INTERNATIONAL JOURNAL OF CURRENT RESEARCH IN CHEMISTRY AND PHARMACEUTICAL SCIENCES

(p-ISSN: 2348-5213: e-ISSN: 2348-5221)
www.ijcrcps.com

Research Article

ENVIRONMENTAL FRIENDLY HERBICIDES–FATTY ACID METALLIC SALTS ON WEED(PARTHENIUM HYSTEROPHOROUS) AND MOSS (INDIAN MOSS)

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Abstract

The study of metallic soap is becoming increasingly important in technological as well as in academic fields. The metallic soaps posses high solubility in non-aqueous solvent and have high metal contents, which lend them unique properties and make them useful for many applications in industries. The application of metallic soaps largely depend on their physical state, stability, chemical reactivity and solubility in polar and non-polar solvent. The physico-chemical characteristics and structure of metal soaps can be controlled up to an extent by the method and conditions of their preparation and so the studies of metal soaps are of great significance for their uses in various industries under different conditions. The metal soaps are widely used in industries such as insecticide, cement, paper, wood, rubber, paints, plastics, greases, lubricants, medicines, cosmetics etc. However, the technological application of soap is largely depended on economic factors.

Keywords: Soap, Fatty acid, IR, Conductivity, Weed and Moss

Introduction

Herbicides are chemicals used to control unwanted plants. These chemicals are bit different from other pesticides because they are used to kill or slow the growth of some plants, rather than to protect them. Some herbicides kill every plant they contact, while others kill only certain plants. 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. 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 particular herbicide can be used most effectively. Herbicides can be used to clear roadside weeds, trees and brush. They can also kill invasive weeds that may cause environmental damage. Herbicides are commonly applied in ponds and lakes to control algae and plants such as water grasses that can interfere with activities like swimming and fishing and cause the water to look or smell unpleasant. [(1-5)]

Materials and Methods

1. Fatty acids soaps were prepared by direct metathesis of the corresponding lauric acid and potassium hydroxide with slight excess of methanol at 50-55^{o}C under vigorous stirring. The precipitated carboxylates were washed several times with distilled water and then with alcohol. The potassium soaps thus obtained were

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first dried in an air oven at 50-55^{o}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.

1. KOH + $C_{11}H_{23}COOH$ ⟶ $C_{11}H_{23}COOK$ + H_2O
Potassium Hydroxide Lauric acid Potassium Laurate (water)
(SOAP)

2.KOH + $C_{11}H_{27}COOH$ ⟶ $C_{11}H_{227}COOK$ + H_2O
Potassium Hydroxide myristic acid Potassium myristate (water)
(SOAP)

2. Infra-Red absorption spectra

The infra-red absorption spectra of fatty acids (lauric and myristic acid)and of corresponding potassium and ammonium soaps(potassium laurate and potassium myristate,) were obtained with "Perkin Elmer, Spectrum RX-1 *.*The Infrared spectra were used to obtain the structural information about potassium and ammonium carboxylates in solid state *region 4000cm^{-1}-400* cm^{-1} using KBr disc method.

3**. Conductance measurement**

A digital conductivity meter (Biocraft direct reading conductometer) and a dipping type conductivity cell with platanized electrode were used for measuring the conductance of the solution at 32ºC. The conductivity measurements have been used to study the structural changes in potassium carboxylates in the solutions, to evaluate various thermodynamic parameters to determine the critical micelle concentration and also to study the nature of micelle formed in solutions

Results and Discussion

The infra-red spectra of potassium carboxylates(laurate and myristate**)** with their assignments are recorded and compared with the result of corresponding fatty acid (lauric acid and myristic acid). The absorption bands maxima, characteristic of the aliphatic portion of the acid molecule remain unchanged on the conversion of fatty acid to the corresponding potassium soaps. The absorption bands of C-H stretching vibrations viz., the symmetrical vibrations of CH_2at 2860-2850 cm^{-1}, the asymmetrical vibration of CH_3 at 2960-2940 cm^{-1} are observed in the spectra of potassium soaps as well as in corresponding fatty acids. The absorption bands observed near 2650-2640, 1700, 950-930, 690-550 cm^{-1} in the spectra of fatty acids have indicated the presence of localized CH_2 group in the form of dimeric structure and the existence of intermolecular hydrogen bonding between two molecules of the acid. The absorption bands observed near 2650-2640, 1700 and 950-930 cm^{-1} corresponding to the -OH group in the spectra of fatty acids have completely disappeared in the spectra of corresponding potassium carboxylates. The absorption maxima observed near 690 cm^{-1} and 550 cm^{-1} in the spectra of fatty acids are assigned to the bending and wagging modes of vibrations of the carboxyl groups of the fatty acids molecules which is not observed in the spectra of potassium and ammonium soaps. The infra-red spectra of potassium carboxylates show marked differences with the spectra of corresponding fatty acids in some spectral regions. The complete disappearance of two absorptions bands of carbonyl group corresponding to the symmetric and asymmetric vibrations of carboxylate ion near 1470-1440 cm^{-1} and 1625-1560 cm^{-1}respectively in the spectra of potassium carboxylate indicates that there is a complete resonance in the C-O bonds of carbonyl group of the carboxylate molecules and the two bands become identical with force constant assuming the value intermediate between those of normal, double and single bonds. It is, therefore, concluded that the resonance character of the ionized carboxyl group is retained in these metal carboxylates. The result confirm that the fatty acids exist with dimeric structure through hydrogen bonding whereas the metal to oxygen bonds in these metal carboxylates are ionic in character. It is also confirmed that the molecules of carboxylates retain the resonance character of the carboxyl group. (Fig:1)

