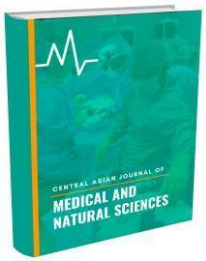

CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES
https://cajmns.centralasianstudies.org/index.php/CAJMNS
Volume: 06 Issue: 04 | October 2025 ISSN: 2660-4159

.

Article

The Biological Effect of The Aqueous Extract of Tumble Thistle (*Gundelia Tournefortii L.*) on The Biological Performance of The Southern Cowpea Beetle *Callosobruchus Maculatus* (Coleoptera: Chrysomelidae)

Hiba Ayad Mahmmod*[1], Adel Ali Haidar[2]

1,2 Department of biology, Faculty of puor sines, Karkuk University, Karkuk, Iraq
* Correspondence: epbm23003@uokirkuk.edu.iq

Abstract: Collection red bean seed samples(Phaseolus vulgaris) infected with the southern cowpea beetle (Callosobruchus maculatus) from local markets in Kirkuk city, starting from December 15, 2024, until April 25, 2025. Biological tests were conducted in the laboratories of the College of Education for Pure Sciences, University of Kirkuk. The tumble thistle plant (Gundelia tournefortii L.), which was collected from several vegetable shops, was extracted using known chemical methods, to study its toxic effects on the southern cowpea beetle. Three different concentrations of the extracts were used: 15%, 20%, and 25%. The study included the evaluation of several biological indicators of the insect, including the egg-laying rate. The results showed that the extract had a significant effect on the average number of eggs laid, as the number decreased with increasing concentration. The control group recorded the highest number of eggs, amounting to 166.6 eggs \ 40 g , while the numbers within the aqueous extract treatments were as follows: 73.3, 66.6, and 60 eggs for the stems, and 73.3, 73.3, and 66.6 eggs for the leaves, at concentrations of 15, 20, and 25%, respectively. The control group also recorded the highest number of emerging insects, amounting to 146.6 insects, while the number decreased with the treatment with the extracts, as the aqueous extract of the stems recorded 66.6, 46.6, and 53.3 insects, and the aqueous extract of the leaves recorded 60, 53.3, and 46.6 insects. The results showed an inverse relationship between the concentrations of the extracts and the percentage of emerging insects, as the percentage decreased with increasing concentration.

Keywords: Gundelia Tournefortii, Callosobruchus Maculatus, Plant Extracts, Cowpea Seed Protection, Oviposition Inhibition

Citation: Mahmmod, H. A., Haidar, A. A. The Biological Effect of The Aqueous Extract of Tumble Thistle (*Gundelia Tournefortii L.*) on The Biological Performance of The Southern Cowpea Beetle *Callosobruchus Maculatus* (Coleoptera: Chrysomelidae). Central Asian Journal of Medical and Natural Science 2025, 6(4), 1700-1706.

Received: 22nd Jun 2025
Revised: 29th Jun 2025
Accepted: 20th Jul 2025
Published: 31th Jul 2025

1. Introduction

Red beansCowpea (Vigna ungucuata) is an economically important legume crop in the world, especially in Asia, Africa and America [1]. It has multiple uses, as it is considered food for humans, fodder for livestock, and a profitable cash crop for farmers and small business owners [2]. The legume family Fabaceae F is one of the most important plant families, as it includes 600 genera and about 1,300 species, but only 18 species of them are used by humans as fodder A. The most important of these is broad beans.Vicia faba LentilsLens culinaris, bean Phaseolus lunatus, mung bean Vigna radiate, pea Pisum sativum and cowpea Vigna ungucuata [3].

This crop is exposed to various damages in various ways, including contamination with insect feces, which exceeds the damage resulting from direct feeding and damage caused by infection, and because of this, its commercial value decreases.Desirability among consumers Jihad and his group, [4] This occurs due to several factors, the most important of which is the mixing of the bodies of complete insects or parts of them or their different stages, such as the egg, larva and pupa, with grains or their products or their molting skins, eggshells, and cocoons, accompanied by unpleasant odors [5] In addition, there is a direct relationship between the rates of seed weights and the weight lost when infected [6].

