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Mortality and Impact of Potassium Carboxylates on *Parthenium hysterophorus*

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ABSTRACT

The present study was carried out to evaluate the efficiency of soap based herbicide containing potassium laurate, potassium myristate, ammonium laurate and ammonium myristate on weed plants as there is urgency in the search for eco-friendly alternative approaches for the removal of weed. An attempt has been made to develop an eco-friendly economical product for integrated herb management strategy. Weeds were directly treated by potassium laurate, potassium myristate, ammonium laurate and ammonium myristate. Application of ANOVA technique used to check the efficacy of mortality of herbicidal soap solution containing potassium laurate, potassium myristate, ammonium laurate and ammonium myristate. Parthenium weed normally germinates in spring and early summer, produces flowers and seed throughout its short life and dies in late autumn. However, with the right conditions (rain, available moisture, mild soil and air temperatures, Parthenium weed can grow and produce flowers at any time of the year. Parthenium weed can produce large quantities of seed, up to 100,000 per plant. More than 340 million Parthenium weed seeds per hectare can be present in the surface soil, compared to 120.000 native grass seeds. There are many herbicides available for the control of weeds, but all of them have negative impact on the crops as well as in environment.

Highlights

- An Eco-friendly technique for unwanted weed control was investigated.
- Herbicides were found effective at low dose.
- ANOVA technique is effectively used to compare the efficacy of four of these herbicides.
- Potassium carboxylates act as a contact herbicide.
- Ammonium carboxylate decomposes within a short period after application. This is desirable as it allows crops affected by the herbicide to grow on the land in future seasons.

Keywords: *Parthenium hysterophorous*, Potassium laurate, Potassium myristate, Ammonium laurate, Ammonium myristate, Mortality.

INTRODUCTION

Weeds are a problem in Indian agriculture, as elsewhere in the world. Weeds compete with crops for moisture and nutrients. Loss of yield due to weed infestation is variable and is more pronounced in crops grown under rain fed conditions. Some parasitic weeds draw water and nutrients from crop plants and can inflict severe damage [1]. Chemical analysis of *P.* hysterophorus has indicated that all its parts including trichomes and pollen contain toxins called sesquiterpene lactones (SQL). Maishi *et al.,* reported that *P. hysterophorus* contains a bitter glycoside parthenin, a major sesquiterpene lactone. Other phytotoxic compounds or allele chemicals are hysterin, ambrosin, flavonoids such as quercelagetin 3,7-dimethylether, 6-hydroxyl kaempferol 3-0 arabinoglucoside, fumaric acid. P-hydroxy benzoin and vanillic acid, caffeic acid, p courmaric, anisic acid, p-anisic acid, chlorogenic acid, ferulic acid, sitosterol and some unidentified alcohols. Parthenin, hymenin and ambrosin are found to be the culprits behind the menacing role of this weed in provoking health hazards [3]. Parthenium hysterophorus from different geographical regions exhibited parthenin, hymenin, coronopilin, dihydroisoparthenin, hysterin, hysterophorin and tetraneurin A as the principal constituents of their sesquiterpene lactones [4]. Gupta et.al., identified a novel hydroxyproline-rich glycoprotein as the major allergen in *P. hysterophorus* pollen. Das *et.al.,* examined the flowers of *P. hysterophorus* and isolated four acetylated pseudoguaianolides along with several known constituents. A novel sesquiterpenoid, charminarone, the first seco-pseudoguaianolide, has been isolated along with several known compounds from the whole plant by [7]. Chhabra *et.al.,* discovered three ambrosanolides from the chloroform extract of this weed. Parthenium hysterophorus invasion causes changes in above-ground vegetation and below-ground soil nutrient contents, disturbing the entire grassland ecosystem in Nepal as reported by Timsina *et.al*. *Parthenium hysterophorus* is a serious invasive weed of pasture systems, reducing pasture productivity 90% [10]. It has become a major weed of grazing lands in central Queensland and New South Wales in Australia. It squeezes grasslands and pastures, reducing the fodder supply. Dhileepan observed dwindling effect of *P. hysterophorus* on grass biomass of grazing fields in Queensland, Australia. The invasive capacity and alleolopathic properties have rendered *P. hysterophorus* with the potential to disrupt the natural ecosystems. It has been reported to be causing a total habitat change in native Australian grasslands, open woodlands, river banks and flood plains [12]. These weeds rapidly invade new surroundings often replace the indigenous species and pose a serious threat to biodiversity in India.

