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Effect of aqueous extract of M. communis to attract and expel Tribolium castaneum adults and larvae at different concentrations

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ABSTRACT

The results of the current study showed in terms of the force of attraction and expulsion. The current study showed that the highest percentage of attraction for the water extract of the myrtle plant was 17.3% at the concentration of 1.5% after 72 hours, while the percentage of the expulsion was 25.3% at the concentration of 3% after 72 hours, while the percentage of attraction for the alcoholic extract was 17.3 % at the concentration 1.5% after 48 hours, while the expulsion percentage was 33.2% at the concentration 3% after 72 hours in the whole insects. As for the larvae, the highest percentage of attraction to the aqueous extract was 0.0% in all concentrations, while the repellent percentage was 16.3% at the 3% concentration after 72 hours, while the percentage of attraction to the alcoholic extract was 0.0% in all concentrations, while the expulsion percentage was 24.6% at the 3% concentration after 72 hours. hour.

Keywords: *Tribolium castaneum , M. communis , larvae , Adults*

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INTRODUCTION

Since the red rusty flour beetle, Tribolium castaneum (Herbst), is one of the most damaging pests of ground grain products like flour, bran, groats, etc., and since pesticides contaminate these materials and breed pesticide-resistant red rusty flour beetles, it is important to find alternatives to pesticide use (Abdullahi. and others, 2019).

Insects are one of the most important animal groups for humans and this is due to their economic importance. Every year and in every country, they cause great economic losses in crops, animals and stored products, as well as transmitting dangerous diseases to him and his animals. On the contrary, some other insects are beneficial to humans to pollinate plants and increase the yield or To produce useful materials (Khambay, 1999).

Several previous studies indicated that some plant extracts proved efficient in inhibiting the growth of bacteria and insects, (Al-Numan, 1998; Abbas, 1998, as it is believed that the inhibitory effect of these extracts lies in their essential oils (Sarac, Tunc, 1994: Alipor et al. 2014).

communis Myrtus

The myrtle plant or Myrtus communis belongs to the order Myrtus communis, which includes 23 families, including the Myrtaceae family (Liu et al., 2016), the family Myrtaceae (Family-Myrtaceae), which is derived from the Greek word Myrtus meaning Myrtle myrtle and Communis meaning common in the earth because it is a plant that grows and exists In the form of aggregates, it is an aromatic plant in the form of an evergreen shrub with a height of 1.8-2.4 m with a summit, native to southern Europe, North Africa and western India and is abundant in gardens because of its aromatic flowers (Basu and Kirtikar, 1988; Stuart, 1994). The stem of the plant is branched into many branches containing evergreen leaves of dark green, glossy, aromatic, spear-shaped, the length of the leaf is 3.8 - 2.5 cm. Greenish-black or white, kidney-shaped, sweet pea-sized fruits, 1.2-0.7 cm in size (Hennia et al., 2019). Elias plant is found in wet as well as shaded places and can withstand summer heat and lack of water in the soil (AL-Hadeethi, 2016).

Kingdom Plantae – Plants
Subkingdom Tracheobionta – Vascular plants
Superdivision Spermatophyta – Seed plants
Division Magnoliophyta – Flowering plants
Class Magnoliopsida – Dicotyledons
Subclass Rosidae
Order Myrtales
Family Myrtaceae – Myrtle family
Genus Myrtus L. – myrtus
Species *Myrtus communis* L.

Figure (2-1): Flowers and leaves of the myrtle

The myrtle plant contains fiber, sugar, antioxidants and many biologically active substances (Dogan, 1978). Like phenolic anthocyanins, flavonoids, myrtle fruits are the main source of active substances. The seeds of the plant produce 15-12% fixed oil consisting of glycerides and fatty acids lauric, olic, linoleic, myris tic, Rastogi and Mehrotra, 1991). Studies indicate that the analysis of the fruit of the myrtle plant contains 14 types of fatty acids, olic acid being the dominant over the rest of the other fatty acids and forms 70-67%, followed by palmatic acid 10–24% and 8-19% stearic acid. The fruit of the myrtle M. communis is the main source of myrtle oil and the oil is greenish-yellow with a refreshing aroma (Giacomo, 1983; Alipor et al. 2014). Myrtle oil contains many active substances that give it its distinctive smell, such as Methyl Benzoate, Myrcene, Benzyl Alcohol, Lianalyl Acetate, Methyl Geranate, Myrtenol, Eucalyptol And Butyl, Butyrate,

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(Rastogi and Mehrotra 1993; Jerkovic et al. 2002; Yadegarinia et al. 2006; Sacchetti et al. 2007; Akin et al., 2010; Berka-Zougali et al., 2012).