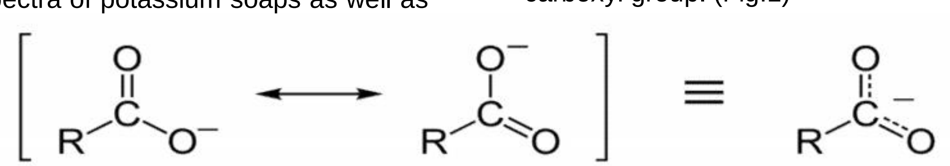

Figure:1 Resonance Hybrids of laurate and myristate

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The infra-red spectra of potassium carboxylates do not show any absorption maxima in the region of 3500-3300 cm^{-1} which confirms the absence of any coordinated water molecules in these carboxylates molecule.

Table-1: Infra-red absorption spectral frequencies (cm^{-1}) of potassium laurate with their assignments.

S.No	Assignments	Lauric Acid	Potassium Laurate
1	CH_3,C-H asymmetrical stretching	2960VW	2940 W
2	CH_2, C-H asymmetrical stretching	2920 VW	2920 VS
3	CH_2, C-H symmetrical stretching	2850 VW	2860 S
4	OH, stretching	2650 VW	-
5	C=O, stretching	1700 VS	-
6	COO^-, C-O asymmetrical stretching	-	1600 VS
7	COO^-, C-O symmetrical stretching	-	1470 MS
8	C-O stretch, OH in-plane deformation	1440 M	-
9	CH_2 (adjacent to COOH group) deformation	1350 W	1380 W
10	CH_3, symmetrical deformation	1350 W	1380 W
11	Progressive bands(CH_2 twisting and wagging)	1200-1190 W	1350-1170 W
12	CH_3,rocking	1110 W	1110W
13	OH, out of plane deformation	950 S	-
14	CH_2, rocking	720 M	720 M
15	COOH, bending mode	690MS	-
16	COOH, wagging	550 MS	-
17	K-OH, bond	-	610 S

Table-2: Infra-red absorption spectral frequencies (cm^{-1}) of potassium myristate with their assignments.

S.No	Assignments	Myristic Acid	Potassium Myristate
1	CH_3,C-H asymmetrical stretching	2960VW	2940 W
2	CH_2, C-H asymmetrical stretching	2920 VS	2920 VS
3	CH_2, C-H symmetrical stretching	2850 S	2860 S
4	OH, stretching	2640 W	-
5	C=O, stretching	1700 VS	-
6	COO^-, C-O asymmetrical stretching	-	1600 W
7	COO^-, C-O symmetrical stretching	-	1460 W
8	C-O stretch, OH in-plane deformation	1410M S	-
9	CH_2 (adjacent to COOH group) deformation	1370 W	1380 M
10	CH_3, symmetrical deformation	1340 W	1340 W
11	Progressive bands(CH_2 twisting and wagging)	1200-1190 W	1300-1170 W
12	CH_3,rocking	1120 W	1110W
13	OH, out of plane deformation	940 M	-
14	CH_2, rocking	720 M	720 S
15	COOH, bending mode	690MS	-
16	COOH, wagging	550 MS	-
17	K-OH, bond	-	610 S

