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Comparative Efficacy of Madrid Plant Extracts in Controlling Red Flour Beetle Populations: A Laboratory Evaluation of Alcohol and Aqueous Solutions

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ABSTRACT

The efficiency of the alcohol and aqueous excerpt from the Madrid plant in killing ratios of colour red cover beetle larvae and adults afterwards behaviours lasting 24, 48, and 72 hours was valued in laboratory research. Three dissimilar Madrid plant absorptions (1.50 per cent, 3.0%, and 4.59 per cent) were selected to stop the beetle's larvae and adults. The outcomes displayed that the Madrid plant excerpt formed notable degrees. Following 72 hours, the watery excerpt's adult expiry rate was 33.0%, while the alcohol excerpt was 60.0% at 3.0% absorption. After 72 hours, the alcohol excerpt is concentrated larval expiry rate was 71.0% at 3.0% absorption; whereas the watery excerpt's extreme rate was 66.0%. After it derives the phenomena of attraction and repulsion, the paper initiates that the Madrid excerpt in the watery form displayed the maximum level of pull, reaching 9.30% at the absorption of 3.0% after 72 hours, while the repulsion rate was 15.550% at the similar absorption and time. Following 48 hours, the alcohol excerpt of Madrid showed a pull rate of 12.550% at 1.50% concentration. Additionally, following 72 hours, a revulsion rate of 19.80% at 3.0% concentration was realized in adult beetles. The extreme pull rate of the watery excerpt for larvae was 0.00% at all absorptions, and after 72 hours, a comparable revulsion rate of 10.950% was realized at a 4.50% concentration. Also, after 72 hours, the alcohol excerpt displayed a revulsion rate of 19.150% at 3.0% absorption and a pull rate of 0.00% at all concentrations.

KEYWORDS: Madrid Extracts, Pesticidal Efficacy, Red Flour Beetle, Concentration Variability, Larval and Adult Mortality

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1. INTRODUCTION

The red covers the beetle; Tribalism castaneum (Herbst), a recognized bother, expressively affects ground grain products, such as grits, bran, and flour. The application of pesticides results in the contamination of these commodities, and repeated use can result in resistance in the red flour beetle due to the effects of these pesticides (Abdullahi et al., 2019). Several research findings have suggested that specific plant extracts effectively restrain the proliferation of bacteria and insects (Al-Naaman, 1998; Abbas, 1998), with the inhibitory effect believed to be due to their essential oils (Alipour et al., 2014).

One of the latest trends in pest control is the exploration of plant-based, microbial, or biological sources containing chemical compounds that adversely affect pests, either by direct killing or indirectly by stopping their feeding or interfering with their biological processes. This can negatively impact their reproduction rate and generation numbers or act as repellents, thereby reducing or limiting their damage (Suleiman, 2005).

2. CONVOLVULUS ARVENSIS (FIELD BINDWEED)

2-1. Description, Classification, and Occurrence of Convolvulus Arvensis:

Locally known as Madrid or Alaiq, and in English as Deer's foot, it belongs to the family Convolvulaceae. This creeping and climbing herb can grow up to a meter long, with elongated, single, arrow-shaped or pointed leaves and trumpet-shaped white flowers with red or pink lines. This plant is widespread in various parts of Iraq, notably in the

Rawanduz, Dohuk, and Sulaymaniyah areas and central regions. It commonly grows in fields and along roadsides (Chakravarty, 1976).

The plant propagates through seeds or rhizomes. Convolvulus Arvensis causes significant losses in the total yield of many crops. Problems include reduced crop yield due to competition for various growth factors and reduced quality, especially when weed seeds are present in large quantities in crop seeds and grains, whether used for cultivation or consumption. The plant can reach a length of 0.4-2 cm, with roots spreading deep into the soil. The leaves are pale green with easily visible veins and flattened ridged petioles. The prevalent leaf varieties in this plant typically exhibit hastate or sagittate forms, characterized by distinctive arrowhead shapes featuring pointed lobes at their bases. Additionally, there are leaves with round, oval, or rectangular shapes, along with some that appear linear.