Akter *et.al.*, conducted an extensive survey on invasive alien species (IAS) and their impact on different land use types viz. road side, low land, fallow land, homestead and railway track in Bangladesh. Among others, *P. hysterophorus* exhibited the ability to invade and adapt to new habitats, thereby reducing the number of indigenous plants. The more vigorous mode of reproduction and the possession of an array of secondary metabolites give the weed the status of invasive alien species. *Parthenium hysterophorus* has multiple harmful aspects and no particular use. Its eradication is a major challenge to government, primarily because of its epidemic proliferation and strong reproductive potential, apart from its wide ecological range. Several physical and chemical methods used in the past to eliminate this weed have proved ineffective, expensive and not eco-friendly. The biomass of this plant is not put to any use and disposed along the roadsides, agricultural fields and railway tracks after uprooting. Further, these weeds are burnt in order to prevent various ailments induced by its toxic sesquiterpene lactone. However, burning of *P. hysterophorus* residues is not a recommended practice as it deteriorates the soil quality by rendering it more alkaline and deficient in organic matter [14]. Tamado *et.al*., conducted experiments to compare the effect of hand hoeing and applying herbicide (2,4-D) on growth of this weed and its effect on yield of sorghum in small holder farming systems in Ethiopia. Hoeing proved to be more efficient than the use of chemical herbicide. Ganesh *et.al.,* produced methane-rich gas from solid-feed anaerobic digestion of *I. carnea.* Patel *et.al.,* reported that a novel chitinase enzyme with potential use in agriculture, industry, environmental protection and chito-oligosaccharide production can be purified from the latex of *I. carnea*. Similarly, *L. camara* which was once brought to India as an ornamental plant encroaches on agricultural land and reduces the carrying capacity of pastures. Two novel triterpenoids have been isolated from the roots of *L. camara* L. Its leaves have yielded an essential oil which is rich in sesquiterpenes, and a hepatoprotective compound oleanolic acid is isolated from the roots [18]. Methanolic extract of *L. camara* leaves exhibit antiulcerogenic activity on gastric and duodenal ulcers in experimental rats [15]. It contains high amount of holocellulose and can serve as a low-cost feedstock for bioethanol production [20]. The decoction of *P. hysterophorus* has been used in traditional medicine to treat fever, diarrhoea, neurologic disorders, urinary tract infections, dysentery, malaria and as emmenagogue [21]. Ethnobotanically, it is used by some tribes as remedy for inflammation, eczema, skin rashes, herpes, rheumatic pain, cold, heart trouble and gynaecological ailments. Parthenium hysterophorus has been found to be pharmacologically active as analgesic in muscular rheumatism, therapeutic for neuralgia and as vermifuge [22]. This weed is also reported as promising remedy against hepatic amoebiasis. Parthenin, the major constituent of the plant, exhibits significant medicinal attributes including anticancer property [7]. The methanol extract of the flowers showed significant antitumour activity and parthenin exhibited cytotoxic properties against T cell leukaemia, HL-60 and Hela cancer cell lines [6]. Previously, Ramos *et.al.,* had established the antitumour potential of *P. hysterophorus* extracts in vitro and in vivo with positive results in terms of tumour size reduction and overall survival of cell lines. Aqueous extract of *P. hysterophorus* has hypoglycaemic activity against alloxan-induced diabetic rats [17]. So, flower extract of this weed can be used for developing drug for diabetes mellitus. Parashar *et.al*., reported the synthesis of silver nanoparticles by reducing silver ions present in the aqueous solution of silver nitrate complex using the extract of *P. hysterophorus*. Kishor *et.al*., prepared compost of *P. hysterophorus* in 14 weeks and assessed its manure value. Compost from this weed on application in soil enhanced its moisture level more than nitrogen, phosphorus and potassium (NPK) alone.

Anaerobic digestion of *Parthenium* dried solids biodegrades the plant growth and conserves the NPK content. This can be applied as organic manure [26]. Javaid used *P. hysterophorus* weed as green manure for maize and mung bean production. There was 43–253% increase in grain yield over control due to various green manure treatments as compared with 96% increase due to NPK fertilizers over control [27, 28]. Milli-compost (MC) was more effective than ordinary parthenium compost (OPC) [29]. So, if tapped properly, this weed can contribute to agronomic processes. Further, weed serve as alternate hosts to pathogens and also harbor pests. Control of weeds during early stages of crop growth, when the young seedlings of crop plants unable to compete with hardy weeds, is crucial for capturing yield potential. For this reason, labour demanding for weeding operation is high during early phase of crop cycle. Manual weed control over large areas is not feasible from the point of labour supply and monetary cost [30]. Some weeds that are wild relatives of crop plants are difficult to distinguish from crop plants at early stages and pose challenge for manual weeding. Under these situations, chemical weed control is relevant for realizing higher productivity and production**.** Certain herbicides affect metabolic pathways and systems unique to plants and not found in animals making many modern herbicides among the safest crop protection products having essentially no effect on mammals, birds, amphibians or reptiles [31, 32]. Mixture of soap solutions (potassium palmitate and potassium stearate) based insecticide containing pyrethroids (synthetic pyrethrum) is an eco-friendly, safe insecticide [33, 34].

MATERIALS AND METHODS

Preparation of soaps: All the Chemicals used were of AR grade. Potassium carboxylates (laurate and myristate) were prepared by direct metathesis of the corresponding lauric acid and potassium hydroxide with slight excess of methanol at 50-55°C under vigorous stirring. The precipitated carboxylates were washed several times with distilled water and then with alcohol. The potassium soaps thus obtained were first dried in an air oven at 50-55°C and the final drying of the soap was carried out under reduced pressure. The purity of the carboxylate was confirmed by elemental analysis and by determination of their melting points.

$$KOH + C_{11}H_{23}COOH \rightarrow \underset{\text{(Soap)}}{C_{11}H_{23}COOK} + H_2O \qquad \text{(i)}$$

$$KOH + C_{11}H_{27}COOH \rightarrow \underset{\text{(Soap)}}{C_{11}H_{27}COOK} + H_2O \qquad \text{(ii)}$$

A digital conductivity meter (model Biocraft direct reading conductometer) and a dipping type conductivity cell with platanized electrode were used for measuring the conductance of the solution at

32ºC.

Ammonium soaps (laurate and myristate) were prepared by refluxing equivalent amounts of corresponding fatty acids and aqueous solution of ammonium chloride for 6-8 h on a water bath. The soaps were purified by recrystallization with methanol and dried under reduced pressure. The ammonium soaps thus obtained were first dried in an air oven at 50-55ºC and the final drying of the soap was carried out under reduced pressure. The purity of the carboxylate was confirmed by elemental analysis and by determination of their melting points. The melting point of the purified ammonium soaps were 118ºC and 112ºC for ammonium laurate and ammonium myristate respectively.

$$NH_4Cl + C_{11}H_{23}COOH \rightarrow \underset{\text{(Soap)}}{C_{11}H_{23}COONH_4} + 2HCl \quad \text{(iii)}$$

$$NH_4Cl + C_{11}H_{273}COOH \rightarrow \underset{\text{(Soap)}}{C_{11}H_{27}COONH_4} + 2HCl \quad \text{(iv)}$$

Field experiment: The four soap based herbicides of different concentration were prepared and sprayed on weed. Parthenium plants were grown in chamber of 24x30 cm diameter each containing 5 kg of sandy loam soil having organic matter 0.9%, pH 8.2, nitrogen 0.05%, available phosphorous 14 mg kg^{-1} and available potassium 210 mg kg^{-1} were arranged in a completely randomized manner under natural conditions. There were fifteen plants of *Parthenium* in each section of chamber.