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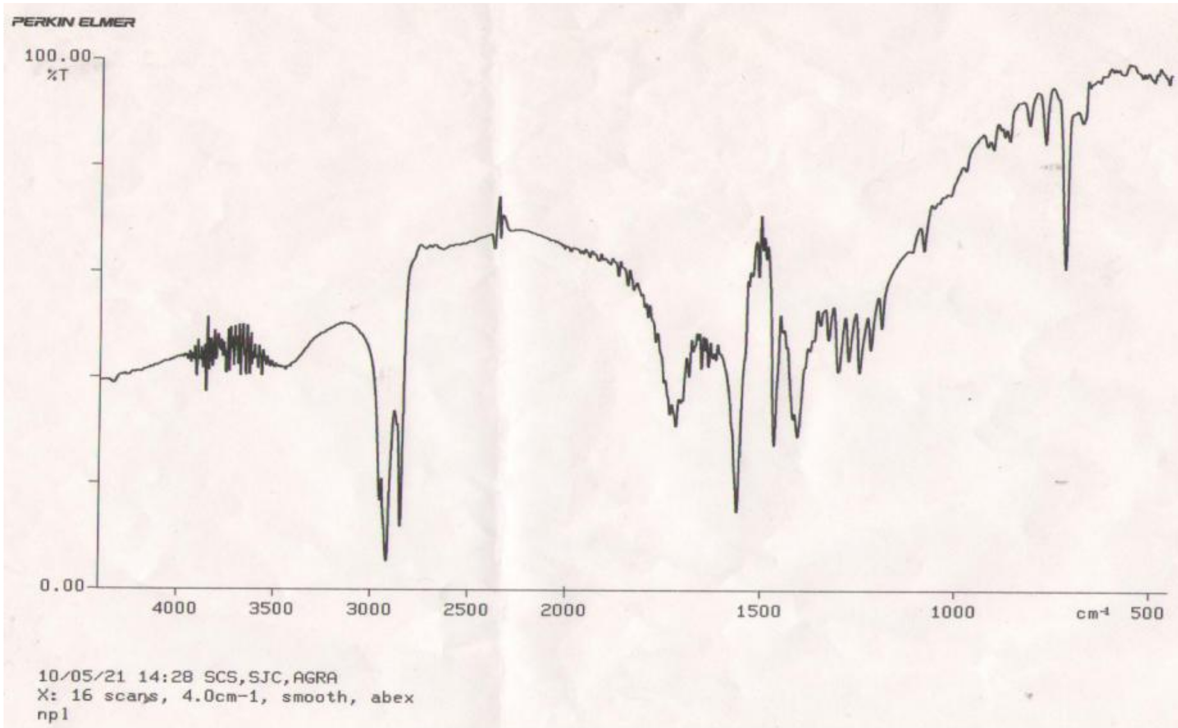