Stems are cylindrical and slender, extending along the ground or climbing on available supports. The stem's length is between 0.3 and 1.8 metres, or one to six feet, forming dense, tangled mats. The flowers consist of five fused petals forming a funnel-like corolla about 2-2.5 cm long, typically white to very pale pink. The pistil is composed of two slender stigmas. The fruits, measuring approximately 8 mm in width, are circular and exhibit a light brown hue. The seeds, ranging from dark brown to black, possess textured surfaces. Their length falls within the range of 0.5-1.2 cm, and their shape varies based on the number of seeds within the fruit. When a single fruit is produced, the seeds appear more rounded, gradually becoming thinner as more fruits develop, typically containing two seeds.

Regarding the root structure, the roots are slender and white, with the primary root having the ability to penetrate the soil to a depth of two to ten feet (0.5-3 m). Lateral roots emerge from buds along the main roots and lateral buds situated at the base of the stem, as depicted in Figure 2-2 (Arora & Malhotra, 2011; Mehrafarin, 2009).

Plantae is the Kingdom
The Magnoliophyta phylum
Magnoliopsida class
Arrangement: Solanales
Convolvulaceae family
Convolvulus is the Genus
Convolvulus scammonia is the species (Al-Snafi, 2016).

Figure (2-2): Madid Plant's Leaves and Flowers (Govaerts, 2019).

2-2. Chemical Composition and Uses of Convolvulus Arvensis:

Convolvulus Arvensis contains essential oils, some fatty acids, fixed oils, and about 6-8% resinous substances including jalapin, complexes of glycosidic acids, and ipuganol phyto sterol glucoside, which is soluble in petroleum. It also contains syto sterol glucoside, soluble in alcohol. Furthermore, the plant is rich in phenolic acids such as umbelliferon, scopoletin, vannilic, syringic, benzoic, protocatechuic, caffeic, chlorogenic, gentisic, p-coumaric, p-hydroxybenzoic, p-hydroxyphenylacetic, ferulic, and salicylic acid.

Additionally, it contains the following: 6-methoxy-7-hydroxycoumarin (scopoletin); 6,7-dihydroxycoumarin (umbelliferone); and 6-methoxycoumarin7-Oglucoside (scopoletin7-O-glucoside), as well as Kaempferol (Austin, 2000; Faraz et al., 2003; Elzaawely & Tamata, 2012; Kaur & Kalia, 2012).

3. MATERIALS & METHODS

3-1 Raising Tribolium castaneum, the Red Flour Beetle (Herbst)

The beetles were acquired from flour infested with the insects sourced from a mill in Samarra. The red flour beetle was cultivated using whole wheat flour, chosen for its elevated levels of Vitamin B1 and protein compared to white flour, as documented by Sinha and Mukerji in 1953. The nutritional content of whole wheat flour surpasses white flour due to its increased proportion of bran and germ. In contrast, white flour (grade zero) primarily comprises endosperm, starch, and gluten, as highlighted by Younis et al. in 1987.

Ten breeding facilities were established by utilizing sanitized 800 ml glass bottles, each filled with 10g of sterilized food medium. Each bottle accommodated ten pairs of insects, covered by muslin cloth and securely sealed with rubber bands. Subsequently, the colonies were introduced into an incubator set at a temperature of 28±2°C and a humidity level of 70±5%, following the protocol outlined by Annon in 1982.

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Following the adult insects' emergence, they underwent identification at the Museum of Natural History within the Department of Insects and Invertebrates, following the procedures outlined in the book numbered 16 dated 3/6/2019, provided in the appendices, to conduct subsequent tests. To obtain adult insects for these tests, the medium was refreshed every two months, as per the methodology described by Al-Hadidi in 1989.

3-1-1 Isolation of Red Flour Beetle Larvae

The adult insects were mainly separated from the larvae using a filter with 0.71 mm width holes, and then the third instar larvae were isolated using a sieve with 0.28 mm diameter holes from the breeding mediums and stored in the incubator until needed after being put in glass bottles.

