Chapter One

INTRODUCTION

The world population is rapidly increasing and it needs further research to help increase food production in order to avoid famines, malnutrition and critical shortage in food supply. Pests contribute significantly to food losses and control of pests is very central to attainment of security at all levels.

Pesticides are extensively used in agricultural production to check or control pests, diseases, weed and other plant pathogens in an effort to reduce or eliminate yield losses and preserve high product quality. Although pesticides are manufactured under very strict regulation processes to function with logical certainly and minimal impact on human health and the environment serious concerns have been raised about health risks resulting from residues. By their nature most pesticides show a high degree of toxicity because they are intended to kill certain organisms and thus create some risk of harm. With this background pesticides have raised grave concern not only of potential effect on human health but also about the impact on wild life and sensitive ecosystems.

Wrong application techniques, badly maintained or totally unsuitable spaying equipments and inadequate storage practices exacerbate these risks. Often the reuse of old pesticides add to the risk of exposure.

Pesticide residues in plants may be un available even when pesticides are used in accordance with good agricultural practices. This is because researches are conducted for the crop yields. But the improvement in yield is sometimes concomitant with the occurrence and persistence of pesticide residues in soil and water.

Pesticides may reach the soil through direct application to the soil surface, incorporation in the top few centimeters. ground water resources and surface run off during rainfall thereby contributing to the risk of environmental contamination. The fate of pesticides in soil and water environment is influenced by the physiochemical properties of the soil and water.

Plant root uptake of persistent residues is a common form plant contamination. The quantity of pesticides absorbed by a single plant generally depends upon the water solubility of pesticide, the quantity of pesticide within the soil Organic matter is the most important soil factor influencing the sorption of pesticides residues.

1. 1 The Objectives of the Study are:-

- To study the impact of two pesticides Folimat and Icarose on garden rocket plant growth.
- To study the impact of Folimat and Icarose residues on soil fertility.
- To evaluate the recommended dose concentration and excessive dose concentration on plant growth and soil.

Chapter Two

LITERATURE REVIEW

During the past few decades pesticides were intensively used to increase agricultural production. However, the lack of awareness of the risk involved in using pesticides has led to environmental pollution and contamination of agricultural resources namely soil and underground water and plants.

2.1 Impact of pesticides application on soil:

Previous studies (Zaki, 1978) had shown that the residues of certain pesticides in soil lead to either increase or decrease in nutritional elements. Hawrth (1983) explained that the type of soil has a great impact on the residues detected in the plant. He found the amount of lindane detected in carrot.

Omer (2001) investigated the possibility of contamination of soil with Sevin after years had elapsed and documented that the soil contaminated through these years. In fact the result of soil analysis showed that 0.156 ppm of Sevin was detected at the end of 7 years. According to Hagar (2002) most soils have pH that ranges between 4.5 and 8. However, the absorption of pesticides is usually greatest in soils with high degree of acidity.

Farehorst (2006) stated that absorption was the most important factor which limits pesticides degradation as well as their transport into the soil.

Zaki (1978) stated that some pesticides might undergo a lot of changes and become more toxic.

Omer (2001) found that high amount of pesticides in the soil (0.0156 ppm of Sevin) despite that pesticides were banned or restricted in many countries but they are still detected in soils.

Hussain *et al* (1988) reported that most of applied DDT was retained on top 5 cm layer in sandy loam soil. It was observed that half life dissipation for DDT in Lab was 890 days but under field condition the half life was 110 days in irrigated land and 112 days in rain fed soil.

Tahir *et al* (1999) analyzed the 45 soil samples recoveries on GC. ECD. It was found that percentage to be 100.67 and 94% at spiking level of 0.77 and 8.7 MgL^{-1}. The data showed the evidence that capillary column GC. ECD could be used reliably and advantageously for pesticide analysis.

FAO (2001) reported that 24 soils to depth (1-6 and 6- 12 inches) from 6 locations of cotton zone of Punjab were found contaminated with pesticide residues. The Fenvalerate, Lindane and Azinphosmethyl were found higher in lower layer than the top zone while in the lower layers residues of Lindane were observed.