Fig: 2-IR Spectrum of Potassium Laurate

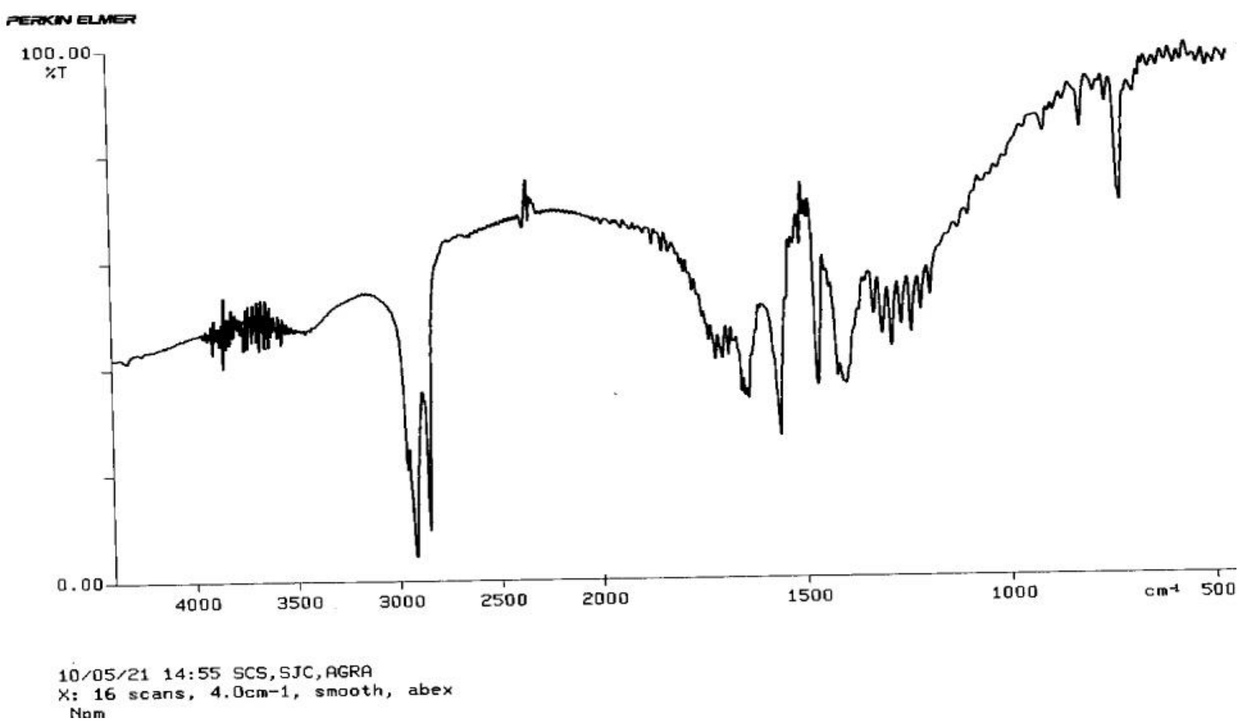

Fig: 3-IR Spectrum of Potassium Myristate

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Conductivity measurement of potassium soaps

The specific conductance, k of the solution of soap (potassium laurate and potassium myristate) in distilled water increases with increasing soap concentration, C. The increase in specific conductance may be due to ionization of metal carboxylates (potassium laurate and potassium myristate) into simple metal cations(K^+andNH_4^+)and fatty acid anions($C_{11}H_{23}COO^-$and $C_{13}H_{27}COO^-$)in dilute solution and due to the formation of ionic micelles at higher soap concentration. The plots of specific conductionce, k Vs soap concentration, C of potassium carboxylates (potassium laurate and potassium myristate,) in distilled water are characterized by an intersection of two straight line at a definite soap concentration corresponding to the CMC of soap in these solution. The results show that the values of the CMC decrease with increasing tail of the soap. The micellization occurs when the energy released as a result of aggregation of hydrocarbon chains of the monomersis sufficient to overcome the electrical repulsion between the ionic head groups and to balance the decrease in entropy accompanying aggregation. The CMC increases with the increase in soap concentration since the kinetic energy of the monomers increases with concentration.

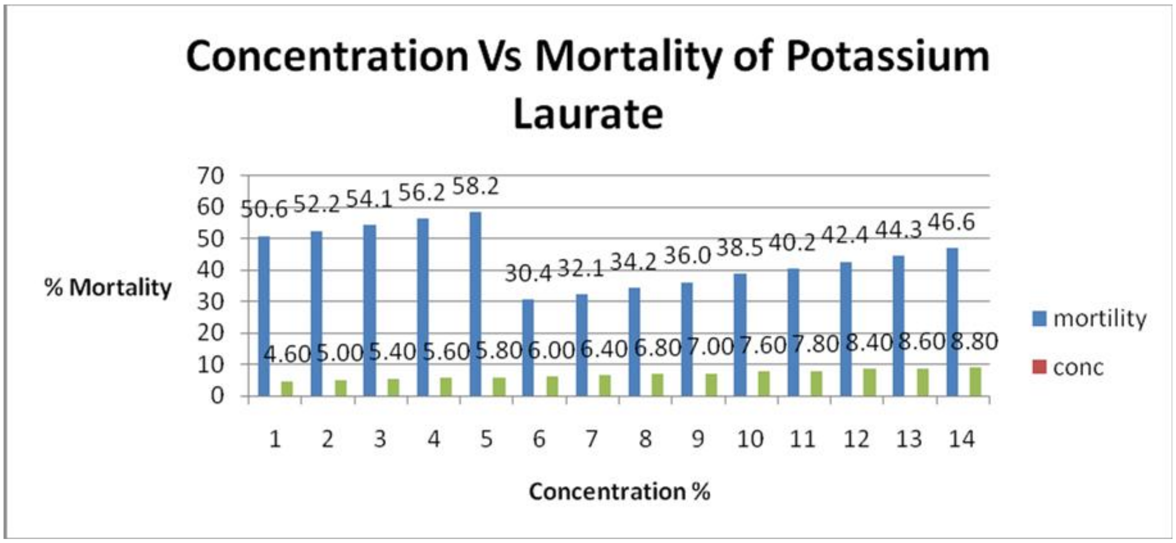

Figure:4-Concentration Vs Mortality of Potassium Laurate (CMC 5.5x 10^{-3}gm/dm^3)