3-1-2 Isolation of Adult Red Flour Beetles

The pupae were isolated from the breeding substrates, relocated with an equivalent breeding medium, and kept in the incubator. Daily scrutiny was performed to observe their progress and the subsequent emergence of adult insects, as detailed by Abbas in 1998.

3-2 Gathering and Categorization of Plants:

The Madrid plant was gathered from Samarra University's gardens. The selected plant parts (leaves) underwent a cleaning process to eliminate any attached foreign impurities. Subsequently, they were subjected to drying in an electric oven at 25°C, with consistent stirring over three days to prevent decay. After drying, each plant was stored in a paper bag under moisture-free conditions until it was ready for extraction and utilization in the experiment, following the procedure outlined by Supavarn et al. in 1974.

3-3 Making Plant Extracts: Ethanol Extract Preparation

The plant extraction was conducted within the laboratory of the Chemistry Department at Samarra University's College of Education, employing the methodology outlined by Riose et al. in 1987.

3-3-2 Procedure for Making Plant Aqueous Extracts

The preparation followed Harborne's (1984) methodology.

3-4 Effect of Attractant and Repellent Substances on the Red Flour Beetle:

The strength of attraction and repulsion of the plant extract for both larvae and adults of the red flour beetle was determined using three different concentrations for each plant extract, using a Chemotropometer. This device consists of a wooden box (96x20x20 cm) with a movable cover and two opposing openings through which a 100 cm long and 3 cm diameter graduated glass tube passes. The ends of the tube are blocked with cotton. The right side was treated with different concentrations to calculate the attraction and repulsion strength for each concentration and extract. Ten larvae for each concentration were introduced, with three replicates, and the experiment was repeated by introducing ten adults for each concentration and three replicates. The results were calculated after 15 minutes by recording the number of larvae and adults on each side of the opening of the graduated tube and measuring the distance they moved towards or away from the substance to calculate the strength of attraction or repulsion according to the equations below (Busvine, 1971).

Attraction Strength =

$$\frac{Total\ Distance\ Covered\ by\ the\ Insects\ Towards\ the\ Extract}{Number\ of\ Replicates}$$

Repellent Strength =

$$\frac{Total\ Distance\ Covered\ by\ the\ Insects\ in\ the\ Opposite\ Direction\ of\ the\ Extract}{Number\ of\ Replicates}$$

Table (3-1): Plants Used in the Study

Arabic Name	English Name	Scientific Name	Family	Parts Used
Convolvulus Arvensis	Deers Foot	Convolvulus Arvensis	Convolvulaceae	Leaves

Table (3-2): Equipment and Tools Used in the Research

Equipment and Tools	Manufacturer	Origin
Sensitive Balance	Sartorius	Canada
Electric Oven	Steri-Vac	U.S.A
Incubator	Memert	Western Germany
Rotary Evaporator	Yamato	Japan

Table (3-3): Materials Used in the Research

Material	Manufacturer and Origin
Absolute Ethanol	BDH
Acetone	=
Wheat Flour	Baghdad
Dry Yeast	Pachmaya

3-5 Statistical Analysis

The SPSS system (version 21.0) was used to analyse the findings with the following statistical tests:

- Independent Samples T-test
- One-sample T-test
- One-Way ANOVA
- Multiple Comparison Test

4. RESULTS AND DISCUSSION

4-1 Result of Repulsion and Attraction of Cynanchum (Madid) Aqueous and Alcoholic Extracts:

About the findings of the current paper about attraction and repulsion strength, According to the paper, at an amount of 3%, the maximum attraction rate for the aqueous Madrid extract was 9.3% after 72 hours, while the repulsion rate was 15.55% at the same concentration and duration. In contrast, the attraction rate aimed at the Madid 12.55% of the extraction was alcohol at a 1.50% absorption after 48 hours, and a repulsion rate remained at 19.8% at a 3% concentration after 72 hours in adult insects, as shown in Tables (4-14) and (4-15). The aqueous extract displayed no attraction for larvae at any concentration, with the highest repulsion rate recorded at 10.95% for a 4.5% concentration after 72 hours. Similarly, the alcoholic extract showed no attraction at any concentration, yet the repulsion rate reached 19.15% at a 3% concentration after 72 hours, as indicated in Tables (4-14) and (4-15).

