment. This was done on the 14th and 21st day after first application of treatments.

2. Average Number of Roots – This was determined by counting only the number of roots of each plant per treatment. This was done on the 14th and 21st day after first application of treatment.

Mortality

Percent Mortality – This was computed using the formula:

$$\%\ \text{Mortality} = \frac{\text{Number of Weed Seedlings that Died}}{\text{Starting Number of Weed Seedlings}} \times 100$$

Statistical Analysis

Data were recorded, consolidated, tabulated and statistically analyzed using Analysis of Variance (ANOVA) for Completely Randomized Design (CRD). Comparison among means was done using Duncan's Multiple Range Test (DMRT) to determine the specific significant differences among treatment means.

RESULTS AND DISCUSSION

Pre-emergence (establishment)

Percentage germination of seeds of selected weed species as affected by the different treatments is shown in Table 1. The results revealed that none of the seeds of *Impatiens wallerana* germinate after the application of the crude extract of *Lantana camara* and *Chromolaena odora*ta and pre-emergence herbicide. Aqueous extract of *Chromolaena odorata* contains soluble allelochemicals that cause an inhibitory effect on germination of paddy and barnyard grass while aqueous leaf extract of *Lantana camara* has been reported to contain some harmful allelochemicals that inhibit germination and root and shoot elongation and development of lateral shoots (Ahmed, Uddin, Khan, Mukul & Hossain, 2007*).* For controlling seed germination of *Cenchrus spinifex, Mimosa pudica* (3.33%) *and Lantana camara* (3.33%) are highly effective. *Mimosa pudica* was found to contain allelochemicals called tannin which can inhibit the growth of cell protein. For controlling the seed germination of *Cyperus rotundus* rhizome to develop shoot, *Chromolaena odorata* (16.67%) was found to be the most effective.

Table 1. Percentage germination (%) of seeds of selected weed species as affected by the different weed extracts

Treatment	Weed Species		
	Impatient wallerana	*Cenchrus spinifex*	*Cyperus rotundus*
T0- Commercial Herbicide	0	0	0
T1- Tap water	70	29.75	63.33
T2- Mimosa pudicaExtract	23.33	3.33	21.11
T3- Lantana camara Extract	0	3.33	34.96
T4- Chromolaenaodorata Extract	0	6.67	16.67

The germination rate of selected weeds species is shown in Table 2. *Lantana camara* and *Chromolaena odorata* crude extracts were the most effective against *Cenchrus spinifex* that results are the same in using commercial herbicide. This implies that to decrease the germination rate of *Cenchrus spinifex*, *Lantana camara* extract is already enough and the use of inorganic herbicide is no longer necessary. According to Ahmed *et al.* (2007), aqueous leaf extract of *Lantana camara* caused a significant inhibitory effect on germination. As reported by B. Hu, G. Hu and Hong (2013), on the other hand, aqueous leaf extract of *Chromolaena odorata* from its leaves and roots will inhibit the seedling growth of some herbaceous weed species. For *Cyperus rotundus ,* the most effective extract in prolonging its germination rate was *Lantana camara*(9.72 days) while *Mimosa pudica*was the most effective against *Cyperusspinifex*at 10.05 days.

Table 2. Germination rate (days) of selected weed species as affected by the different weed extracts

Treatment	Weed Species		
	Impatient wallerana	*Cenchrus spinifex*	*Cyperus rotundus*
T0- Commercial Herbicide	0	0	0
T1- Tap water	8.4	7.18	3.17
T2- Mimosa pudicaExtract	3	10.05	0.95
T3- Lantana camara Extract	0	1.05	99.72
T4- Chromolaenaodorata Extract	0	6	4.4

Post- Emergence (Growth and Development)

On the height *of Cenchrus spinifex* as affected by the different treatments (Table 3), results revealed that among all the invasive weeds tested, *Lantana camara* was the most effective. The application of *Lantana camara* resulted to stunting of *Cenchrus spinifex* at 7.49 cm and 13.04 cm at 14 and 21 days, respectively. This, however, is not as effective as the commercial herbicide that resulted to the death of plants. Moreover, with the application of *Lantana camara*, *Cenchrus spinifex* was observed to continue to grow but at a slower rate.This implies that *Lantana camara* is the most effective weed extract to control the growth and development of *Cenchrus spinifex*. *Lantana camara* contains the allelochemical lantadene (Frohne & Ptander, 1983) that are concentrated in the leaves and in unripe and ripe fruits that have been shown to inhibit the growth of aquatic weeds. Xong, Wang, Zhang and Hu (2006) also suggest that these allelochemicals could potentially be used to improve the management of weeds in aquatic systems. In the present study, *Lantana camara* can be used for the management of *Cenchrus spinifex.* Furthermore, Hossain and Alam (2010) reported that different concentrations of aqueous leaf extracts of *Lantana camara* caused a significant inhibitory effect on shoot elongation of some crops.