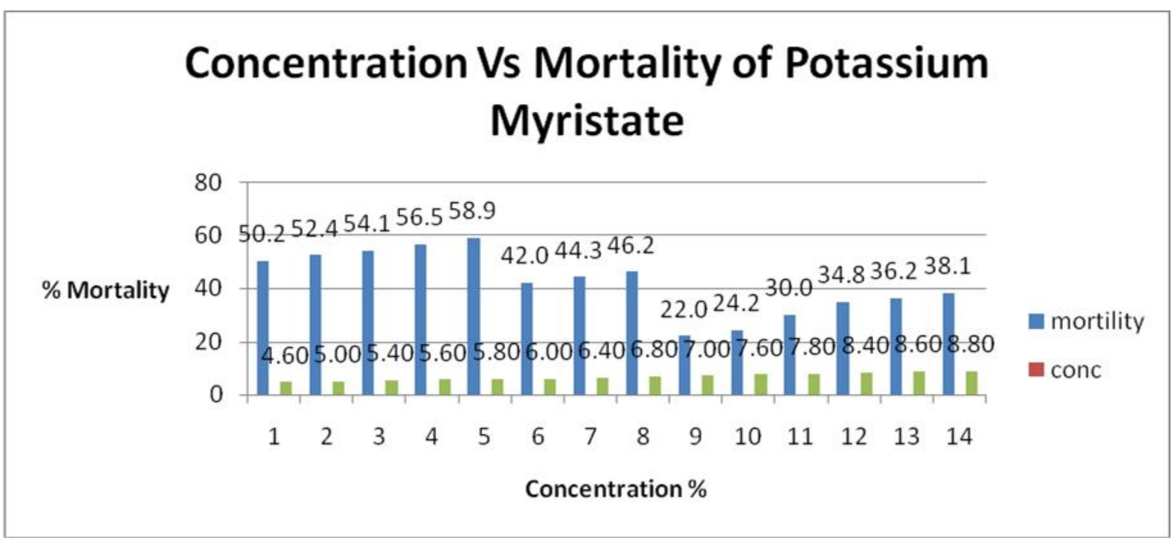

Figure:5-Concentration Vs Mortality of Potassium Myristate (CMC 4.5x 10^{-3}gm/dm^3)

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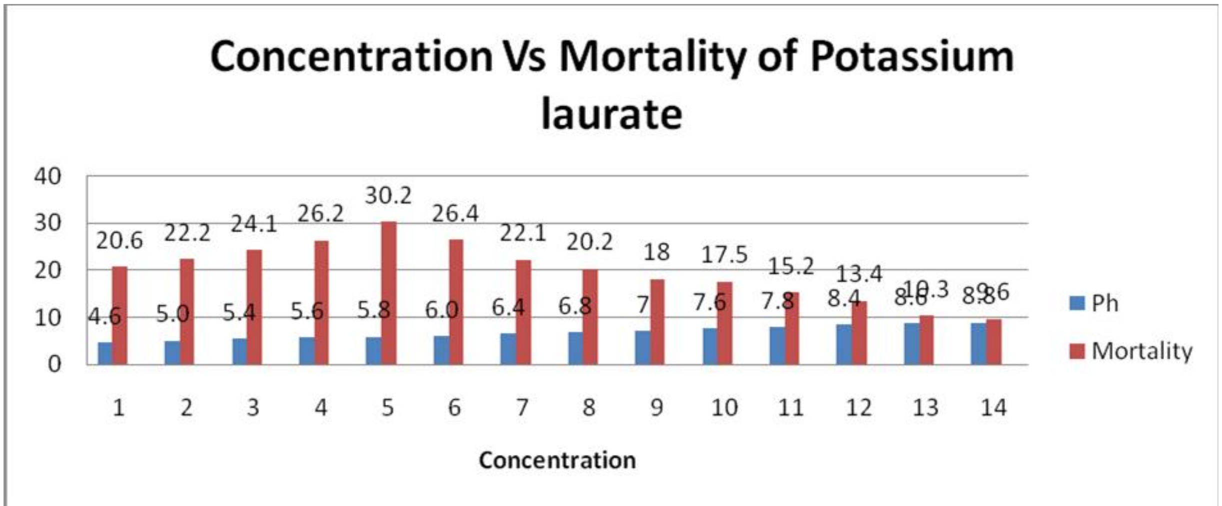

Figure:6-Concentration vs Mortality of Potassium Laurate (CMC 5.5x 10^{-3}gm/dm^3)