Baily *et al* (2005) pointed out that even after several decades of labs application, presence of Organic Carbon (OC) especially DDT from a broad range of soils across the Provinces of Canada in 1999 was observed the level of total DDT, the highest level measured from non agricultural land was 119- 150 ng^{-1} concentration with Lindane ($14ng^{-1}$) and Dieldrin ($27ng^{-1}$).

Gao *et al* (2005) studied the OCs like DDT, DDD, DDE, HCH, HCB, Endosulfan, Dieldrin, Endrin were quantified to detect current level of OC in agricultural soil by (ECD.13OC) were detected with DDTs was the main residues while HCH on second level.

Ismail and Maznah (2005) investigated the persistence of Fenvalerate at various temperatures and moisture levels in three different soil types, peat sandy clay and sandy loams soils. It was observed that temperature and soil moisture had significantly influenced the degradation of Fenvalerate in the soils. The rate of dissipation was also affected by the physiochemical properties of the soil.

Generally the half life of Fenvalerate in tropical soils should slightly make degradation faster than in temperate regions where the climatic conditions and soil characteristics are very different.

Mayanglam- bam *et al* (2005) studied the persistence and leaching of quinalphos widely used in India agriculture for control of pests in various crops under field conditions using soil column.

The activity of dehydrogenase and alkaline phosphomonosterase of soil is inhibited by the residues of quinalphos. Activities varied by the insecticide applications. It was noted that quinalphos is moderately persistent with half life of 30 days and 15 capable of leaching to surface soil. Any large concentration of it can cause ground water contamination.

Shegunova *et al* (2007) screened the OC in soil and biotic samples from the Czech Republic although these pesticides had never been used in large quantities in this region. Results indicated that their residues were found to be persisting in the top layer soil. Concentration in mountains was generally higher than those in agricultural areas and detection of traces of pesticides in the region supported the occurrence on soil due to the atmospheric redistribution rather than as a result of direct application.

Younis (1979) working on Sevin on lettuce, noticed an increase in the vegetative growth two weeks after treatment. He explained that the pesticides might work as foliar fertilizer. Using Malathion on tomato, he found no effect on height but the roots were greatly affected.

2.2 Impact of pesticides application on plant:

Dennis (1999) observed that tomato (*Solanum lycoberscum*) suffered from dwarfism when treated with an over dose of Sevein. He ascribed this phenomenon to the deformation of roots accompanied by its incapability to absorb water and nutrients. When the same experiment was conducted using carrot (*Daucus carota* L.) the vegetative part was greatly increased.

Abdelgwad (2001) performed an experiment to investigate the effect of Sevin on carrot. He found that the weight of carrots treated with Sevin was significantly increased. This could be related to the fact that the Sevin acts as growing hormone in certain plants (garden rocket).

Ashraf (2007) stated that Sevin pesticides reduces the activity of microorganisms which lead to the reduction of the absorption of some minerals especially in garden rocket plant. He also found that the stability of pesticides especially their concentration, solubility and evolution in the air.

Kawamura *et al* (1986) screened 10 samples of fruits and vegetables from the market for organic carbon pesticide residues. In most samples the residues level was found to be 0.01 mg/ kg. Frequently the residuce of pesticides was higher in fruits than in vegetables.

Frank *et al* (1987) surveyed grown vegetables in Canada for pesticide residues during 1980- 85. Most of the samples were found contaminated.

FAO (2001) discussed the presence of pesticide residues from Pakistan. Vegetables samples collected from different locations around Muitan city. It was observed that all the vegetables samples analyzed were contaminated out of which 63% samples found exceeding MRLs for Carbofuran, Dichlorvos, Deltamethrin and Methyl Parathion, Fenitrothion and Quinalphos methyl. While the Pyrethriods and Cypermethrin were not detected in any sample. About 60% apples were found with excess MRL values of Carbonfuran while Methamidophos, Azinphosmethyl and Dimethoate residues were also observed.

Anwar *et al* (2004) determined the presence of pesticide residues of 6 most commonly used pesticides of Organo Phosphate group (OP) (i.e Methamidophos, Dimethoate Carbofuran, Methyle Parathion, Malathion and Azinphosmethyl). In vegetables (i.e.turnip, spinache cauliflower, squash melon, tomato, cabage and cucumber) purchased from various market places of Marda city (NWFP), Lahore and Faisalabad (Punjab) Pakistan. It was observed that the residues of Carbofuran, the most commonly used pesticide on vegetables in Pakistan was only recorded in high quantities.