Furthermore, Table 3 showed that *Mimosa pudica* significantly reduced the growth of *Conyza canadensis* after 14 days from the application (1.01 cm) and was even as effective as the commercial herbicide 21 days after application (0.34 cm). Results also revealed reduction on the height of *Conyza canadensis* from 14 to 21 days after application which means that the application of *Mimosa pudica* resulted to tissue death but not the overall death of plants as compared to the commercial herbicide. *Mimosa pudica* contains several allelochemicals like mimosine, ethanol, alkaloids, and tannins. It has also contained methanol, which was recently found and was screened for herbicidal activity.

Table 3. Average plantheight (cm) of common weed species 14 days and 21 days after the application of the different weed extracts

Treatments	**Weed species**					
	C. spinifex		***C. canadensis***		***C. rotundus***	
	14 Days	**21 Days**	**14 Days**	**21 Days**	**14 Days**	**21 Days**
T_0 - Commercial Herbicide	0.00[e]	0.00[d]	0.15[c]	0.00[d]	0.00[c]	0.00[d]
T_1 - Tap water	21.09[a]	22.52[a]	4.02[a]	4.84[b]	9.47[a]	10.42[a]
T_2 - *Mimosa pudica*Extract	11.94[b]	19.18[b]	1.01[b]	0.34[d]	7.49[b]	2.39[c]
T_3 - *Lantana camara* Extract	7.49[d]	13.04[c]	3.93[a]	3.25[c]	9.49[a]	6.31[b]
T_4–*Chromolaenaodorata* Extract	9.81[c]	14.04[c]	4.40[a]	7.03[a]	6.80[b]	6.04[b]
Mean	10.06	13.75	2.70	3.10	6.65	5.03
C.V.	9.25	13.23	15.46	7.74	5.83	8.66

Means within the same column followed by a common letter are not significantly different from each other at 5% level using the Duncan's Multiple Range Test (DMRT)

From among the organic herbicides used, *Mimosa pudica* was found to be the most effective after 21 days from the application (2.39 cm) and was comparable to *Chromolaena odorata* 14 days after application (7.49 cm). As mentioned by S. Rizvi & V. Rizvi (2012), *Mimosa pudica* contains several allelochemicals like mimosine, alkaloids, flavonoids, tannin, and methanol that are known to be toxic. Methanol can be an alternative fuel for internal combustion, known as a wood alcohol which was used as an organic solvent because of its toxicity.

The effects of the crude extract of different invasive weed species on the length of leaves of common weeds is shown in Table 4. Results revealed that *Mimosa pudica* crude extract was most effective against *Cenchrus spinifex* that resulted in shorter leaves at 18.86 cm and 18.70 cm after 14 and 21 days from application, respectively. The result further revealed a reduction in the leaf length by 0.16 cm that signifies not just limitation in growth but as well as the death of leaf tissues. Furthermore, *Mimosa pudica* was also found to be the most effective among all organic herbicides tested against *Conyza canadensis* resulting 0.63 cm average leaf length after 21 days from application. This is 5.20 cm reduction from its length 14 days from the application (5.83 cm). On the other hand, both *Mimosa pudica* and *Chromolaena odorata* caused a significant reduction in the leaf length of *Cyperus rotundus*. However, only *Chromolaena odorata* caused tissue death as exemplified by reduced leaf length from 11.73 cm to 11.33 cm after 14 and 21 days, respectively. As reported by Cheman (2010), the application of *Chromolaena odorata* contains phytochemical components like monoterpene and sesquiterpene that are evaluated as feeding deterrents to insects.

Table 4. Average length (cm) of leaves 14 days and 21days after the application of the different weed extracts

Treatments	**Weed species**					
	C. spinifex		***C. canadensis***		***C. rotundus***	
	14 Days	**21 Days**	**14 Days**	**21 Days**	**14 Days**	**21 Days**
T_0 - Commercial Herbicide	0.00[c]	0.00[c]	0.00[d]	0.00[d]	0.00[d]	0.00[c]
T_1 - Tap water	21.73[a]	28.46[a]	4.06[b]	4.63[a]	14.50[a]	15.00[a]
T_2 - Mimosa pudicaExtract	18.86[b]	18.70[b]	5.83[a]	0.63[c]	9.43[c]	12.06[b]
T_3 - Lantana camara Extract	20.56[ab]	17.46[b]	3.00[c]	3.36[b]	12.63[ab]	12.83[b]
T_4 - Chromolaenaodorata Extract	19.70[b]	27.53[a]	3.76[b]	4.33[a]	11.73[bc]	11.33[b]
Mean	16.17	18.43	3.33	2.59	9.66	10.24
C.V.	6.49	4.23	12.00	10.53	13.86	9.19