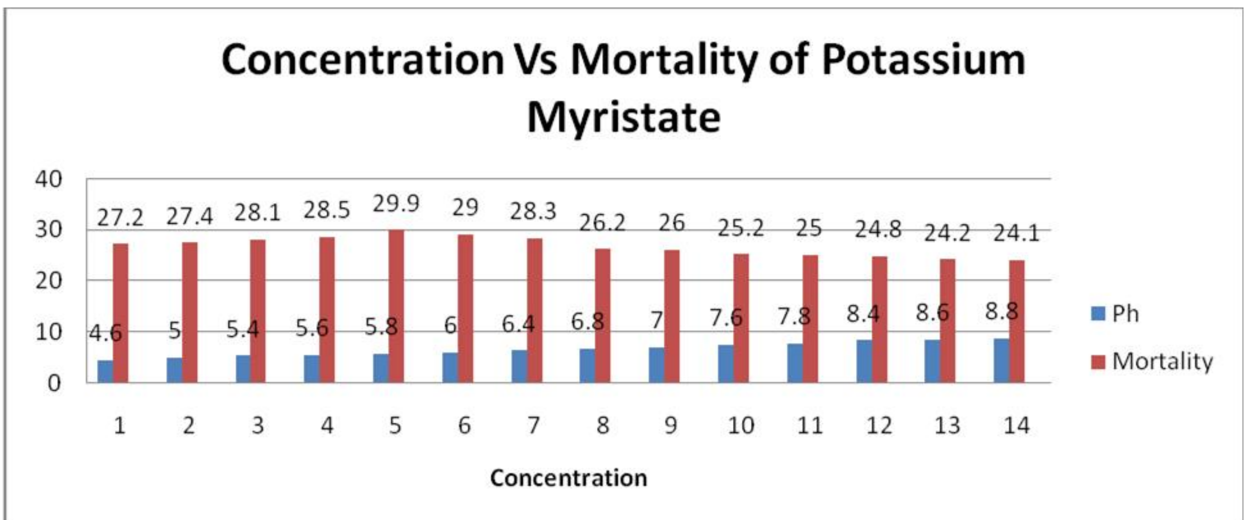

Figure:7-Concentration Vs Mortality of Potassium Myristate (CMC 4.5x 10^{-3}gm/dm^3)

Applications of potassium soaps on weed (*Parthenium hysterophorous*) and moss (Indian moss)

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. [6-10]

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Figure:8 Field area for the growth of weeds

Figure:9 Newly growing weeds plant(stage-1)

Figure:10 Weeds are present after weekly application

Weed (*Parthenium hysterophorous*)

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Parthenium hysterophorous is a weed of National Significance. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts. Some people suffer severe allergic reactions to the plant or its pollen: it can cause dermatitis, hay fever and asthama. Parthenium weed is toxic to cattle and meat from livestock that eat the weed can be tainted. It also threatens biodiversity in the Einasleigh Uplands bioregion and grasslands in the central highlands of Queensland. Parthenium weed is native to the subtropics of North and South America. It is a fast-maturing annual (or, under certain conditions, a short-lived perennial) with a deep tap root and an erect stem that becomes woody with age. It may eventually reach a height of 2m. Its leaves are pale green, branched and covered with soft fine hairs. The small white flowers (4mm across) have fine distinct corners and grow on the stem tips. Each flower produces four or five black wedge-shaped seeds that are 2mm long with thin white scales. Its large and persistent soil seedbank, fast germination rate and ability to undergo dormancy make it well adapted to semi-arid environments. It also releases chemicals that inhibit the germination and growth of pasture grasses and other plants. 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. In summer, if plants are stressed (eg due to lack of water),parthenium weed can complete its life cycle in four weeks. Buried seeds have been found to last much longer than seed on the soil surface, and a significant proportion can still germinate after eight to ten years. 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 and moss, but all of them have negative impact on the crops as well as in environment. Hence an attempt has been made to develop an eco-friendly economical product for integrated herb management strategy. Therefore, the present study was carried out to evaluate the efficiency of soap based herbicide containing potassium laurate and potassium myristate on weed plants as there is urgency in the search for eco-friendly alternative approaches for the removal of weed and moss. Weeds are directly treated by soaps (potassium laurate and potassium myristate). These two 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. [11-15] 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 and potassium myristate respectively of various pH and concentrations**.** These two soap based herbicides of different concentration were prepared and sprayed on weed and moss. 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 was fifteen plants of parthenium and moss in each section of chamber. Suspentions two chemical herbicides namely potassium laurate and potassium 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. [16-20] The plants of first section were treated with soap solution of potassium laurate, second section of the row was treated with the soap solution of potassium 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. (Table:3) have been prepared and sprayed on weeds. 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 pH4.6-5.8.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. So, the soap based solution of potassium laurate having pH 5.8 were 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. [21-25] Seventh, eighth, ninth, tenth, eleventh, twelfth, thirteenth,

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fourteen and fifteen 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 mortility of these solution was also low (30.4-46.6%). (Table: 3 Fig:11). The solution of potassium laurate having pH 5.8 was found to be more effective for the control of weed. The mortility 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. [26-30]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. [31-35] As their mortality was also high. (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 have good efficacy against weed.(Table:4,Fig:11). 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 6.8-8.8of 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, Fig: 11). In our experiment we conclude that, the liquid spray herbicide contains potassium myristate having pH 5.8 is found to be most effective (Fig:11) than other solutions of potassium myristate as their mortality was high as 58.9%.They cause “leaf burning” and eventually death of the plant.