Suspensions of four chemical herbicides namely potassium laurate, potassium myristate, ammonium laurate and ammonium myristate were prepared in water. Different doses of test herbicides were sprayed with a hand atomizer on 2 and 4 weeks grown *Parthenium* plants, corresponding to vegetative stages, respectively. The control treatment was sprayed with tap water. Effect of herbicides was monitored till all the plants in herbicidal treatments become dead. Dead regarding the herbicidal efficacy of various employed chemicals were collected in terms of number of days taken by each herbicide to completely kill the target weed. Weeds were further monitored for one month after death to examine regeneration of *Parthenium* in test herbicidal treatments.

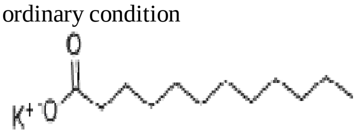
Statistical analysis (ANOVA Technique): ANOVA to compare mortality on weed due to different soap solution (potassium laurate, potassium myristate, ammonium laurate and ammonium myristate)concluded that there is no significant difference between the mortality on weed due to different test solution (potassium laurate, potassium myistate, ammonium laurate and ammonium myristate) as P>0.05. All these carboxylates are equally effective herbicides to destroy weeds.

Specification of potassium and ammonium soaps

Lauric acid: Lauric acid is the saturated fatty acid, with the molecular formula $CH_3(CH_2)_{10}COOH$ with a 12 carbon atom chain, thus falling into the medium chain fatty acids, is a white, powdery solid with a faint odor of bay oil or soap (Table 1).

Table 1. Specification of lauric acid

Appearance	White powder	pH	10-11
Molecular formula	$C_{12}H_{24}0_2$	Colour	White
Molar mass	200.31776	Moisture	<6%
Molecular weight	238	Feel	Soapy
Melting point	43.2°C	Odor	Slight odor of bay oils
Boiling point	298.9°C	Solubility	Sparingly soluble in water
Stability	Stable under ordinary condition		



Myristic acid: Myristic acid is a common saturated fatty acid with the molecular formula $CH_3(CH_2)_{12}COOH$. (Table 2)

Appearance	White crystalline solid	pH	10-11
Molecular formula	$C_{14}H_{28}0_2$	Colour	White
Molar mass	228..37092	Moisture	<6%
Molecular weight	266	Feel	Soapy
Melting point	54.4°C	Odor	Slight odor
Boiling point	250.5°C	Solubility	Do not dissolve in water, Soluble in alcohol and ether
Stability	Stable under ordinary condition		

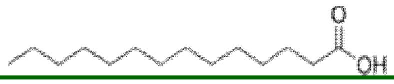


Table 2. Specification of myristic acid

RESULTS AND DISCUSSION

Weeds were directly treated by soaps (potassium laurate, potassium myristate, ammonium laurate and ammonium myristate). Herbicides can be defined as crop protecting chemicals used to kill weedy plants or interrupt normal plant growth. Herbicides provide a convenient, economical, and effective way to help manage weeds. They allow fields to be planted with less tillage, allow earlier planting dates, and provide additional time to perform the other tasks that farmer personal life require. Due to reduced tillage, soil erosion has been reduced from about 3.5 billion tons in 1938 to one billion tons in 1997, thus reducing soil from entering waterways and decreasing the quality of the nation's surface water. Without herbicide use, no-till agriculture becomes impossible. However, herbicide use also carries risks that include environmental, ecological, and human health effects. It is important to understand both the benefits and disadvantages associated with chemical weed control before selecting the appropriate control. Herbicides may not be a necessity on some farms or landscape settings, but without the use of chemical weed control, mechanical and cultural control methods become that much more important. There are many kinds of herbicides from which to choose. Many factors determine when, where, and how a particular herbicide can be used most effectively [35].

These four soap based herbicides of different concentration were prepared and sprayed on the weeds. It can be used as a good herbicide because it does not have negative impact on the crops. Parthenium seeds were sown in a chamber which is divided into four sections and first plant on every section was kept as control and first, second, third, fourth, section were sprayed with potassium laurate, potassium myristate, ammonium laurate and ammonium myristate respectively of various pH and concentrations. These four soap based herbicides of different concentration were prepared and sprayed on weed. Parthenium plants were grown in chamber of 24x30 cm diameter each containing 5 kg of sandy loam soil having organic matter 0.9%, (pH 8.2), nitrogen 0.05%, available phosphorous 14 mg kg^{-1} and available potassium 210 mg kg^{-1} were arranged in a completely randomized manner under natural conditions. There were fifteen plants of *Parthenium* in each section of chamber. Suspensions four chemical herbicides namely potassium laurate, potassium myristate, ammonium laurate and ammonium myristate were prepared in water. Different doses of test herbicides were sprayed with a hand atomizer on 2 and 4 weeks grown *Parthenium* plants, corresponding to vegetative stages, respectively. The control treatment was sprayed with tap water. Effect of herbicides was monitored till all the plants in herbicidal treatments become dead. Dead regarding the herbicidal efficacy of various employed chemicals were collected in terms of number of days taken by each herbicide to completely kill the target weed. Weeds were further monitored for one month after death to examine regeneration of *Parthenium* in test herbicidal treatments.