Chang *et al*(2005) monitored the pesticide residues in marketed fresh fruits and vegetables in Taiwan and introduced the Hazard

Analytical Critical Control Point (HACCP) system to industries and growers of vegetables and fruits for improving the safety of agricultural products. Six local bureau of health in central Taiwan (1999- 2004) collected 1999 samples of fruits and vegetables from supermarkets and traditional markets and analyzed them for the presence of 70- 79 pesticide residues using multi- residues analytical methods.

The detection limits of these methods ranged from 0.03- 0.4 ppm. Only four samples contained the pesticide residues that exceeded the MRL (0.2% i. e. 4 of 1999). On the whole Taiwan during (1997- 2003) pesticide residues were detected in 13.9% of the 1955 samples. To decrease the health risk to humans and the environment from exposure to pesticides the government sampled and analyzed the agricultural products regularly for pesticides. The limits are set by the Department of Health every year.

Parveen *et al* (2004) monitored the pesticide residues from 270 citrus and apple samples from the different selling points of Karachi, Pakistan, during 1991- 2001 by HPLC ND GC- FID. It was observed that the majority of the samples were contaminated with OC pesticides exceeding the MRLs.

Hassan *et al* (2007) analyzed 124 vegetable samples for pesticide residues of 7 commonly used pesticides. It was observed that 89 vegetable samples were found to be contaminated. Out of which 47 samples exceeded MRLs. Cypermthrin was found in 39 samples, Methamidophos in 27, Fenvalerate in 22, Malathion in 20, Chlorpyrifos in 9, Endosulfan in 7 and Methyl Parathion found only in one sample of vegetable.

Masud and Hassan (1995) analyzed the fruit and vegetable samples from the grower's fields and main selling points in Quetta/ Pishin district of Balochistan during 1992 for pesticide residues. Out of 50 samples 19 (38%) were found to be contaminated in which one (5%) exceeded the MRL.

Chapter Three
MATERIALS AND METHODS
3:1 Study Area:

An experiment was conducted 0n November 2014, at the Farm of the College of Agricultural Studies (380 meter) above the sea level in Sudan University of Science and Technology, Khartoum North, Sudan, dry and semi- dry climate, latitudes 15° and 40ˉ North longitude 22° 32ˉE.

Garden rocket seeds were sown by hand on mid December, two rows on ridge of 60 cm apart and with intra- row spacing of 5 cm. The crop was thinned to one plant per hill. Cultural practices were done as recommended by the Agricultural Research Center (ARC). Folimat and Icaros were applied one month after sowing as aqueous pray, at a volume rate of 120L per feddan. Untreated control was included for comparison. The plots received 4 hand weeding at biweekly intervals standing from sowing; sub- plot size was 7×2.4m. The treatments were arranged in a randomized complete block design with 3 replicates.

Urea and phosphorus fertilizers were used at the rate of 150kg/ha and 120kg/ha respectively. The pesticides were sprayed one month after planting. Plots were separated by sacks to prevent lateral movement of the pesticides. The whole plants were pulled and then washed for different measurements. Soil samples were taken before and after planting at 30cm. depth for all measurements.

3:2 Measurements of plants:-

For all treatments plant height (cm), fresh and dry weight (g) and leaf area (cm^2) were measured .

3:3 Soil analysis:

The distributed samples were collected from surface soil by auger methods, were dried under shade by spreading on sheets of stout paper placed inside wooden trays. Each sample was then divided into two unequal portions. The smaller portions were stored in polythen bags. The major portions were grinded and sieved (2mm), the fine earth of each sub-sample was thoroughly mixed and placed inside labeled glass jars with screw tops.

The chemical characteristics determined on samples were as follows:

Chemical analyses were carried out for soil ECe ds/m bib E.C meter of the saturation extract, pH by pH meter of the saturation.

The nitrogen % Kjeladhal method, phosphorus (ppm) by Spectrophotometer, soluble sodium and potassium (meg/L) by Flame photometer, calcium carbonate % by Calcimeter, CO_3 and HCO_3 (meg/L) by titration of hydrochloric acid, calcium + magnesium meg/L by titration of EDTA and chloride meg/L by titration of $AgNO_3$.