Table-3-Impact of Potassium Laurate on Weed Plant

S.No	Weed Plants	pH value of potassium laurate	Effect on plants(after weekly application)	Effect on plants (after bi-weekly application)	Toxicity
1	plant	control	------------------	-------------------	-------------
2	Plant	4.6	Need frequent application	Effective	Less toxic
3	Plant	5.0	Need frequent application	Effective	Less toxic
4	Plant	5.4	Need frequent application	Effective	Less toxic
5	Plant	5.6	Need frequent application	Effective	Less toxic
6	Plant	5.8	Need frequent application	Most Effective	More toxic
7	plant	6.0	Need frequent application	Less Effective	Less toxic
8	plant	6.4	Need frequent application	Less Effective	Less toxic
9	plant	6.8	Need frequent application	Less Effective	Less toxic
10	plant	7.0	Need frequent application	Less Effective	Less toxic
11	plant	7.6	Need frequent application	Less Effective	Less toxic
12	plant	7.8	Need frequent application	Less Effective	Less toxic
13	plant	8.4	Need frequent application	Less Effective	Less toxic
14	plant	8.6	Need frequent application	Less Effective	Less toxic
15	plant	8.8	Need frequent application	Less Effective	Less toxic

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Table-4- Impact of Potassium Myristate on Weed Plant

S.No	Weed Plants	pH value of potassium myristate	Effect on plants(after weekly application)	Effect on plants (after bi-weekly application)	Toxicity
1	plant	control	--------------------	------------------------	----------------------
2	plant	4.6	Need frequent application	Effective	Less toxic
3	plant	5.0	Need frequent application	Effective	Less toxic
4	plant	5.4	Need frequent application	Effective	Less toxic
5	plant	5.6	Need frequent application	Effective	Less toxic
6	plant	5.8	Need frequent application	Most Effective	More toxic
7	plant	6.0	Need frequent application	Less Effective	Less toxic
8	plant	6.4	Need frequent application	Less Effective	Less toxic
9	plant	6.8	Need frequent application	Less Effective	Less toxic
10	plant	7.0	No impact	Need frequent application	Less toxic
11	plant	7.6	No impact	Need frequent application	Less toxic
12	plant	7.8	No impact	Need frequent application	Less toxic
13	plant	8.4	No impact	Need frequent application	Less toxic
14	plant	8.6	No impact	Need frequent application	Less toxic
15	plant	8.8	No impact	Need frequent application	Less toxic

Figure 11: (a) Newly growing weed plants(stage-1) (b) Growth of healthy weeds (c) Weed remain healthy after the fourth week of application(d) No impact on weed plants, plants remain healthy(e)No impact after the complete growth of weed (f) Weeds are completely dead

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MOSS (INDIAN MOSS)

Mosses were sown in a lawn, 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 and potassium myristate respectively of various pH concentrations. These two soap based herbicides of different concentration were prepared and applied on moss plant. There were fifteen moss plants in each section. Suspensions of two chemical herbicides namely potassium laurate and potassium myristate of different pH and concentrations were prepared in water. Different doses of test herbicides were sprayed with a hand atomizer on 1 and 2 weeks grown moss plants. The control treatment was sprayed with water. Effect of herbicides were monitored till all the plants in herbicidal treatments become dead. The plants of first section were treated with soap solution of potassium laurate and second section of the row was treated with the soap solution of potassium myristate respectively. First plant on every section was kept as control. Fourteen spray solutions of potassium laurate of different concentration having pH 4.6-8.8 have been prepared and sprayed on moss. The first section of the first plant of the lawn was control and was healthy. The second, third, fourth, fifth , sixth, seventh, eighth , ninth , tenth, eleventh, twelfth, thirteenth and fourteenth plants which were treated with potassium laurate solution having pH 4.6-8.8. Sprays were applied bi-weekly in the beginning and weekly after four weeks of application. After bi-weekly application the mosses were found healthy and it needed frequent application of spray. So, the soap based solution of potassium laurate having pH 4.6-8.8 needs frequent application. The mortality of this formulation was low (20.6-9.6%) (Table:5, Fig:12,13). The second, third, fourth, fifth, sixth, seventh eighth, ninth, tenth, eleventh, twelfth, thirteenth and fourteenth plant of second section were treated with the herbicidal solution containing potassium myristate having pH 4.6-8.8. Sprays were applied bi-weekly in the beginning and weekly after four weeks of application. After bi-weekly application the leaves were found healthy but plant needed frequent application of spray and also less effective. Even after the fourth week of application, there were not much improvement on the structure of the plant as their mortality was low. (27.2-10.1%) (Table 5, Fig: 12, 13)