Table 4-1: Impact of Various Aqueous and Alcoholic Madrid Extract Concentrations on Adult Red The flour Beetle Attract Rate after (24, 48, and 72) Hours of Therapy.

Plant Type	Extract Type	Extract Concentration (%)	Time/Hours		
			24	48	72
Madid	Aqueous	**1.5**	1.4	3.9	5.3
		3.0	3.0	4.9	7.0 ab
		4.5	4.5	6.2	5.2 bc
		Average Killing by Aqueous Extract	4.2 a	5.4 a	6.3 a
	Alcoholic	**1.5**	4.3	6.1	8.5 a
		3.0	3.0	8.5	10.3 a
		4.5	4.5	8.6	8.9 a
		Average Killing by Alcoholic Extract	7.1 a	8.6 ab	9.8 a
		Overall Average Killing	5.7 b	7.0 ab	8.1 a

Table (4-2): Impact of Various Aqueous and Alcoholic Madrid Extraction Concentrations on Red The flour Beetle (Tribolium castaneum) Larval Attract Rate after 24, 48, and 72 Hours of Therapy.

Plant Type (Madid)	Extract Type	Extract Concentration (%)	Time/Hours	24	48	72
	Aqueous	1.5		0	0	0
		3.0		0	0	0
		4.5		0	0	0
		Average Killing by Aqueous Extract		0	0	0
	Alcoholic	1.5		0	0	0
		3.0		0	0	0
		4.5		0	0	0
		Average Killing by Alcoholic Extract		0	0	0
		Overall Average Killing		0	0	0

Note: Identical letters show no important changes at the ($P \leq 0.050$) level, whereas dissimilar lowercase letters denote significant differences. "N" represents the number of samples.

Table 4-3: Impact of Various Aqueous and Alcoholic Madrid Extraction The amount on Adult Red The flour Beetle (Tribolium castaneum) Repulsion Rates following 24, 48, and 72 Hours of Therapy.

Plant Type (Madid)	Extract Type	Extract Concentration (%)	Time/Hours	24	48	72
	Aqueous	1.5		5.8	8.7	9.8 B
		3.0		8.9	11.4	11.0 bc
		4.5		9.45	12.4	12.5 b
		Average Repulsion by Aqueous Extract		7.1 b	9.9 b	12.3 a
	Alcoholic	1.5		7.6	11.25	13.3 A
		3.0		10.2	13.25	13.0 b
		4.5		15.5	17.6	17.6 a
		Average Repulsion by Alcoholic Extract		9.1 c	11.6 b	15.5 a
		Overall Average Repulsion		9.1 c	11.6 b	13.9 a

Table (4-4): Impact of Various Aqueous and Alcoholic Madrid Extract The amount on Red The flour Beetle (Tribolium castaneum) Larval Repulsion Rates after 24, 48, and 72 Hours of Treatments.

Plant Type (Madid)	Extract Type	Extract Concentration (%)	Time/Hours	24	48	72
	Aqueous	1.5		4.4	6.6	5.9 b
		3.0		3.2	5.2	5.2 d
		4.5		5.6	8.6	8.4 c
		Average Repulsion by Aqueous Extract		3.4 c	6.1 b	8.2 a
	Alcoholic	1.5		3.3	6.9	11.0 a
		3.0		10.4	15.2	14.9 a
		4.5		8.6	13.4	12.9 b
		Average Repulsion by Alcoholic Extract		5.4 c	11.2 b	14.2 a
		Overall Average Repulsion		5.4 c	8.6 b	11.2 a

Note: Identical letters show no important changes at the level of ($P \leq 0.050$), while dissimilar lowercase letters imply the presence of significant differences. "N" stands for the number of samples.