The southern cowpea beetle *Callosobruchus maculatusbelonging* to the order Coleopterais one of the important insect pests in grain stores around the world due to its ability to cause damage to different types of grains, including beans, as severe infections cause huge losses in weight loss [7]. Stored grains and their products are estimated due to their exposure to For more than one insect pest with huge economic losses estimated at about 10-40%From the world's stock [8],[9] Stored insect pests are a global problem as they reduce the quantity and quality of grain consumed. As a result of the excessive use of pesticides and their negative effects on the environment, researchers have turned to finding safe alternatives to control stored materials and reduce their damage and harm[10].

The mountain heelsTumble Thistle (*Gundelia tournefortiiL.*) as shown in Figure 1, belonging to the Asteraceae familyF: Asteraceae, one of the largest and most diverse plant familieswhose extracts can be used as insecticides, also known as the "composite family."Compositae [11] is called by a number of common names in the Arab world. This multiplicity is attributed to the geographical, cultural, and linguistic diversity among countries and local communities. The most prominent common names are: Akoub, Kaib, Christians' thorn, Kharshaf, and Salbin.heelsMountain, bird or bird, horn, honey, and gornej [12], [13], This reflects the plant's deep roots in the food and medicinal culture of those environments. Its many names also indicate its historical presence and importance in the daily lives of rural communities, whether Was it For food purposes MT herapeutic [14], [15] and it has importance in the traditional diet and medicinal use and as a source of income for communities, especially rural ones in these countries [16]. Research reports indicate the discovery of a group of free amino acids, including lysine.Lysine, alanine, threonine, leucine, and phenylalanine were harvested from Lebanon and Jordan [17]. Given the damage caused by pesticides in general as environmental pollutants, carcinogens, mutagens, and the emergence of resistant generations, this plant was used in our study as a safe and inexpensive insecticide against this insect.

Related Work

Beetle Breeding

Southern Beans *Callosobruchus maculatus*

Southern cowpea beetle individuals were collected from infected local cowpea seeds from local markets in Kirkuk city from August 3 to 6, 2024, and identified and classified at the Iraqi Natural History Museum.- University of Baghdad Annex 1, infected seeds were placed in 400 ml glass bottles, 100 g/bottle, the nozzles were sealed with a cloth for ventilation, tied with rubber bands and placed in an incubator at a temperature of1±30°Cand relative humidity 5±70%To allow the insect to reproduce and lay eggs for a week, the adults were isolated to obtain the first generation individuals.F1, and insect farms were continuously renewed to obtain immature stages for laboratory experiments and to remove the skins of molts. New farms were allocated after isolating the newly emerged adults from the old farms and adding them to the healthy seeds [18].

Collect Seeds

Red bean seeds were collected from local markets in Kirkuk city during the period from March 1 to 5, 2024, and stored in a freezer at a temperature of20°C for 24 hours to eliminate any insect stages that may be present on or inside the seeds [19].

Preparation of Mountain Heel Extract

Gundelia tournefortiiL

I collected Heel plants from the local markets of Kirkuk city for the period from March 202024To 29 of it, picture 7 was cleaned and washed well to remove impurities, and the leaves were separated from the stems and both parts were exposed to air to dry at room temperature for 25 days. Their final weights after drying ranged (3000 ± 10 g), and were ground using an electric grinder mixer brand RAF as shown in Figure 2 , of German origin and was sieved through a 0.08 mm sieve to obtain its fine powder and stored separately. [20] in dark, tightly sealed bottles to prevent light from reaching them until use.