Table:5-Impact of Potassium Laurate on Moss Plant

S.No	Moss Plants	pH value of potassium laurate	Effect on plants(after weekly application)	Effect on plants(after bi-weekly application)	Toxicity
1	plant	control	--------------------	---------------------	---------------------
2	Plant	4.6	Need frequent application	Less Effective	Less toxic
3	Plant	5.0	Need frequent application	Less Effective	Less toxic
4	Plant	5.4	Need frequent application	Less Effective	Less toxic
5	Plant	5.6	Need frequent application	Less Effective	Less toxic
6	Plant	5.8	Need frequent application	Effective	Slightly toxic
7	plant	6.0	Need frequent application	Less Effective	Less toxic
8	plant	6.4	Need frequent application	Less Effective	Less toxic
9	plant	6.8	Need frequent application	No Impact	Least toxic
10	plant	7.0	Need frequent application	No Impact	Least toxic
11	plant	7.6	Need frequent application	No Impact	Least toxic
12	plant	7.8	Need frequent application	No Impact	Least toxic
13	plant	8.4	Need frequent application	No Impact	Least toxic
14	plant	8.6	Need frequent application	No Impact	Least toxic
15	plant	8.8	Need frequent application	No Impact	Least toxic

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Table: 6-Impact of Potassium Myristate on Moss Plant

S.No	Moss Plants	pH value of potassium myristate	Effect on plants(after weekly application)	Effect on plants (after bi-weekly application)	Toxicity
1	plant	control	--------------------	------------------------	----------------------
2	plant	4.6	Need frequent application	Less Effective	Less toxic
3	plant	5.0	Need frequent application	Less Effective	Less toxic
4	plant	5.4	Need frequent application	Less Effective	Less toxic
5	plant	5.6	Need frequent application	Less Effective	Less toxic
6	plant	5.8	Need frequent application	Effective	toxic
7	plant	6.0	Need frequent application	Effective	Less toxic
8	plant	6.4	Need frequent application	Effective	Less toxic
9	plant	6.8	Need frequent application	Effective	Less toxic
10	plant	7.0	No impact	Need frequent application	Least toxic
11	plant	7.6	No impact	Need frequent application	Least toxic
12	plant	7.8	No impact	Need frequent application	Least toxic
13	plant	8.4	No impact	Need frequent application	Least toxic
14	plant	8.6	No impact	Need frequent application	Least toxic
15	plant	8.8	No impact	Need frequent application	Least toxic

Figure: 12 Field area for the growth of moss

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Figure: 13 The moss growth remained the same

Conclusion

1. Herbicidal Soaps (Potassium laurate and potassium myristate) are 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.
2. 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.
3. Since most of the test herbicides were found to be less effective, though it could kill a very small fraction of moss plant .The recurrence of the moss with the availability of the moisture, decomposition of herbicide within a short period after application and the lack of rain fastness made this herbicide a less effective to treat moss and to control its population.
4. The result confirm that the fatty acids exist with dimeric structure through hydrogen bonding whereas the metal to oxygen bonds in these metal carboxylates are ionic in character. It is also confirmed that the molecules of carboxylates retain the resonance character of the carboxyl group**.**
5. The values of the CMC decrease with increasing tail of soap. The micellization occurs when the energy released as a result of aggregation of hydrocarbon chains of the monomersis sufficient to overcome the electrical repulsion between the ionic head groups and to balance the decrease in entropy accompanying aggregation. The CMC increases with the increase in soap concentration since the kinetic energy of the monomers increases with concentration.

   Potassium carboxylates are post-emergence herbicide. It performs by its increasing herbicide activity by absorption and reducing surface tension .Thus helps carboxylate solution to spread evenly and to get absorbed on the weed plant.

Acknowledgements

Authors are thankful to School of Chemical Sciences, Department of Chemistry, St. John's College, Agra for providing the analytical instrumentation facilities.

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