Means within the same column followed by a common letter are not significantly different from each other at 5% level using Duncan Multiple Range Test (DMRT)

On the average length of roots (Table 5), *Cenchrus spinifex* and *Conyza canadensis* roots were greatly reduced when applied with *Mimosa pudica* at 6.26cm and 0.13cm, respectively. Furthermore, the effectively of *Mimosa pudica* is comparable to that of the commercial herbicide when applied on *Conyza canadensis*. On the other hand, root growth of *Cyperus rotundus* was greatly limited when applied with *Chromolaena odorata* crude extract. *Chromolaena odorata* is also involved in allelophatic interactions inhibiting the growth of many plant species.

Table 5. Average length (cm) of rootsas affected by the application of the different weed extracts as organic herbicide gathered during the termination of the study

Treatments	Weed species		
	C. spinifex	C. canadensis	C. rotundus
T0 - Commercial Herbicide	0.00[c]	0.00[c]	0.00[c]
T1 - Tap water	7.65[a]	3.87[a]	3.45[a]
T2 - Mimosa pudica Extract	6.26[b]	0.13[c]	3.05[a]
T3 - Lantana camara Extract	8.01[a]	2.36[b]	3.58[a]
T4 - Chromolaena odorata Extract	7.85[a]	3.11[ab]	2.02[b]
Mean	5.95	1.89	2.42
C.V. (%)	12.45	26.45	13.51

Means within the same column followed by a common letter are not significantly different from each other at5% level of significance using Duncan Multiple Range Test (DMRT).

As shown in Table 6, both *Mimosa pudica* extract, and *Lantana camara* resulted to lighter above ground fresh weight of both *Cenchrus spinifex* and *Conyza canadesis.* On the other hand, *Cyperus rotundus* above ground fresh weight was significantly reduced with the application of *Chromolaena odorata* crude extract at 0.10 g. *Lantana camara* is reported to have allelopathic effect against agronomic crops, and it is one of the most toxic weeds in the world. Furthermore, it is reported to compete with some agricultural and forest crops through allelopathy by inhibiting germination and initial growth (Hossain & Alam, 2010).

Table 6. Average above ground fresh weight (g) as affected by the application of the different weed extracts as organic herbicides gathered during the termination of the study

Treatments	**Weed species**		
	C. spinifex	***C. canadensis***	***C. rotundus***
T_0 - Commercial Herbicide	0.00^{d}	0.00^{d}	0.00^{c}
T_1 - Tap water	1.11^{a}	0.74^{a}	0.18^{a}
T_2 - *Mimosa pudica Extract*	0.51^{c}	0.34^{bc}	0.15^{ab}
T_3 - *Lantana camara* Extract	0.52^{c}	0.28^{c}	0.13^{ab}
T_4 - *Chromolaena odorata* Extract	0.78^{b}	0.45^{b}	0.10^{b}
Mean	0.58	0.36	0.11
C.V. (%)	16.40	18.30	27.85

Means within the same column followed by a common letter are not significantly different from each other at5% level of significance using Duncan Multiple Range Test (DMRT).

Table 7 presents the effects of different treatments on the below ground fresh weight of selected weed species. No significant difference among all organic herbicides was noted on *Cenchrus spinifex.* For both *ConyzaCanadensis* and *Cyperus rotundus* , lightest below ground fresh weights were achieved with the application of *Mimosa pudica* at 0.10g and 0.08g, respectively.This might be because of the allelochemical contents of*Mimosa pudica* like tannin thatcan inhibit cell protein synthesis (Ranjan, Kumar, Seethalakstuni&Rao, 2013), methanol that is very toxic and can even cause death when ingested by livestock animals. Other toxic substances in *Mimosa pudica* are alkaloids, ketones, aflatoxins, phenolic acid and glucosides (S. Rizvi & V. Rizvi, 2012).

Table 7. Average below ground fresh weight (g) as affected by the different weed extracts as organic herbicides gathered during the termination of the study

Treatments	Weed species		
	C. spinifex	*C. canadensis*	*C. rotundus*
T0 - Commercial Herbicide	0.00[b]	0.00[d]	0.00[d]
T1 - Tap water	0.35[a]	0.17[a]	0.12[a]
T2 - *Mimosa pudica Extract*	0.33[a]	0.10[c]	0.08[c]
T3 - *Lantana camara* Extract	0.33[a]	0.14[ab]	0.11[ab]
T4 - *Chromolaena odorata* Extract	0.34[a]	0.13[b]	0.09[bc]
Mean	0.27	0.11	8.00
C.V. (%)	17.33	14.46	19.36

Means within the same column followed by a common letter are not significantly different from each other at 5% level of significance using Duncan Multiple Range Test (DMRT).