Extraction of the Heel Plant

Aqueous extracts of the leaves and stems of this plant were prepared using the following extraction methods:

Preparation of Aqueous Extracts

Aqueous extracts of heels were prepared at a weight of 201 gram of powdered leaves and stems were taken separately and 200 ml of deionized water was added to it. The result was 220 ml of the infusion solution, i.e., in the ratio (1:01 weight/volume) [21]. It was placed in the refrigerator at 3°C for 24 hours for the purpose ofTNaqYA [22], filtered through several using Qualitative filter papers to get rid of the unground parts and fiber residues, the extracts were poured into sterile glass containers and placed in an electric oven as shown in Figure 3 at a temperature of 40 for 24 hours to completely evaporate the water and to preserve the active ingredients. After drying, they were placed in sterile, tightly sealed plastic containers and stored in the refrigerator away from light until use [23].

Preparing the Concentrations for The Experiment

A0.25 g of each of the extracts was dissolved separately in 10 ml of water and alcohol to obtain solutions with concentrations of 2500%. These solutions were diluted to obtain concentrations of (15%, 20% and 25%) by using the dilution law C1V1=C2V2.

2. Materials and Methods

To determine the effect of heel extracts on insect productivity, cowpea seeds were frozen at -20°C for sterilization for 24 hours and soaked in heel solution for 10 minutes. Focus on one thingSpread on filter papers for drying at laboratory temperature, and distribute insideforYballsAt a rate of 40 grams for each and with three replicates for each concentration. Five pairs of adult insects (5 males/5 females) were introduced.) inside it andcloseTMouthAccuseUsing clothtoelastic bands And hugged in the incubatorAt 30 degrees2±andHumidity 75+5% and the rate of egg numbers was calculated after the death of insects. For each concentration ofHeel solutionBy applying the Abbott equation Abbot formula [24] The rate of complete exit [25] is according to the following equation:

Figure 1. The Tumble Thistle (Gundelia tournefortii L.)

FigurE 2. Electric grinder.

Figure 3. Electric oven.

3. Results and Discussion

As shown in Table 1 , the demonstrated the effect of alcoholic and aqueous extracts of Gundelia tournefortii at different concentrations on the number of eggs laid by Callosobruchus maculatus adults. The highest oviposition rate was observed with the aqueous extract of stems and leaves at a 15% concentration, reaching 73.3 eggs per 40 g of cowpea seeds, compared to the control group, which recorded approximately 200 eggs per 40 g. An inverse relationship between extract concentration and the number of eggs laid was evident. For the aqueous stem extract, the numbers at 15%, 20%, and 25% concentrations were 73.3, 66.6, and 60 eggs, respectively, and for the aqueous leaf extract, the corresponding values were 73.3, 73.3, and 66.6 eggs.

These results align with the findings of Idoko and IIeke, who reported significant differences in the oviposition rates of C. maculatus when exposed to different plant extracts throughout their lifespan. This inverse relationship may be attributed to the insect-repellent properties of the extracts, which reduce contact with the seeds and subsequently decrease egg-laying activity. It is also possible that the adult beetles were affected—perhaps fatally—before oviposition, due to the presence of active compounds such as malic acid, which interferes with the insect nervous system causing irritation or temporary paralysis, and tannins, which are natural chemical compounds with notable physiological impacts on insects.

In pest management, such extracts act as astringents, affecting the insect's digestive tract, impairing food digestion, and thereby limiting growth and reproduction. Recent studies have demonstrated that Gundelia tournefortii extracts significantly influence insect biological cycles, particularly oviposition and adult emergence rates. This suggests the potential of this plant to disrupt both reproductive and developmental processes in insect pests. These effects are largely attributed to biologically active constituents including flavonoids, terpenoids, and essential oils.

For instance, in a study on the whitefly Bemisia tabaci, Gundelia tournefortii extracts significantly inhibited oviposition, with various concentrations leading to a marked reduction in the number of eggs laid and adult emergence compared to the control, indicating a potential inhibitory effect on immature developmental stages, Bagheri et al.

Table 1. The Extract effectplants Heelsmountainous in productivity KLobby postpartumASouthern C.maculata.