The economic and medicinal importance of the myrtle plant

The myrtle plant has been used since ancient times, as the ancient Greeks used it, and the therapeutic dose was 3-5 grams of its fruits (Hakeem 1895). It was also used in traditional medicine to treat some conditions such as diabetes, diarrhea, severe diarrhea, treatment of foot ulcers, fetid ulcers and internal ulcers, bleeding, sprains, rheumatism and fractures. It is used in the manufacture of oils to protect and strengthen the hair, as it is mixed with other oils to strengthen and increase hair growth for its hair-strengthening properties, as well as for the treatment of mental and bladder diseases. 1994; Flaminia et al. 2004; Miraj and Sadegh, 2016).

Its fruits and leaves are also used in the treatment of newborn children who suffer from redness of the skin and are useful as they contain anti-inflammatory and analgesic substances. et al., 2008) and insect repellent (Traboulsi et al., 2001). It is also recommended to take it for its benefits as it contains antioxidants and can protect the body because it contains hydrogenated fats that inhibit the action of free radicals (Serce et al., 2010). In the present endowment, myrtle fruit jam is used. As a food rich in vitamins. The plant also contains fibers, sugars, antioxidants, and many effective biological compounds, including phenols and flavonoids (Hayder et al., 2004).

Description of the red rusty flour beetle

The adults of the rusty flour beetle T.castaneum are characterized by being insects of small size, and the whole has a flat shape, about 4-3 mm in length and about 1 mm in width, the antennae are macelic and ends with three large brains of approximately equal sizes, and on the head and front chest there is a minute mortise as well as On the two sheaths, its sheath is striped with long, sunken lines interspersed with pits, and the larva is white at the beginning of its formation and then becomes yellowish and cylindrical in shape, and there are two short prongs of brown color on the end of the abdomen. And it goes through a dormancy stage that lasts 7-15 days before it metamorphoses into a full insect. (1990, Dennis; Devi et al. 2015; Etebari and Asgari 2016).

As for adults, they are very active and move quickly when they are anxious and disturbed. The average life of the red rusty flour beetle is one year (Dennis, 1990). All phases of the rusty red flour beetle are found in warm places throughout the year, and their activity increases in the summer and spring, as the temperature and humidity Their optimum growth is 53 m and 70% respectively (Solomon, 2005; Gullan and Cranston, 2014).

MATERIALS & METHODS

Ten farms were prepared, where clean and sterilized glass bottles of (800) milliliters were prepared in which 10 g/vial of sterile nutrient medium was placed in them, then ten pairs of insects were placed for each bottle. Then the colonies were placed in an incubator at a temperature of 2±28°C and a humidity of 5±70% (Anon, 1982).

After the complete insects came out, they were diagnosed in the Natural History Museum / Department of Insects and Invertebrates according to Book No. 16 dated 3/6/2019 attached in the appendices, to conduct tests on them, and the medium is renewed every two months to obtain complete insects for subsequent tests (Al-Hadidi, 1989).

Isolation of red rusty flour beetle larvae

The adults were first isolated from the larvae by means of a sieve with holes diameter of 0.71 mm, then the third larval stage by means of a sieve with holes diameter of 0.28 from the culture media and placed in glass bottles and kept in the incubator until needed.