4-3 Effectiveness of Convolvulus Arvensis (Madid) Aqueous and Alcoholic Extract:

The results of the current study, as shown in Table (4-5), demonstrate the impact of Madrid plant extract on the mortality rates of adult red flour beetles (Tribolium castaneum). The highest mortality rate for adult red flour beetles was observed at a 4.5% concentration of the aqueous extract, reaching 33.3%. In comparison, the lowest mortality rate was 16.7% at a 1.5% concentration of the aqueous extract. In contrast, the highest mortality rate for adult red flour beetles with the alcoholic extract was 60% at a 4.5% concentration, and the lowest was 18% at a 1.5% concentration. Regarding the larvae, the results in Table (4-5) indicated that the highest mortality rate for larvae of red flour beetles was 66% at a 3% concentration of the aqueous extract, with the lowest being 35% at a 1.5% concentration. However, the highest mortality rate for larvae with the alcoholic extract was 73.7% at a 4.5% concentration, and the lowest was 43.8% at a 3% concentration.

Treatment with 800.0 mg/L of Madrid plant extracts resulted in more than half of thread-like cocoons not moulting and not transforming into adult stages. This corroborates the current study's findings regarding Madrid extracts' insecticidal and repellent capabilities. Researcher Zhen et al. (2013) indicated that Madrid plant extracts are highly effective in controlling S. litura and L. erysimi pests. They attributed this efficacy to phenolic compounds and alkaloids in Madid extracts, which kill and repel insects. This may explain the results of the current study regarding the ability of Madrid extracts to repel and kill red flour beetles.

Table (4-5) shows the mortality rates of adult red flour beetles after 24, 48, and 72 hours of therapy with various amounts of aqueous and alcoholic extracts.

Plant Type (Madid)	Extract Type	Extract Concentration (%)	Time/Hours	24	48	72
	Aqueous	1.5		10.0	13.3	18.1 B
		3.0		13.3	16.7	16.7 d
		4.5		16.7	23.3	24.4 c
		Average Mortality by Aqueous Extract		13.3 c	17.8 b	23.3 a
	Alcoholic	1.5		15.0	16.7	32.2 a
		3.0		21.0	31.0	31.8 B
		4.5		36.7	48.0	48.2 a
		Average Mortality by Alcoholic Extract		24.2 c	31.9 b	40.4 a
		Overall Average Mortality		18.8 c	24.8 b	31.9 a

Note: Identical letters show no important changes at the level of ($P \leq 0.05$), whereas lowercase letters imply the presence of significant differences. "N" stands for the number of samples.

Table (4-6): Impact of Varying Aqueous and Alcoholic Madrid extract the concentrations on Red The flour Beetle (Tribolium castaneum) Larval Mortality Rates after 24, 48, and 72 Hours of Therapy.

Plant Type (Madid)	Extract Type	Extract Concentration (%)	Time/Hours	24	48	72
		1.5		28.0	30.0	38.8 b
		3.0		16.7	33.3	35.6 c
	Aqueous	4.5		33.3	36.7	45.6 b
		Average Mortality by Aqueous Extract		26.0 c	33.3 b	57.1 a
		1.5		40.0	40.0	48.4 a
		3.0		26.7	36.7	43.8 b
	Alcoholic	4.5		40.0	40.0	51.2 a
		Average Mortality by Alcoholic Extract		35.6 b	38.9 b	70.8 a
		Overall Average Mortality		30.8 c	36.1 b	64.0 a

Note: Identical letters show no important variances at the ($P \leq 0.050$) level, whereas dissimilar lowercase letters denote significant differences. "N" represents the number of samples. The table shows the effects of the unlike absorptions of Madrid's watery and alcohol-based extracts on the red flour beetle larvae's death rates across different periods. The data is presented with letters indicating the statistical significance of the results.