The plants of first section were treated with soap solution of potassium laurate, second section with the soap solution of potassium myristate, third, and fourth section with the soap solution of ammonium laurate and ammonium myristate respectively. First plant on every section was kept as control. Fourteen spray solutions of potassium laurate in water of different concentration having pH 4.2-8.8, have been prepared and sprayed on weeds (Table 3). The first section of the chamber was control and was healthy. The second, third, fourth, fifth and sixth plants which were treated with potassium laurate solution having pH 4.6-5.8.Sprays were applied bi-weekly in the beginning and weekly (after four weeks of application). After bi-weekly application the leaves were not found healthy but weeds needed frequent application of spray. The soap based solution of potassium laurate having pH 5.8 was found to be effective as it needs frequent application. The mortality of this formulation was high (58.2%). Roots of treated plants lose their ability to take up soil nutrients, and stem tissues fail to move food effectively through the plant. The killing action of growth-regulating chemicals is not caused by any single factor but results from the effects of multiple disturbances in the treated plant.

Table 3. Mortality and impact of potassium laurate on weed plant

S. No	Weed plant	Concentration of potassium laurate %	pH value of potassium laurate spray	Effect on plant	% mortality
1	plant1	--	--	--	--
2	plant2	0.002	4.6	Effective	50.6
3	plant3	0.003	5.0	Effective	52.2
4	plant4	0.004	5.4	Effective	54.1
5	plant5	0.005	5.6	Effective	56.2
6	plant6	0.006	5.8	Effective	58.2
7	plant7	0.007	6.0	Need frequent application	30.4
8	plant8	0.008	6.4	Need frequent application	32.1
9	plant9	0.009	6.8	Need frequent application	34.2
10	plant10	0.010	7.0	Need frequent application	36.0
11	plant11	0.011	7.6	Need frequent application	38.5
12	plant12	0.012	7.8	Need frequent application	40.2
13	plant13	0.013	8.4	Need frequent application	42.4
14	plant14	0.014	8.6	Need frequent application	44.3
15	plant15	0.015	8.8	Need frequent application	46.6

Seventh, eighth, ninth, tenth, eleventh, twelfth, thirteenth, fourteenth, and fifteenth plants were subjected with the solution having pH 6.0 - 8.8. After the bi-weekly and weekly application of potassium laurate soap solution, the formulation of pH 6.0-8.8 was found to be less effective against the weed. The mortality of this solution was also low (30.4-46.6%). (Table 3, Figure 1). The solution of potassium laurate having pH 5.8 was found to be more effective for the control of weed. The

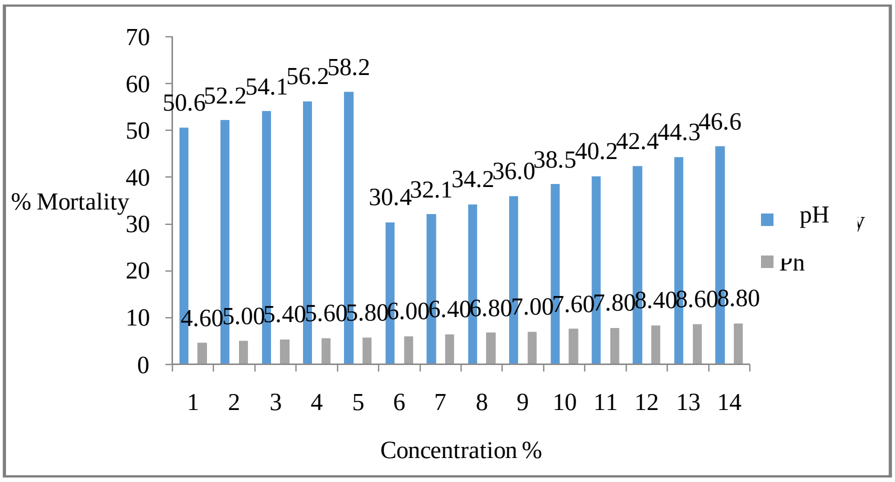


Figure 1. Concentration Vs Mortality of potassium laurate (CMC 5.5x 10^{-3} gm/dm^3).

mortality of this solution was the highest among various solutions of potassium laurate. All contact herbicides cause cellular breakdown by destroying cell membranes, allowing cell sap to leak out. Effected plants initially have a “water soaked” appearance, followed by rapid wilting and burning or leaf speckling and browning. Plant death occurs within a few days [36]. As potassium laurate is a surfactant it penetrate the waxy cuticle of the leaf or to penetrate through the small hairs present on the leaf surface. Since water has a high surface tension it tends to maintain its round, droplet shape when sitting on the surface of leaf. The surfactant acts to break down this surface tension of the droplet allowing the liquid to spread over the leaf surface.

The second, third and fourth plant of second section were treated with the herbicidal solution containing potassium myristate having pH 4.6-5.4 (Table 4). Sprays were applied bi-weekly in the beginning and weekly (after four weeks of application). After bi-weekly application the leaves were found to be unhealthy but plant needed frequent application of spray. The leaves turned dark green, become wrinkled, and fail to unfold from the bud. The roots become shortened, thickened, brittle, and club like due to their high mortality (50.2-54.1%). Fifth and sixth plants were treated with soap solution having pH value 5.6-5.8 resulting in leaf looping and an onion-like appearance. The tip of the terminal leaf become rigid, not free flapping (flag like). Even after the fourth week of application there were not much improvement on the structure of the plant, mortality was high (56.5-58.9%), and had good efficacy against weed (Table 2, Figure 2).