Preparation of plant extracts Ethanol extranet

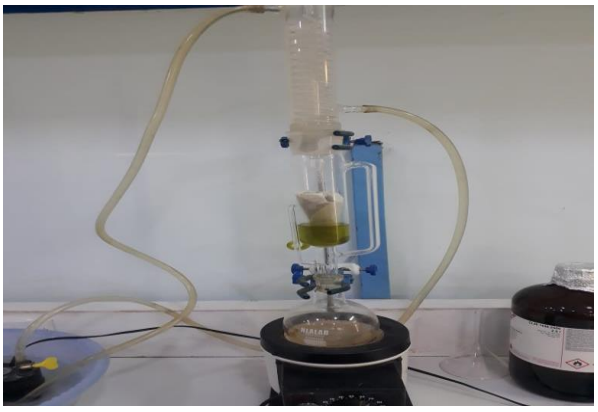
The plant extracts were prepared in the Graduate Studies Laboratory / College of Education - University of Samarra by using the method (Riose et al. 1987), where the used dried plant parts (leaves) were crushed by an electric grinder.

Until a fine powder was obtained, and then two solvents were used to dissolve the extracts of the used plant parts, one of them was an organic solvent (ethyl alcohol) and the other was an inorganic solvent (distilled water). The ratio of the dry plant parts used to the solvent was (1 g: 20 ml) in the extracts.

Preparation of ethanolic leaf extracts

Weighing 40 g of dry powder of the myrtle plant (leaves) in the extraction container (Extraction Thamble) and the extraction process was carried out using the device (Soxhlet extracter) Figure (3-1). Using 500 ml of organic solvent ethyl alcohol with a concentration of 97% and a boiling point of (60) C, the heating continued until the dark vegetable color had disappeared. This process took from (5-24) hours each time, depending on the type of plant.

After the extraction process, the solvent was evaporated from the extract under low pressure and a temperature of 60°C using a rotary vacuum evaporator device, and the extract was obtained in a thick viscous shape, where it was kept in sterile and dark colored glass bottles with a cap of (50) ml capacity with the name of the plant and the plant part written on it. The extract, the weight of the extract and the date of extraction, after which it was kept in the refrigerator until use at a temperature of 5°C (Islam, 1983).



Soxhlet extractor

Preparation of aqueous extracts of study plants

The method of Harborne (1984) was used to prepare the extracts, as 10 g of dry matter powder of the leaves of the myrtle plant was taken and 200 ml of cold distilled water was added to each of them and mixed for 15 minutes by means of a magnetic mixer. The solution was left for 24 hours at laboratory temperature and the solution was filtered using The filtrate was transferred to a centrifuge at a speed of 3000 rpm for 10 minutes to precipitate the suspended plant parts and obtain a clear solution. The clear solution was isolated and dried in an electric oven at a temperature of 45 °C, then the dried powder of the extract was weighed and kept in the refrigerator until use. As for the boiled water extract of plants, it was prepared with the same previous steps, except that the distilled water used in the preparation was boiled for the purpose of testing the effectiveness of the water extract of plants in killing the whole and larvae of the red rusty flour beetle. , 5 g of dry powders of plants respectively in 100 ml of distilled water, while the control concentration is treated with distilled water only.

RESULTS AND DISCUSSION

Effect of attraction and expulsion of M. communis water and alcohol plants: -

The results of the current study showed in terms of the force of attraction and expulsion. The current study showed that the highest percentage of attraction for aqueous extract was 16.2% at concentration 1.5%, and the lowest percentage of attraction for aqueous extract was 8.3% at concentration 3% after 24 hours, while the highest percentage of expulsion was 25.3% at concentration 3% after 72 One hour and the lowest percentage of expulsion was 15.3% at the concentration of 1.5% after 72 hours, while the highest percentage of attraction for the alcoholic extract was 17.3% at the concentration of 1.5% after 48 hours and the lowest percentage of attraction for the alcoholic extract was 4.3% at the concentration of 0.75% after 24 hours, while the highest percentage of expulsion was for the extract The alcoholic was 33.2% at 3% concentration after 72 hours in whole insects and the lowest percentage of expulsion of the alcoholic extract was 12.8% at concentration 0.75% after 24 hours in whole insects as shown in Table (1) and (2). As for the larvae, the highest percentage of attraction to the aqueous extract was 0.0% in all concentrations,

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while the repellent percentage was 16.3% at the 3% concentration after 72 hours, while the percentage of attraction to the alcoholic extract was 0.0% in all concentrations, while the expulsion percentage was 24.6% at the 3% concentration after 72 hours. hour as shown in Table (3) and (4).