% of productivity	Average number of emergents For every 40 grams of bean seeds	Average number of eggs laid	% For the abstract	Abstracts
d 90.85	66.6a	73.3b	15%	
96.69d	46.6c	66.6b	20%	legs
d88.83	53.3d	60b	25%	water
d85.81	60b	73.3b	15%	
c72.71	d53.3	73.3b	20%	papers
c69.96	46.6c	66.6b	25%	water
5.57	6.78	7.23		LSD5%
.77a86	a146.6	a166.6		control

Numbers with similar letters in the same column mean that there are no significant differences at the probability level.$p<0.05$.

As for the emergence of C. maculatus adults, our findings revealed that aqueous extracts of G. tournefortii affected emergence rates at different concentrations. The highest emergence (66.6 adults/40 g seeds) was recorded with the 15% aqueous stem extract, whereas the lowest (46.6 adults/40 g seeds) occurred with the 25% aqueous leaf extract, compared to 146.6 adults/40 g in the control group. Again, an inverse relationship was observed between extract concentration and emergence rate. For stem extract concentrations of 15%, 20%, and 25%, the number of emerged adults was 66.6, 46.6, and 53.3, respectively; for the leaf extract, the values were 60, 53.3, and 46.6, respectively.

4. Conclusion

This reduction is likely due to the action of flavonoids, terpenoids, and polyphenolic compounds known for their neurotoxic or physiological disruptive effects. Hassan and El Nemr noted that such compounds interfere with insect neural function or essential life processes such as feeding and reproduction, thus decreasing egg hatchability or causing larval mortality. These extracts may also act as repellents and anti-feedants, forming a film over the insect's body that restricts movement and causes death Kordy et al. Additionally, the presence of alkaloids, sulfur compounds, and phenolics in these extracts may contribute to their evident insecticidal action Isman. Ultimately, a marked reduction in adult emergence was achieved.

The effect of extracts of the mountain heel plant on reducing the rate of egg laying and the duration of the larval and pupal stages, leading to an increase in the duration of their development, as well as its effect on the rate of adult emergence. An inverse relationship was found between the concentration of extracts of the mountain heel plant and the percentage of killing without causing disfigurement. The effectiveness of mountain heel plant extracts as repellents for the southern cowpea beetle. The activity of the alcoholic extract of the mountain heel plant as a protective material for cowpea seeds prepared as seeds due to its lack of effect on germination.

REFERENCES

[1] P. Watcharatpong, A. Kaga, X. Chen, and P. Somta, "Narrowing down a major QTL region conferring pod fiber contents in Yardlong bean Vigna unguiculata, a vegetable cowpea," *Genes*, vol. 11, p. 363, 2020.

[2] N. Abdullahi, "The effect of insecticides and air-tight storage on the storability of cowpea in Maiduguri, Nigeria," *African J. Gene. Agr.*, vol. 6, no. 1, pp. 31-37, 2010.

[3] A. Al-Jasani, "Impact of some plants' medical properties in combating economic insects," M.S. thesis, College of Agriculture, University of Baghdad, Iraq, 2007.

[4] M. M. Jihad, A. A. Haider, and M. O. Mohammed, "The biological effect of some plant oils on the life of the Callosobruchus maculatus (Fab) (Coleoptera: Bruchidae)," *Samarra J. Pure Appl. Sci.*, vol. 4, no. 3, pp. 38–45, 2022.

[5] A. A. Haider and S. M. Abdullah, "The biological effect of some plant oils on the life of Callosobruchus maculatus," *Tikrit J. Pure Sci.*, vol. 20, no. 2, pp. 71–79, 2020.

[6] A. H. Hassan, "Biological and molecular study of the southern cowpea beetle Callosobruchus maculatus (Fab.) (Coleoptera: Chrysomelidae) on four cowpea seed cultivars," PhD thesis, College of Education, Tikrit University, Iraq, 2013.

[7] N. A. G. Muhammad and A. A. Haider, "A practical study of the camouflage of the southern cowpea beetle Callosobruchus maculatus F. (Coleoptera: Chrysomelidae)," *J. Agr. Bio. Sci.*, vol. 2, no. 6, pp. 21–26, Jun. 2024.