Table 4. Mortality and impact of potassium myristate on weed plant

S.No	Weed plant	Concentration of Potassium myristate %	pH value of potassium myristate spray	Effect on plant	% Mortality
1	plant1	--	--	--	-
2	plant2	0.002	4.6	Effective	50.2
3	plant3	0.003	5.0	Effective	52.4
4	plant4	0.004	5.4	Effective	54.1
5	plant5	0.005	5.6	Effective	56.5
6	plant6	0.006	5.8	Effective	58.9
7	plant7	0.007	6.0	Less Effective	42.0
8	plant8	0.008	6.4	Less Effective	44.3
9	plant9	0.009	6.8	Less Effective	46.2
10	plant10	0.010	7.0	Need frequent application	22.0
11	plant11	0.011	7.6	Need frequent application	24.2
12	plant12	0.012	7.8	Need frequent application	30.0
13	plant13	0.013	8.4	Need frequent application	34.8
14	plant14	0.014	8.6	Need frequent application	36.2
15	plant15	0.015	8.8	Need frequent application	38.1

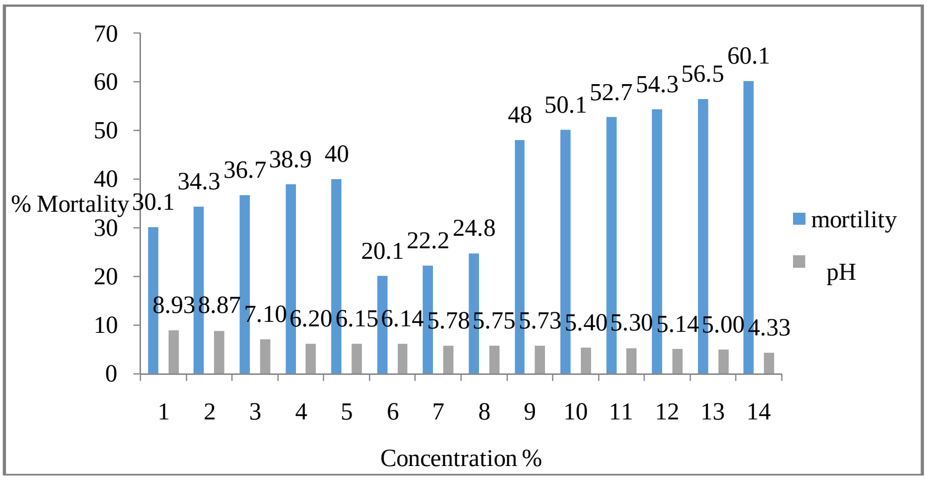


Figure 3. Concentration Vs Mortality of ammonium laurate (CMC 5.0X 10^{-3}gm/dm^3).

Seventh, eighth plants which were treated with the herbicidal solution having pH 6.0-6.8 of potassium myristate showed less impact even after the fourth week bi-weekly application as their mortality was not very high.

Ninth, tenth, eleventh, twelfth, thirteen, fourteenth and fifteenth plants were treated with the solution having pH 6.8-8.8 of potassium myristate. After the application of bi-weekly in beginning and weekly (after four weeks of application), the mortality (46.2-38.1%) of these solutions were also lower than the other solutions of potassium myristate , the leaf were healthy and plants were growing normally. So these solution having pH 7.6-8.8 of potassium myristate were found less toxic and also no impact (Table 4, Figure 2). In our experiment we conclude that, the liquid spray herbicide contains potassium myristate having pH 5.8 is found to be most effective (Figure 2) than other solutions of potassium myristate as their mortality was high as 58.9%. They cause “leaf burning” and eventually death of the plant. The third and fourth plant of third section was subjected to the herbicide solution of ammonium laurate having pH 8.93-7.10 (Table 5, Figure 3). Even after the fourth week of bi-weekly application the weed growth remained the same as the mortality of these solutions were very low, the plant needed frequent application for the control of weed.

In the, third and fourth plant of third section was subjected to the herbicide solution of ammonium laurate having pH 8.93-7.10 (Table 5). Even after the fourth week of bi-weekly application the weed growth remained the same as the mortality of these solutions were very low, the plant needed frequent application for the control of weed.

Table 5. Mortality and impact of ammonium laurate on weed plant

S.No	Weed plant	Concentration of ammonium laurate %	pH value of ammonium laurate spray	Effect on plant	% mortality
1	plant1	--	--	--	--
2	plant2	0.002	8.93	Need frequent application	30.1
3	plant3	0.003	8.87	Need frequent application	34.3
4	plant4	0.004	7.10	Need frequent application	36.7
5	plant5	0.005	6.20	Need frequent application	38.9
6	plant6	0.006	6.15	Need frequent application	40.0
7	plant7	0.007	6.14	Less Effective	20.1
8	plant8	0.008	5.78	Less Effective	22.2
9	plant9	0.009	5.75	Less Effective	24.8
10	plant10	0.010	5.73	Effective	48.0
11	plant11	0.011	5.40	Effective	50.1
12	plant12	0.012	5.30	Effective	52.7
13	plant13	0.013	5.14	Effective	54.3
14	plant14	0.014	5.00	Effective	56.5
15	plant15	0.015	4.33	Most effective	60.1

Herbicides prevent cell division primarily in developing root tips and are effective only on germinating, small seeded annual grasses and some broadleaves. Seeds of treated broadleaved plants germinate, but they either fail to emerge or emerge as severely stunted seedlings that have thickened, shortened lower stems, small leaves, and short, club shaped roots. Injured seedlings have short, club-shaped roots and thickened, brittle stem tissue. Seedlings die from lack of moisture and nutrients because of the restricted root system [37]. Phosphorylated amino acid (nitrogen metabolism) Disrupters, this herbicide provides broad-spectrum control of most annual grasses and broadleaves and some perennials. It affects growth by disrupting nitrogen metabolism, thus interfering with other plant processes. It is a contact herbicide with slight translocation throughout the plant. Good spray coverage is important for maximum efficacy. Injury is similar to that of the cell membrane disrupter herbicides. Sensitive plants show “leaf burning,” yellowing and browning, and eventual death after a week or so. Fifth and sixth plants of this section were subjected with the soap solution having pH 6.20 - 6.15. After the weekly and bi-weekly application of solution of ammonium laurate and even after fourth week of application, the weeds grew normally. Solutions of ammonium laurate having pH 6.20

- 6.15 also need frequent application and the mortality (38.9-40.0%) of these solutions was less toxic and hence not enough to control weeds.