Chapter Four

RESULTS AND DISCUSSION

4.1 The effect of Folimat and Icarose pesticides on garden rocket growth:-

4.1.1 Fresh weight (g):-

The data in table (1) showed that the highest fresh weight for garden rocket plant was recorded for the recommended dose of Folimat (67.3g.) with significant difference compared to the control (51.0g.) treatment when the low value of fresh weight was reported for the upper dose (53.0g.) which was significantly lower when compared to the recommended dose .

In the case of Icarose pesticide, the data revealed that the fresh weight for garden rocket plant followed the same trend as that for Folimat viz. the highest fresh weight was given by the recommended dose (73.3g.) which was not significantly different compared to the control (69.3g.) and significantly different compared the upper dose which gave the lowest fresh weight (68.0g.).

4.1.2 Dry weight (g) :-

The data for the dry weight of garden rocket plant almost followed the same tread as that for the fresh weight.

The recommended dose of both pesticides gave the highest dry weight (3.7gm) and (2.8gm) for Folimat and Icarose respectively. The difference between the recommended dose and control is not significant for Icrose and significant for Folimat.

The data also showed that the lowest dry weights were reported by the upper dose of the two pesticides (2.2gm.) and (1.8gm.) for Folimat and Icarose respectively.

4.1.3 Leaf area (cm^2) :-

The data in table (1) revealed that no significant different was reported between recommended dose and the control for Folimat in leaf area of garden rocket plant while a significant difference was found incase of Icarose. The result showed that the highest values of leaf area were given by the recommended dose for both pesticides (87.7 cm^2) and (86.0cm^2) for Folimat and Icarose respectively. The upper dose of both pesticides registered the lowest values of leaf area with the values of (66.3 cm^2) and (67.3 cm^2) for Folimat and Icarose respectively.

Younis (1979) working on Sevin on lettuce, noticed an increase in the vegetative growth two week after treatment. He explained that the pesticide might work as foliar fertilizer.

4.1.4 Plant height :-

The data in table (1) showed that the highest height for garden rocket plant was recorded for the recommended dose of Folimat (75.7 cm.) with no significantly difference compared to control (71.7 cm.).

Where is the upper dose recorded the shortest height (64.7 cm.) which was significant different compared to recommend dose.

The same trend was observed for Icarose treatment table (1). The recommended dose recorded the highest (79.7cm.) which was significantly different compared to control and the shortest height was recorded for the upper dose (59.0 cm.) with no significant difference compared to the control.

Table (1): The Impact of Folimat and Icrose pesticides on Garding Rocket Growth:-

Pesticide	Treatment	Fresh Weight (g)	Dry Weight (g)	Leaf Area (cm^2)	Plant Height (cm)
Folimat	Control	53.0^{b}	1.7^{b}	82.3^{a}	71.7^{a}
	Recommended dose	67.3^{a}	3.7^{a}	87.7^{a}	75.7^{a}
	Upper dose	51.0^{b}	2.2^{b}	66.3^{b}	64.7^{b}
	Control	69.0^{a}	2.3^{a}	71.7^{b}	61.3^{b}
Icarose	Recommended dose	73.3^{a}	2.3^{a}	86.0^{a}	79.7^{a}
	Upper dose	68.0^{a}	1.8^{a}	67.3^{b}	59.0^{b}
L.S.D		8.45	1.34	10.15	5.85
CV%		10.0	20.3	6.6	9.6

Table (2): soil analysis before planting and after pesticides(folimat and Icrose applications

Treatment	PH paste	ECe Ds/m	Soluble cations Meg/L				Soluble anions meg/L				Total N %	P ppm	$CaCO_3$ %
			Na	K	Ca	Mg	HCO_3	CO_3	Cl	SO_4			
Soil before planting	7.9	0.82	6.4	1.3	2.4	1.6	2.8	0.0	7	8.6	0.02	6.0	6.0
Folimat,recommended dose	7.8	0.66	5.5	0.3	0.7	1.1	2.7	0.0	6	3.9	0.04	6.4	5.8
Folimat, upper dose	7.9	0.63	4.8	0.1	0.7	0.9	2.5	0.0	5	3.0	0.03	8.0	5.5
Soil before planting	7.9	0.28	6.4	1.3	2.4	1.6	2.8	0.0	7.0	8.6	0.02	6.0	6.0
Icrose,recommended dose	7.9	0.63	5.1	0.1	0.9	1.0	2.8	0.0	5.5	3.4	0.02	7.3	5.8
Icrose,upper doae	7.9	0.73	5.7	0.1	0.6	0.8	3.0	0.0	5.0	3.2	0.04	6.6	5.5

4.2 Soil Analysis :-

Composite soil samples were collected from each treatment before planting and after pesticides (Folimat and Icarose) applications for chemical analysis. The results were shown in table (2).