[8] S. Iron, N. Khamas, and H. Matni, "Impact of using some spices in combating adult insects in flour," *Diyala J. Agric. Sci.*, vol. 6, no. 6, pp. 248–257, 2014.

[9] H. Nakakita, "The use of physical control methods for product protection," *J. Stor. Prod. Resh.*, vol. 34, no. 3, pp. 197–206, 1998.

[10] D. S. Bulus, "Efficacy of some plant powders in the control of maize weevil (Sitophilus zeamais) on stored maize grains," *Inter. J. Sci. Nature*, vol. 3, no. 2, pp. 406–410, 2012.

[11] I. Açar, "The role of plant extracts in the control of storage pests: A review," *Turkish J. Agr. For.*, vol. 42, no. 5, pp. 345–356, 2018.

[12] M. Nassar, "Botanical insecticides: Impact on storage pest management," *Egyptian J. Agr. Resh.*, vol. 93, no. 2, pp. 321–330, 2015.

[13] J. Eghbariah, "Traditional Arabic Palestinian herbal medicine (TAPHM)," M.Sc. thesis, An-Najah National University, Academia.edu, Iraq, 2020.

[14] S. Baydoun, N. A. Apostolides, and T. Ulian, "Gundelia tournefortii L. (Akkoub): A review of a valuable wild vegetable from the eastern Mediterranean," *Genetic Resources Crop Evol.*, vol. 71, pp. 3987–3995, 2024. [Online]. Available: https://doi.org/10.1007/s10722-024-01927-2.

[15] M. Saeed, "Gundelia: A systematic review. Medicinal and molecular perspectives," *Pak. J. Biol. Sci.*, vol. 16, no. 24, pp. 1238–1247, 2013.

[16] S. Lev-Yadun, "Why do some plants have aposematic thorns?" *J. Theor. Biol.*, vol. 198, no. 3, pp. 619–626, 1999.

[17] A. G. Taylor, "Seed treatments: past, present, and future," *Seed Sci. Resh.*, vol. 29, no. 1, pp. 1–10, 2019.

[18] F. Kalaf, T. Mustafa, and A. H. Haidar, "Use of some nanomaterials as insecticides against the saw-toothed grain beetle Oryzaephilus surinamensis L. (Coleoptera: Silvanidae)," *Kirkuk Uni. J. Agri. Sci.*, vol. 13, no. 3, pp. 159–174, 2022.

[19] M. Shaho Mirza and R. Rokhush, "Combating southern cowpea beetle (Coleoptera: Bruchidae) Callosobruchus maculatus: Some chemistry-free solutions," *College Research Magazine*, vol. 11, no. 1, pp. 494–505, 2011.

[20] N. Q. Haj, L. E. Mohammood, and M. Mo, "Synthesis and biological evaluation of three new chitosan Schiff base derivatives," *ACS Omega*, vol. 5, no. 23, pp. 13948–13954, 2020.

[21] D. Sharma, N. K. Sharma, and U. N. Dwivedi, "Evaluation of aqueous and ethanol extract of medicinal plants," *J. Medicinal Plant Resh.*, vol. 7, no. 9, pp. 496–503, 2013.

[22] S. A. Azeez, O. S. Omotoso, and M. A. Azeez, "Phytochemical analysis and antioxidant activities of aqueous stem extract," *Asian Pac. J. Trop. Biomed.*, vol. 3, no. 3, pp. 203–207, 2013.

[23] N. Elnaker, M. A. Farag, A. Porzel, and L. A. Wessjohann, "A metabolomics approach to evaluate the effect of lyophilization versus oven drying on the chemical composition of plant extracts," *Sci. Rep.*, vol. 11, p. 22679, 2021.

[24] W. S. Abbott, "A method of computing the effectiveness of an insecticide," *J. Econ. Entomol.*, vol. 18, no. 2, pp. 265–267, 1925.

[25] H. The Virgin Blossom Slave and H. Glorious Hamed, "Impact of the rosary plant Melia azedarach in combating the southern cowpea beetle Callosobruchus maculatus," M.S. thesis, College of Education, University of Mosul, Iraq, 1999.