The study aligns with researcher Mordue and others' (1998) findings regarding the impact of alkaloids isolated from C. mongolicum on the hormonal balance in insects and their competitive interaction with certain cell membrane proteins, affecting their function. In a study conducted by Sun et al. (2012), the physiological processes of the alkaloids extracted from the C. mongolicum Madrid plant were discovered. The research indicated that the effect of these isolated alkaloids on moulting hormone titers significantly influences the growth and development of insects. It was noted that increased concentrations of alkaloids led to more disturbances and higher mortality rates, especially after 72 hours post-treatment.

CONCLUSIONS

1. The plant extracts under the paper clearly impact the viability of the red flour beetle, distinguished by its great effectiveness in eradicating the beetle's whole life cycle. There is a noticeable difference in the effect of aqueous and alcoholic extracts on similar plant parts.
2. The death rates of the red flour beetle are directly correlated with the length of exposure to the alcoholic or watery plant extract.
3. The existence of secondary chemicals in extracts that are watery and alcoholic exhibits a strong repellent effect on insects. This repellent characteristic can be utilized to keep insects away from areas that need protection from infestation.

REFERENCES

I. Abbas, Sahla K. (1998). "Study of the Effect of Four Herbal Plants on the Red Rusty Flour Beetle Tribolium castaneum (Herbst.) (Coleoptera: Tenebrionidae)", Master's thesis, College of Education for Girls, University of Tikrit, p. 73.

II. Abdullahi, G.; Muhamad, R. and Sule, H. (2019). Biology, host range and management of red flour beetle Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae): A REVIEW. J. Agric. Res. 7(1): 48-64.

III. Ahmad, M., Khan, M. P. Z., Mukhtar, A., Zafar, M., Sultana, S., & Jahan, S. (2016). Ethnopharmacological survey on medicinal plants used in herbal drinks among the traditional communities of Pakistan. Journal of Ethnopharmacology, 184, 154-186.

IV. Al-Hadidi, I. A. M. (1989). "The Combined Effect of Temperature and Moisture Content of Wheat on the Viability of Three Types of Storage Insects Tribolium castaneum (Herbst.), Tribolium confusum Duval. (Coleoptera): Tenebrionidae, Oryzaephilus surinamensis. (Coleoptera: Silvanidae)", Master's thesis, College of Science, Salahaddin University, Ministry of Higher Education and Scientific Research, Republic of Iraq.

V. Alipour, G., Dashti, S., & Hosseinzadeh, H. (2014). Review of pharmacological effects of Myrtus communis L. and its active constituents. Phytotherapy Research, 28(8), 1125-1136.

VI. Al-Naaman, Adiba Y. Sharif Hamo (1998). "The Molecular Effect of Some Plant Extracts on the Growth and Metabolism of Gram-Positive and Gram-Negative Bacteria", Ph.D. thesis, College of Science, University of Mosul, Iraq, p. 77.

VII. Al-Rawi, Nawfal N. R., Awad Shaaban Dawood, B. M. M. (2013). "Effect of Some Wheat Varieties and Their Conditions on the Development Rate of the Red Rusty Flour Beetle Troguderma granarium (Everts) and Tribolium castaneum (Herbst.) and the Food Preference Under Laboratory Conditions", Tikrit Journal of Pure Science, Volume 18, Issue 4, pp. 1–7.

VIII. Al-Snafi A. E. (2016). The chemical constituents and pharmacological effects of Convolvulus arvensis and Convolvulus scammonia- A review. J. Pharm. 6(6): 64-75.

IX. Annon, M. R. (1982). "The Effect of Competition between Confused Flour Beetle and Rusty Flour Beetle Tribolium confusum (Duval) & Tribolium castaneum (Herbst) on Their Population Growth under Different Environmental (Laboratory) Conditions", Master's thesis, College of Science, University of Baghdad, Ministry of Higher Education and Scientific Research, Republic of Iraq.

X. Arora M and Malhotra M.(2011) . A review of macroscopical, phytochemical and biological studies on Convolvulus arvensis (field bindweed). Pharmacologyonline; 3: 1296-1305.