The soil is slightly alkaline in reaction with pH value of 7.9 and 7.8 for all treatments which may indicate that the studied pesticides had no effect on soil pH .

The electrical conductivity of the saturated soil extract varied between 0.82 and 0.63 ds/m indicating the soil is not saline. It also revealed that the application of the two studied pesticides at different doses had no effect on the EC.e values.

The soluble cations examined include Na^{+}, K^{+}, Ca^{++} and Mg^{++}. The result indicated that the concentrations of these Cations were decreased with the application of Folimatt and Icarose. The highest concentrations of these Cations were reported for the soil before planting and after that concentrations decreased with the application of pesticides at different rate.

When the soluble anions were considered the results revealed that with the exception of Sulphate (SO_4). The application of both pesticides did not result in a noticeable difference in the concentrations of each of HCO_3, CO_3 and CL. In case of the SO_4 a marked decrease in the concentration was observed when comparing the value of this anion reported for the soil before planting with the values after the two pesticides application.

The percentage of soil total nitrogen were very low varying between 0.02-0.04% which was the usual case in the dry and semi-dry regions of the Sudan.

The amounts of available soil phosphorus for all treatments were low varying between 6.0-73 ppm. Similar low values of soil nitrogen and available soil phosphorus had been reported by Block huis (1993) for the Sudan Soils.

Application of the two studied pesticides at different rates resulted in percentages of calcium carbonate ($CaCO_3$) that were very close to each other varying between 5.5 and 6.0%. This observation may suggest that the application of the studied pesticides at the two examined doses had no effect on the amount of $CaCO_3$in the soil.

Chapter Five

CONCLUSION AND RECOMMENDATIONS

5:1 Conclusion:

The main findings in this study can be summarized as follows:-

(1) The recommended dose of each of the studied pesticides (Folimat and Icarose) gave the highest values of each of fresh weight, dry weight, leaf area and plant height of garden rocket plant.

(2) The upper dose of the examined pesticides resulted in the lowest values of each of the studied parameters which were not significantly different compared to the control in most cases.

(3) The result of soil chemical analyses revealed that the examined pesticides had no noticeable effect on each of soil pH, ECe, soluble anions except for SO_4, total soil nitrogen, available soil phosphors and percentage $CaCO_3$. Whereas, the values for each of soluble cations (Na^+, K^+, Ca^{++} and mg^{++}) and SO_4 decreased with the applications of each of the studied pesticides compared to their values for the soil before planting.

5: 2 Recommendations:-

The following recommendations can be withdrawn from this study:-

(1) Pesticides should be applied at the lowest effective level (recommended dose).

(2) Excessive use of the pesticides adds residues to plant that on human health hazards and soil pollutions .

(3) Some pesticides increase vegetative growth of some plants , but not others . So, it is important to know whether pesticide application is useful or not.

(4) In this experiment the application of both pesticides did not increase the vegetative growth significantly. So , it Is not recommended to apply them to garden rocket

References:-

Abdelgwad A. A. (2001). Performed and experiment to investigate the effect of Sevin on carrot. Cairo University, Dar Elthgafa Press. Cairo, Egypt.

Anwar, T., Tahir, S., Ahmed, I. and Hayat, Y. H. (2004). Pesticide residues in vegetables collected from markets of Mardan (NWEP), Lahore and Faisalabad (Punjab), Pakistan. Bulletin of Pure and Applied Sciences, 23 A(1): 11- 19.

Ashraf, E. A. (2007). The stability of pesticides in soil depend on the character of the presence of pesticides especially the concentration, solubility and evolution in the air. Agricultural Research Journal, wad madani, Sudan.

Bailey, P., Waite, D., Abbott, Q. L. and Ripley, B. D. (2005). Residues of DDT and other selected organochlorine pesticides in soils from Saskatechiwan, Canada (1999). Canadian Journal of soil Science. 85 (2): 265- 271.