TABLE 1: Effect of different concentrations of aqueous and alcoholic extracts of M. communis on attraction rates of red rusty flour beetle adults after (24, 48 and 72) hours of treatment

Average Kill Extract	Average concentration	time/hour			extract concentration	Extract type	plant type
		72	48	24			
11.5 a	9.6 c	11.7	8.9	8.1	0.75	aqueous extract	M. communis
	16.2 a	17.3	16.1	15.3	1.5		
	8.6 c	11.1	8.3	6.3	3.0		
		13.4 a	11.1 b	9.9 b	Average kill by aqueous extract		
8.2 b	7.3 c	10.3	7.2	4.3	0.75	Alcoholic extract	
	11.8 b	12.3	12.8	10.3	1.5		
	5.4 d	2.6	5.4	8.3	3.0		
		8.4 a	8.5 a	7.6 a	Average kill with alcoholic extract		
		10.9 a	9.8 a	8.8 a	Average overall homicide		

TABLE 2: Effect of different concentrations of the aqueous and alcoholic extract of M. communis on the expulsion rates of the red rusty flour beetle whole after (24, 48 and 72) hours of treatment

Average Kill Extract	Average concentration	time/hour			extract concentration	Extract type	plant type
		72	48	24			
15.6 b	10.5 e	13.2	10.1	8.3	0.75	aqueous extract	M. communis
	15.2 d	15.9	15.3	14.3	1.5		
	21.0 b	25.3	19.3	18.3	3.0		
		18.1 a	14.9 b	13.6 b	Average kill by aqueous extract		
19.4 a	13.9 d	15.3	13.5	12.8	0.75	Alcoholic extract	
	17.9 c	22.3	16.1	15.3	1.5		
	26.5 a	33.1	24.3	22.1	3.0		
		23.6 a	18.0 b	16.7 b	Average kill with alcoholic extract		
		20.9 a	16.4 b	15.2 b	Average overall homicide		

TABLE 3: Effect of different concentrations of aqueous and alcoholic extracts of M. communis on attraction rates for red rusty flour beetle larvae after (24, 48 and 72) hours of treatment

Average Kill Extract	Average concentration	time/hour			extract concentration	Extract type	plant type
		72	48	24			
0	0	0	0	0	0.75	aqueous extract	M. communis
	0	0	0	0	1.5		
	0	0	0	0	3.0		
		0	0	0	Average kill by aqueous extract		
0	0	0	0	0	0.75	Alcoholic extract	
	0	0	0	0	1.5		
	0	0	0	0	3.0		
		0	0	0	Average kill with alcoholic extract		
		0	0	0	Average overall homicide		

TABLE 4: Effect of different concentrations of aqueous and alcoholic extracts of M. communis on expulsion rates of rusty red flour beetle larvae after (24, 48 and 72) hours of treatment

Average Kill Extract	Average concentration	time/hour			extract concentration	Extract type	plant type
		72	48	24			
9.2 b	6.7 e	9.6	7.1	3.5	0.75	aqueous extract	M. communis
	8.9 d	12.2	9.6	5.0	1.5		
	12.1 c	16.3	13.3	6.7	3.0		
		12.7 a	10.0 b	5.1 c	Average kill by aqueous extract		
14.7 a	10.1 d	13.6	9.9	6.8	0.75	Alcoholic extract	
	14.9 b	19.2	15.2	10.3	1.5		
	19.1 a	24.6	20.1	12.7	3.0		
		19.1 a	15.1 b	9.9 C	Average kill with alcoholic extract		
		15.9 a	12.5 b	7.5 c	Average overall homicide		

With regard to the results of the current study and the force of attraction and repulsion of myrtle against the red rusty flour beetle, it agreed with the results of the study of Al-Mallah et al. (2012), which indicated the effect of the extract of myrtle as an attractant and repellent for Indian flour moth larvae. The researcher noted that the results of his study varied in the degree of response to the extract of the plant. Ace between attraction and expulsion The reason attributed to the presence and difference in the concentrations of the active substances in the extract of the plant. The reason for the force of attraction and repulsion for the results of the current study may be due to the fact that the leaves of the myrtle plant contain terpene alcohols as basic compounds, flavonoid glycosides and tanning materials (Lawerence, 1990), which play a role in the variation of attracting and repelling adult insects and larvae.