Seventh and eighth plants which were treated with the herbicidal solution having pH 6.14-5.78 of ammonium laurate showed no impact even after the fourth week bi-weekly application as their mortality was low. Ninth, tenth, eleventh, twelfth, thirteen, fourteen and fifteenth plants were with the solution having pH 5.75- 4.33 of ammonium laurate (Table 5). The oldest leaves turned yellow on the leaf margin, the veins remained green and eventually, the plant turned brown. Plants become straw colored several days or week after treatment and gradually turn brown and died. After the application of bi-weekly in beginning and weekly (after four weeks of application) the mortality of these solutions was higher than the other solution of ammonium laurate (24.8-60.1%). The leaf was healthy and plants were growing normally. The solution of ammonium laurate (pH 5.3-4.33) was found effective and needed frequent application. (Table 5, Figure 3). In our experiment, we concluded that the liquid spray herbicide, ammonium laurate of pH 4.33 is more effective (Figure 3) than other solutions of ammonium laurate (as their mortality was high as 60.1%). Ammonium carboxylate is advantageous as it decomposes within a short period after application. This is desirable as it allows crops which may be affected by the herbicide to be grown on the land in future seasons.

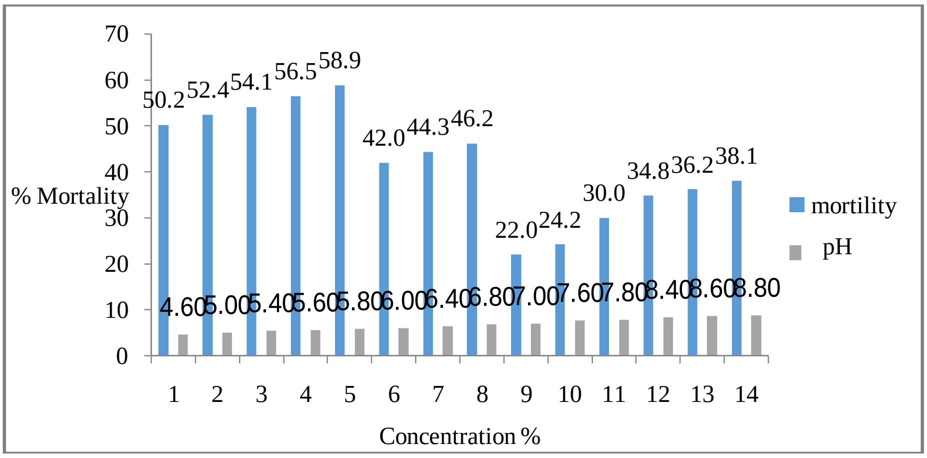


Figure 3. Concentration Vs Mortality of potassium myristate (CMC 4.5x 10^{-3}gm/dm^{3}).

First weed plant in the first section was control, healthy and grew normally. In the second and third plant of fourth section which were subjected to the herbicide solution of ammonium myristate having pH 8.93-8.83. (Table 6, Figure 4) After bi-weekly in the beginning and weekly application,

Table 6. Mortality and impact of ammonium myristate on weed plant

S.No	Weed plant	Concentration of ammonium myristate %	pH value of ammonium myristate spray	Effect on plant	% mortality
1	plant1	--	--	--	--
2	plant2	0.002	8.93	Need frequent application	30.7
3	plant3	0.003	8.87	Need frequent application	32.8
4	plant4	0.004	7.10	Need frequent application	34.9
5	plant5	0.005	6.20	Need frequent application	40.8
6	plant6	0.006	6.15	Need frequent application	42.2
7	plant7	0.007	6.14	Less Effective	20.0
8	plant8	0.008	5.78	Effective	50.9
9	plant9	0.009	5.75	Effective	52.5
10	plant10	0.010	5.73	Effective	54.7
11	plant11	0.011	5.40	Effective	56.3
12	plant12	0.012	5.30	Effective	58.5
13	plant13	0.013	5.14	Effective	60.3
14	plant14	0.014	5.00	Effective	62.7
15	plant15	0.015	4.33	Most effective	65.9

Tenth, eleventh, twelfth, thirteenth, fourteenth and fifteenth plants of this section were subjected to the soap solution of ammonium myristate having pH 5.73-4.33. On applying these solutions on these weeds found to be effective. So, these solutions of ammonium myristate were found to be effective for controlling the weed. In our experiment we conclude that, the liquid spray herbicide contains pH 4.33 is found to be more effective (figure 4) than other solutions of ammonium laurate as their mortality was high 65.9%. However, herbicides like ammonium carboxylate with low residual activity (i.e., that decompose quickly) often do not provide season-long weed control (Table 6, Figure 4).

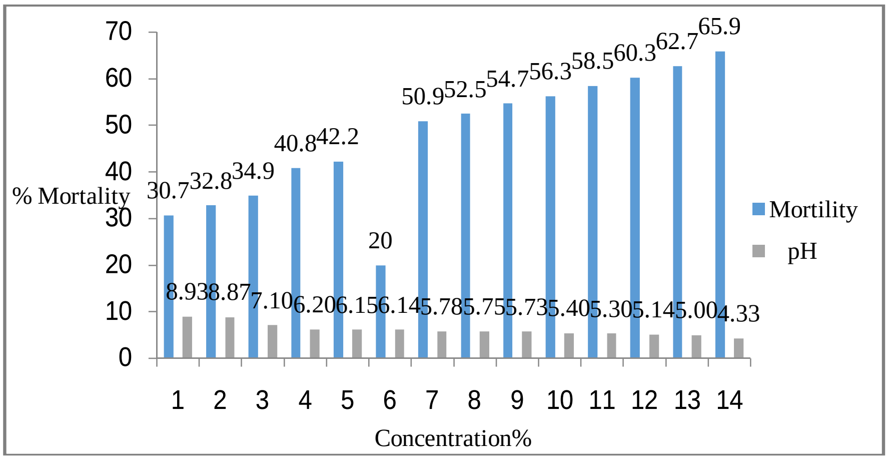


Figure 4. Concentration Vs Mortality of ammonium myristate (CMC 4.5X 10^{-3}gm/dm^{3}).