Change, J. M., Chen, T. H. and Fang, T. J. (2005). Pesticide residue monitoring in marketed fresh vegetables and fruits in Central Taiwan (1999- 2004) and introduction to the HACCP system. Yaowu Shipin Fenxi, 13 (4): 308- 376.

Dennis, C. A. (1999). Reported that the Sevin act as a nitrogenous fertilizer when sprayed on leaves of lettuce and lead to noticeable increase on the length and density of plant after two weeks of treatment. University of Alexandria Egyptian Library for Printing and Distribution. Egypt.

FAO (2001). Policy and strategy for rational use of pesticides in Pakistan. United Nation Development Program, Government of Pakistan. No. UN- PK/FAO/2001/002, pp 251.

Farenhorst, A. (2006). Importance of soil organic matter fractions in soil- landscape and regional assessments of pesticide absorption and leaching in soil. Soil Sc. Soc, Am. S. (70), 1005- 1012.

Frank, K. R., Brunanand, H. E. and Ripley, B. D. (1987). Residues of insecticide and herbicides on Ontario- grown vegetables. J. ADC, 70 (60): 1080- 1086.

Gao, H. J., Jiang, X., Wang, F., Bian, Y. R., Wang, D. Z., Dend, J. C. and Yan, D. Y. (2005). Residual levels and new inputs of chlorinated POPs in agricultural soil from Taihu lake region. Pedosphere, 15 (3): 301- 309.

Hagar, M. G. (2002). The fate of pesticides in soil. A paper presented at workshop at Arab Corporation for Development. Khartoum, Sudan.

Hassan, N., Anwar, T., Akhtar, S., Tahir, S. and Ahmed, I. (2007). Pesticide residues limits in vegetables groaround Karachi city, Pakistan. J. exp. Zool. India, 10 (1): 103- 106.

Hawrth (1983). Salmonella Mutagen city test results for 250 chemical environmental mutagen.

Hussain, M. (1988). Environmental degradation, realities and remedies. Feroz Sons Private Ltd. Karachi.

Ismail, B. S. and Maznah, Z. (2005). Persistent of Fenvalerate in three Malaysian agricultural soils. Bulletin of environmental contamination and toxicology.

Kawamura, Y., Takeda, M., Uchiyama, M. and Saito, Y. (1986). Survey of organophosphorus pesticide residues in vegetable and fruits. Bull. Nat. Inst. Hygienic Sci. 104: 147- 151.

Masud, Z. and Hassan, N. (1995). Environmental toxicology Assessment. Edited by M. Richardsons and published by Taylor Francis, England, UK, pp. 269- 279.

Mayanglam- bam, T., Vi, K. and Singh, D. K. (2005). Quinalphos persistence and leaching under field conditions and effects of residues on dehydrogenase and alkaline phosphomonoesterases activities in soil. Bulletin of environmental contamination and toxicology, 75 (6): 1067- 1076.

Omer I. E. (2001). Pesticides residues in Elfashir Agricultural area, workshop at Elfashir city. Western Darfur State, Sudan.

Parveen, Z., Khuro, M. I. and Kausar N. (2004). Evaluation of multiple pesticide residues in apples and citrus fruits, 999- 2001, Pakistan, Bull. Contam. Toxical., 73: 312- 318.

Poterva, C. (2007). Agriculture pesticides disruption of nitrogen fixation. Environ. Health Prospect (12)., 23- 239.

Shegunova, P., Klanova, J. and Holoubek, K. I. (2007). Residue of organochlorinated pesticides in soil from the Czoh Republic. Environmental pollution (Amsterdam, Netherlands) 146 (1): 257- 261.

Tahir, S., Anwar, T., Aziz, S., Werrer, R. A. and Ahad, K. (1999). Analysis of pesticide residues in fortified water, soil and vegetable samples. J. Biological Sciences. 2 (1); 233- 235.

Younis. Z. M. (1979). The effect of chemical pesticides on the environmental. Ainshamis University. Arabic, Distribution and Printing House. (Cairo. Egypt).

Zaki, M. M. (1978). Explained the effect of pesticides on the environment. Einshamis University, 2nd edition. Elder Alarabic Press.