CONCLUSIONS

The presence of secondary compounds in alcoholic and aqueous extracts that have a high power to expel the insect, as the expulsion characteristic is used to keep insects away from the places to be protected from insect infestation.

The most efficient plant extract in killing the rusty red flour beetle is the extract of the myrtle plant because it contains chemical compounds and its essential oils.

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REFERENCES

1. 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.
2. Abdulqader, A. T., Al-Sammarie, A. M. Y., & Mustafa, M. A. (2022, May). A comparative environmental study of aqueous extracts of ginger and grapes to protect hepatocytes in Albino rabbits and a comparison of extracts in preserving Awassi lamb meat from oxidation. In IOP Conference Series: Earth and Environmental Science (Vol. 1029, No. 1, p. 012001). IOP Publishing.
3. AL-Hadeethi, M. A. (2016). Anatomical and Palynological Study of Myrtus communis L. Diyala J. Pure Sci. 12(4): 1-15.
4. 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.
5. Alipour, G.; Saeedeh D. and Hossein H. (2014). Review of Pharmacological Effects of Myrtus communis L. and its Active Constituents. Phytother. Res. 28: 1125–1136.
6. AL-Janabi, M.A.A. and Ali H. R. (2014). Effect of Different Levels of Nitrogen Fertilizer and Row Spacing on some Yield Traits and It's Components of Rape Seed (Brassica napus L.). J. Trikit Agr. sci. 14(2): 139-149.
7. 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.
8. Arora M and Malhotra M.(2011) . A review on macroscopical, phytochemical and biological studies on Convolvulus arvensis (field bindweed). Pharmacologyonline; 3: 1296-1305.
9. Austin DF.(2000) . Bindweed (Convolvulus arvensis, Convolvulaceae) in North America from medicine to menace. Bulletin of the Torrey Botanical Club; 127(2): 172 -177.
10. Ayvaz A, Sagdic O, Karaborklu S and Ozturk I(2008). Insecticidal activity of the essential oils from different plants against three stored-product insects, J Insect Sci, 10(21), 1-13.
11. Berka-Zougali, B., Ferhat, M. A., Hassani, A., Chemat, F., & Allaf, K. S. (2012). Comparative study of essential oils extracted from Algerian Myrtus communis L. leaves using microwaves and hydrodistillation. International journal of molecular sciences, 13(4), 4673-4695.
12. Bosly, H.A. & Kawanna, M.A. (2014). Fungi species and red flour beetle in stored wheat flour under Jazan region conditions. Toxicology and Industrial Health. 30(4): 304-310.
13. Brophy, Joseph J.; Craven, Lyndley A.; Doran, John C. (2013). Melaleucas : their botany, essential oils and uses. Canberra: Australian Centre for International Agricultural Research. pp. 378–379.
14. Busvine , J.R. (1971) . Acritical Review Of The Technique For Testing Insecticides . 2nd ed., Coomonwealth Agricultural , Bureau. 345P.
15. Campbell , J.F. and C. Runnion (2003) . Patch Exploitation by female red flour Beetles , Tribolium castaneum . Journal of Insect Science V. 3, No (20) , pp: 1-8 .
16. Casida , J . E ., (1973) . Pyreturun : the natural insectides acadmic press London , pp : 323 .
17. Chakravarty H (1976). Plant wealth of Iraq (A dictionary of economic plants) 1. Botany Directorate, Ministry of Agriculture and Agrarian Reform. Baghdad. Iraq.
18. Chistokhodova, N.; Nguyen, C.; Calvino, T.; Kachirskaia, I.; Cunningham, G.; Howardmiles, D(2002). antithrombin activity of medicinal plants from central Florida. J. Ethnopharm., 81(2), 277-280
19. Choi WS, Park BS, Lee YH, Jang DY, Yoon HY, Lee SE (2006) Fumigant toxicities of essential oils and monoterpenes against Lycoriella mali adults. Crop Prot 2:398–401
20. Clark , L.R. (1970) . Analysis of pest situations through the life system approach . pp : 45-58 . In Concepts of pest management . Eds Rabb , R.L. , and Guthrie , E.F. , North Carolina state University , Raleigh , U.S.A. 242 .
21. Cotton, R. T. 1963. Rotating fumigants can overcome resistance of hardy insect pests. The Northwestern Miller 268(11): 32-34.
22. Dang, H. X., Pryor, B., Peever, T., and Lawerence, C. B. (2015). The Alternaria genomes database: a comprehensive resource for a fungal genus comparised of saprophytes, plant pathogens, and allergic species. BMC Genomics 16:239.
23. Dennis Calvin, Assistant professor. (1990). Entomological notes Department of Entomology confuse flour Beetil and Red flour Beetile . College of agricultural Science cooperative extension . Page 1 of 3.
24. Devi, M. B., & Devi, N. (2015). Biology of rustred flour beetle, Tribolium castaneum (Herbst) (Tenebrionidae: Coleoptera). Indian Journal of Entomology, 77(1): 81-82.