Potassium laurate is a contact herbicides, it kills the weed part by contact by the chemical by destroying cell membranes. They appear to burn plant tissues within days of application. Good coverage of the plant tissue is necessary for maximum activity of these herbicides [38]. ANOVA technique was applied to check the efficacy of mortality in herbicidal soap solution containing potassium laurate, potassium myristate, ammonium laurate and ammonium myristate. Descriptive statistics for mortality of weed due to different solution (potassium laurate, potassium myristate, ammonium laurate and ammonium myristate) shows that (Table 7) average mortality by potassium laurate, potassium myristate, ammonium laurate and ammonium myristate is 44.0±9215, 42±1177, 40 ±1326 and 47 ± 1388 respectively. Table 8 concludes that there is no significant difference between

Table 7. Descriptive statistics for mortality on weed plant due to different soap solution (potassium laurate, potassium myristate, ammonium laurate and ammonium myristate)

No. of Soap Solutions	No. of Plants	Mean	Std. Deviation
Potassium laurate	14	44.0000	9.21537
Potassium myristate	14	42.1357	11.77309
Ammonium laurate	14	40.6286	13.26942
Ammonium myristate	14	47.3714	13.88516

the mortality on weed due to different test solution (potassium laurate, potassium myristate, ammonium laurate and ammonium myristate) as P>0.05. All these carboxylates are equally effective herbicides to destroy weeds.

Table 8. ANOVA to compare mortality on weed due to different soap solution (potassium laurate, potassium myristate, ammonium laurate and ammonium myristate)

Soap solution	Sum of Squares	df	Mean Square	F	Sig.
Between solutions	354.756	3	118.252	0.798	0.500
Within solutions	7701.249	52	148.101		
Total	8056.006	55			

Where df is degree of freedom, F indicates significant different values produced by weather treatments, Sig. indicates significance

APPLICATION

Potassium Carboxylates can be used as a herbicide to kill Parthenium hysterophorus.

CONCLUSION

Potassium and ammonium carboxylates are post-emergence herbicide. It performs by its increasing herbicide activity by absorption and reducing surface tension therefore helps carboxylate solution to spread evenly and to get absorbed on the weed plant. In the present study, the test herbicides were found effective even at a lower dosage, there are comparatively less environmental risks in their usage. Furthermore, since weed did not regenerate after death of the top that also increases the importance of these herbicides for their selections against *Parthenium*. Thus, in light of the results of the present study, it is recommended that *Parthenium* should be managed using lowest doses of these herbicides especially those which take comparatively less time to kill this alien weed species.

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REFERENCES

[1]. R. K. Malik, S. Singh, Little seed Canarygrass (phalaris minor) resistance to isoproturon in india, *Weed Technol.*, **1995**, 9, 419-425.
[2]. A. I. Maishi, P. K. S. Ali, S. A. Chaghtai, G. A. Khan, Proving of *Parthenium hysterophorus*, L. *Brit Homoeopath J.*, **1998**, 87,17–21.
[3]. H. Lata, V. K. Garg, R. K. Gupta, Sequestration of nickel from aqueous solution onto activated carbon prepared from *Parthenium hysterophorus* L. *J. Haz. Mat.*, **2008**, 157, 503-509.
[4]. J. R. Fuente, L. Novara, S. R. Alarcon, O. J. Diaz, M. L. Uriburu, V. E Sosa, Chemotaxonomy of Parthenium: *P. hysterophorus–P. glomeratum*, *Phytochemistry*, **1997**, 45, 1185–1188.
[5]. N. Gupta, B. M. Martin, D. D. Metcalfe, P. V. Subba Rao, *J. Allergy Clin Immunol*., **1996**, 98, 903–912.
[6]. B. Das, V. S. Reddy, M. Krishnaiah, A. V. S. Sharma, K. Ravi Kumar, J. V. Rao, V. Sridhar, Acetylated pseudoguaianolides from *Parthenium hysterophorus* and their cytotoxic activity, *Phytochemistry*. 2007, 68, 2029–2034.
[7]. B, Venkataiah, C. Ramesh, N. Ravindranath, B. Das, Charminarone, a seco-pseudoguaianolide from Parthenium hysterophorous, *Phytochemistry*, 2003, 63, 383–386.
[8]. B. R. Chhabra, J. C. Kohli, R. S. Dhillon, Three ambrosanolides from *Parthenium hysterophorous*, *Phytochemistry*, 1999, 52, 1331–1334.
[9]. B. Timsina, B. B. Shrestha, M. B. Rokaya, Z. Munzbergova,. Impact of *Parthenium hysterophorus* L. invasion on plant species composition and soil properties of grassland communities in Nepal, *Flora Morphol Distribution Funct Ecol Plants*., **2011**.
[10]. H. Evans, Invasive potential of the weed Parthenium hysterophorus–the role of allelopathy, *Biocontrol News Inf.* 1997, 18, 389-398.
[11]. K. Dhileepan, Biological control of Parthenium (Parthenium Hysterophorus) in Australian rangeland translates to improved grass production, *Weed Sci.*, **2007**, 55, 497–501.
[12]. C. Lakshmi, C. R. Srinivas, Parthenium: A wide angle view, *Ind .J Dermatol Venereol Leprol*., **2007**, 73, 296–306,.
[13]. A. Akter, M. I. Zuberi, Study on P. hysterophorus and its ability to reducing the number of indigenous plants. *Int J. Biodivers Conserv*., **2009**, 15, 129–134.
[14]. R. K. Singh, S. Kumar, S. Kumar, A. Kumar, Development of *parthenium* based activated carbon and its utilization for adsorptive removal of p-cresol from aqueous solution, *J Haz Mat.*, **2008**, 155, 523–535.