Development

The effects of different treatments on the number of leaves of selected weed species are shown in Table 8. *Mimosa pudica* crude extract significantly reduced the number of leaves of *Cenchrus spinifex* after 14 days (2.07) and 21 days (3.61), *Conyza canadensis* after 14 days (3.33) and 21 days (1.66) and *Cyperus rotundus* after 14 days (2.79). Its effectiveness, however, is not comparable to using commercial herbicide. Nonetheless, it was found to effectively affect the development of all selected weed species. This could be due to its toxicity. Allelochemicals of *Mimosa pudica* are concentrated in the different parts of the plant's body. Its seed contains alkaloids, mimosine, a non-protein alpha-amino acid, mucilage, and flavonoids; while in its leaves is the adrenaline-like substances; in its roots are the flavonoids, phytosterol, alkaloids, tanninsand glycoside. The whole body of *Mimosa pudica* contains tubulin, turgorine, and methanol (S. Rizvi & V. Rizvi, 2012).

Table 8. Average number of leaves of the weeds samples 14 days and 21 days after the first application of the different weed extracts

Treatments	Weed species					
	C. spinifex		*C. canadensis*		*C. rotundus*	
	14 Days	21 Days	14 Days	21 Days	14 Days	21 Days
T0 - Commercial Herbicide	0.00[c]	0.00[d]	0.00[c]	0.00[d]	0.00[c]	0.00[b]
T1 - Tap water	3.03[a]	4.33[b]	5.54[a]	7.96[a]	9.54[a]	3.82[a]
T2 - *Mimosa pudica Extract*	2.07[b]	3.61[c]	3.33[b]	1.66[c]	2.79[b]	3.50[a]
T3 - *Lantana camara* Extract	1.61[b]	3.83[bc]	4.05[b]	5.33[b]	2.75[b]	3.56[a]

T4 - *Chromolaena odorata* Extract	2.72[a]	6.60[a]	5.95[a]	8.31[a]	3.34[b]	3.52[a]
Mean	1.88	3.67	3.77	4.65	3.68	2.88
C.V. (%)	18.22	9.58	11.42	16.40	8.63	11.03

Means within the same column followed by a common letter are not significantly different from each other at 5% level of significance using Duncan Multiple Range Test (DMRT).

Effects of the different crude extracts on the number of roots of the different weed samples were shown in Table 9. The results showed that among the plant crude extracts applied to *Cenchrus spinifex*, *Mimosa pudica* reduces the average number of leaves to (5.17).The same result was also observed for *Conyza canadensis* (0.67) and for *Cyperus rotundus* , the average number of roots was reduced greatly by the application of *Chromolaena odorata*(4.77), *Lantana camara*(5.22) and *Mimosa pudica* (5.50). Their effectiveness, however, is not comparable to the effects of chemical herbicides in which all the treated plant samples died.

Table 9. Average number of roots ofthe weed samples gathered during the termination of the study

Treatments	**Weed species**		
	C. spinifex	***C. canadensis***	***C. rotundus***
T_0 - Commercial Herbicide	0.00[d]	0.00[d]	0.00[c]
T_1 - Tap water	5.72[bc]	20.20[a]	6.69[a]
T_2 - *Mimosa pudica Extract*	5.17[c]	0.67[d]	5.50[b]
T_3 - *Lantana camara* Extract	6.83[a]	4.22[c]	5.22[b]
T_4 - *Chromolaena odorata* Extract	6.38[ab]	8.67[b]	4.77[b]
Mean	4.82	6.75	4.44
C.V. (%)	11.43	15.80	12.03

Means within the same column followed by a common letter are not significantly different from each other at 5% level of significance using Duncan Multiple Range Test (DMRT).

However, the study needs chemical analyses of the active components responsible for the herbicidal effects of the different invasive weed species.

CONCLUSION

The application of the crude extracts of *Mimosa pudica*is considered as the best alternative for management of the selected weed species. Along with *Lantana camara* and *Chromolaena odorata,* they were found to be efficient and effective in controlling *Impatiens wallerana, Cenchrus spinifex, Conyza canadensis,* and

Cyperus rotundus weeds.This reflects greatly the potential of the three invasive weed species asan alternative to the use of synthetic herbicides, especially with *Mimosa pucida*crude extract.

TRANSLATIONAL RESEARCH

The outcome of this study entitled "Weed Management Potentials of Identified Invasive Weed Species" may be translated into use in the community by sending the information to the Philippine Association for Institutional Research Incorporated. Further analyses on the use of weeds to control other weeds using allelopathy and the full method of its process will help identify areas in the procedure that can be improve.

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