25. Dogan, S., & Haerdi, W. (1978). Preconcentration on silver wool of volatile organo-mercury compounds in natural waters and air and the determination of mercury by flameless atomic absorption spectrometry. International Journal of Environmental Analytical Chemistry, 5(2), 157-162.
26. Hennia, A., Nemmiche, S., Dandlen, S., & Miguel, M. G. (2019). Myrtus communis essential oils: insecticidal, antioxidant and antimicrobial activities: a review. Journal of Essential Oil Research, 31(6), 487-545.
27. Kadham, S. M., Mustafa, M. A., Abbass, N. K., & Karupusamy, S. (2022). IoT and artificial intelligence–based fuzzy-integral N-transform for sustainable groundwater management. Applied Geomatics, 1-8.
28. Khambay, B. P., Beddie, D. G., Hooper, A. M., Simmonds, M. S., & Green, P. W. (1999). New insecticidal tetradecahydroxanthenediones from Callistemon viminalis. Journal of natural products, 62(12), 1666-1667.
29. Liu, C., Ang, S., Huang, X. J., Tian, H. Y., Deng, Y. Y., Zhang, D. M., ... & Wang, L. (2016). Meroterpenoids with new skeletons from Myrtus communis and structure revision of myrtucommulone K. Organic letters, 18(16), 4004-4007.
30. Liu, H. X., Chen, K., Liu, Y., Li, C., Wu, J. W., Xu, Z. F., ... & Qiu, S. X. (2016). Callviminols AE, new terpenoid-conjugated phloroglucinols from the leaves of Callistemon viminalis. Fitoterapia, 115, 142-147.
31. Mahdi, E. M., & Mustafa, M. A. (2022). Effect of different concentrations of extract of Urtica dioica and Cladosporium cladosporiodes on Tribolium castaneum or: Coleoptera after 24-48 hours of exposure in Samarra City/Iraq. HIV Nursing, 22(2), 3207-3210.
32. Mehrotra, V., & Giannelis, E. P. (1991). Metal-insulator molecular multilayers of electroactive polymers: intercalation of polyaniline in mica-type layered silicates. Solid State Communications, 77(2), 155-158.
33. 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.
34. Mustafa, H. A., Asaad, M. M. K., Obayes, A. K., & Mustafa, M. A. (2022). Isolation and Identification of Some Types of Pathogenic Bacteria from the Prepuce (Foreskin) of Circumcised Children in Samarra City/Iraq. HIV Nursing, 22(2), 2776-2780.
35. Mustafa, M. A., Kadham, S. M., Abbass, N. K., Karupusamy, S., Jasim, H. Y., Alreda, B. A., ... & Ahmed, M. T. (2023). A novel fuzzy M-transform technique for sustainable ground water level prediction. Applied Geomatics, 1-7.
36. Yaseen, R. A. A., Ibrahim, M. A., & Mustafa, M. A. (2022). The effect of Schanginia aegyptica and Urtica dioica powder on the growth of Trigonella foenum seedlings in laboratory sterilized soil. HIV Nursing, 22(2), 243-247.