[15]. T. Tomado, P. Milberg, Control of Parthenium (Parthenium hysterophorous) in Grain Sorghum (sorghbicolor) in the small holder farming system on Eastern Ethiopia, *Weed Technol.*, **2004**, 18, 100-105.

[16]. P. S. Ganesh, R. Sanjeevi, S. Gajalakshmi, E. V. Ramasamy, S. A. Abbasi, Recovery of methane-rich gas from solid-feed anaerobic digestion of ipomoea (*Ipomoea carnea*), *Bioresour Technol*., **2008**, 99, 812–818.

[17]. V. S. Patel, V. P. Chitra, L. Prasanna, V. Krishnaraj, Hypoglycemic effect of aqueous extract of *Parthenium hysterophorus* L. in normal and alloxan induced diabetic rats, *Ind. J. Pharmacol*., **2008**, 40, 183–185.

[18]. L. Misra, H. Laatsch, Triterpenoids, essential oil and photo-oxidative 28 → 13-lactonization of oleanolic acid from Lantana camara, *Phytochemistry*, **2000**, 54, 969–974.

[19]. R. Sathish, B. Vyawahare, K. Natarajan, Antiulcerogenic activity of Lantana camara leaves on gastric and duodenal ulcers in experimental rats, *J Ethnopharmacol*., **2010**, 134(1):195-197.

[20]. R. C. Kuhad, R. Gupta, Y. P. Khasa, A. Singh, Enhanced production of cellulase-free thermostable compounds, *Bioresour Technol*., **2010**, 101, 8348–8354.

[21]. A. Surib-Fakim, M. D. Swerab, J. Gueho, E. Dullo, Medicinal plants of Rodrigues, *Int J Pharmacogn*., **1996**, 34, 2–14.

[22]. A. I. Maishi, P. K. S. Ali, S. A. Chaghtai, G. Khan, A proving of *Parthenium hysterophorus*, L. *Brit Homoeopath J.,* **1998**, 87, 17–21.

[23]. A. Ramos, R. Rivero, M. C. Victoria, A. Visozo, J. Piloto, A. Garcıa, *J. Ethnopharmacol.*. **2001**, 77, 25–30.

[24]. V. Parashar, R. Parashar, B. Sharma, A. Pandey J. Digest, Nanomater Biostruct., **2009**, 4, 45-50.

[25]. P. Kishor, A. K. Ghosh, S. Singh, B. R. Maury, Potential use of parthenium (*Parthenium hysterophorus* L.) in agriculture, *Asian J Agric Res.*, **2010**, 4, 220-22.

[26]. V. N. Gunaseelan, Parthenium as an additive with cattle manure in biogas production, *Biol Wastes*, **1987**, 21, 195–202.

[27]. A. Javaid, Use of parthenium weeds as green manure for maize and mungbean production, Philipp *Agric Sci*., **2008**, 91(4), 478-482.

[28]. A. Javaid, M. B. M. Shah, Growth and yield response of wheat to EM (effective microorganisms) and parthenium green manure, *Afr. J. Biotechnol*., **2010**, 9, 3373–3381.

[29]. P. Apurva, S. K. Sinha, P. C. Thakur, Somatic embroyogenesis and root proliferation from internode of Anthocephalus cadamba in vitro rice, *Asian J. Exp. Biol Sci.*, **2010**, 1, 337–343.

[30]. S. Saksena. Managing weeds; accent on chem control, *Pestic. Inf., xxviii*. **2003**, 6-11.

[31]. P. K. Gupta, Pest, *in the Ind. Environ-Environmental Sci. Series.* Interpret New Delhi, **1986**, 15-16.

[32]. Dheeraj, Jaison Susan, Sidhardhan Nisha Insecticidal effect of the mixture of Potassium soap and pyrethroids on Potato Leaf roll virus (PLRV) found on Potato plant, *J. Applicable Chem.*, **2013** 2(3), 518-525

[33]. Jain Dheeraj, Verghese .P Susan, Sidhardhan Nisha, Fatty Acid Metallic Salts and Pyrethroids - Environmental friendly Pesticides, *Int. JSRR*, **2013**, 21-172.

[34]. Nisha Sidhardhan, Susan Verghese. P, Environmental Friendly Herbicides -Fatty acid metallic Salts on weed (Parthenium hysterphorous and Moss, *Int. J. Chem.curr.Res. Pharma.sci*., **2015**, 2(4), 1-14.

[35]. P. M. Rice J. C. Tonye. D. J. Bedunah, C. E. Carlson, A human security framework for the management of invasive non indigenous plants, *J. App. Ecology.*, **1997**, 34, 1397-1412.

[36]. G. Hussan, A. Amin, First Annual Tech. Report, HEC Int. Linkage Project with Univ. of Queensland, Aus., on Parthenium Weed, **2009**.

[37]. S. B. Powels, J. A. M. Holtum, Herbicide resistant weeds in Australia, *Proct* 9^{th} *Aus. Weeds Conf. Crop Sci. Society of S. Aus*., **1990**, 211-215.

[38]. T. V. Muniappa, T. V. R. Prasad, K. Krishnamurthy,Comparative efficacy and economics of mechanical and chemical methods of control of *parthenium hyterophorous* L, *Ind. J. Weed Sci.*, **1980**, 12,137-144.