XI. Austin DF.(2000) . Bindweed (Convolvulus arvensis, Convolvulaceae) in North America from medicine to menace. Bulletin of the Torrey Botanical Club; 127(2): 172–177.

XII. Busvine , J.R. (1971) . Acritical Review Of The Technique For Testing Insecticides. 2nd ed., Commonwealth Agricultural, Bureau. 345P.

XIII. Chakravarty H (1976). Plant wealth of Iraq (A dictionary of economic plants) 1. Botany Directorate, Ministry of Agriculture and Agrarian Reform. Baghdad. Iraq.

XIV. Elzaawely AA and Tawata S2012. Antioxidant activity of phenolic rich fraction obtained from Convolvulus arvensis L. leaves grown in Egypt. Asian Journal of Crop Science 4(1): 32-40.

XV. Faraz M, Kamalinejad M, Ghaderi N and Reza H2003. Phytochemical screening of some species of Iranian plants. Iranian Journal of Pharmaceutical Research; 77-82

XVI. Harborne, J. B. (1984). Methods of plant analysis. In Phytochemical methods (pp. 1–36). Springer, Dordrecht.

XVII. Kaur M and Kalia AN. Convolvulus arvensis- A useful weed. Int J Pharm Pharm Sci 2012; 4(1):38–40.

XVIII. Mehrafarin A, Meighani F, Baghestani MA, Labbafi MR and Mirhadi MJ.2009 . Investigating morphophysiological variation in field bindweed (Convolvulus et al.) populations of Karaj, Varamin, and Damavand in Iran. African Journal of Plant Science 3 (4): 64-73.

XIX. Mordue, A.J.; Simmonds, M.S.; Ley, S.V.; Blaney, W.M.; Mordue, W.; Nasiruddin, M.; Nisbet, A.J.1998. Actions of azadirachtin, a plant allelochemical, against insects. Pestic. Sci. 54, 277–284.

XX. Mukerji , D. and Sinha , R.N. , (1953) . Effect of food on the life history of the flour beetle, Tribolium castaneum (Herbst) ., J. Kansas Ent. Soc. 26 (3): 118-124.

XXI. Riose ,J.L.,Recio,M.C.and Villar , A.(1987) .Antimicrobial activity of selected Plants employed in the Spanish Mediterranean area. J.Ethanopharmacol. , vol.21,pp: 139-152.

XXII. Suleiman, Amal Kamal (2005), "Toxicity of Some Plant Extracts Eucalyptus camaldulensis and Melia azedarach L. and Nerium oleander L. on the Viability of the Red Flour Beetle Tribolium castaneum (Herbst.) Tenebridae: Coleoptera)", Master's thesis, University of Tikrit, College of Education, Ministry of Higher Education and Scientific Research, Republic of Iraq.

XXIII. Sun, H.; Fu, X.; Chen, X.; Shi, W.P2012. Toxicity and influences of the alkaloids from Cynanchum mongolicum A.L. Iljinski (Asclepiadaceae) on growth and cuticle components of Spodoptera litura Fabricius (Noctuidae) larvae. Nat. Prod. Res. 26, 903–912.

XXIV. Supavarn, P., Knapp, F. W., & Sigafus, R. (1974). Biologically active plant extracts for control of mosquito larvae. Mosquito News, 34(4), 398-402.

XXV. Younis, A. H. A., Mahfouz Abdul Qader Mohammed, & Zaki Abdul Yass (1987). "The Nutritional Value of Wheat Grains", Ministry of Higher Education, University of Mosul, Dar Al-Kutub Printing and Publishing House, University of Mosul, Iraq-Mosul, p. 77.

XXVI. Zhen, C.A.; Guo, Y.Y.; Zhang, X.C.; Miao, J.; Shi, W.P. (2013). Optimization of conditions for extracting pesticidal alkaloids from Cynanchum mongolicum (Maxim.). Nat. Prod. Res. 27: 23–27.