Effect of Walnut Extract on Germination Characteristics of Several Species of Weeds

Sahar Hussein Hamarashid

Sulaimani Polytechnic University, Technical College of Applied Science, Halabja, Iraq.

Email: Sahar.rashid@spu.edu.iq

Abstract

Some plants can prevent seed germination and growth in other plants by producing toxic allelochemicals materials. This study aimed was to effect of walnut extract on germination characteristics of several species of weeds. The experiment was conducted in factorial based on a completely random design with three replications. The treatments of the experiment were two walnut cultivars, four species of weeds (Soutani, Rajal, Khardel, and Zivan) and four levels of walnut extract (0, 10, 20 and 30 percent). Results showed that there was a significant difference among walnut extract concentration, weed species, and interaction between them for all studied traits (P< 0.01). In present study with increase the concentration of walnut extract from zero to 30%, in all four types of weeds the germination rate, germination percentage, root, stem and seedling length, and seed vigor index were significantly reduced. Also in the treatment of 30%, walnut extract species of Khardel showed the highest, and Shoufan, Rajal, and Zivan showed the lowest germination rate, germination percentage, root, stem, and seedling length, and seed vigor index.

Keywords: Walnut extract, Weed, Seedling length, Seed vigor.

1. Introduction

Some plants can prevent the germination of seeds and growth of other plants by producing toxic allelochemicals. Allelopathy is defined as the chemical interactions that occur between living organisms, including plants, insects, and microorganisms [1]. The organic compounds that are involved in the allelopathy are called allelochemical compounds collectively [2,3]. Due to the widespread and indiscriminate use of chemical pesticides, especially herbicides in recent decades, the use of allelopathic plants, as well as their residues in the soil to control plants and create suitable growing conditions, has been considered [4]. The allelopathic effect of walnut (Juglans regia L.) to higher plants is well documented [5], although still little is known about its mechanism and potential uses to control weeds [6]. The juglone is a major walnut naphthoquinone and is allelopathic to different plants [7]. The other bioactive materials (phenolics, diarylheptanoids, α-tetralone derivatives, and/or terpenoids) present in walnut had been less investigated [8]. However, they participate in allelopathic interactions with other higher plants during the growing season. The antibacterial and antioxidant potential of walnut has been confirmed [14]. The environmental significance of walnut allelochemicals considers the effects of (i). root exudates, (ii). fallen walnut leaves and/or (iii). broken husks on the germination of surrounding plants. In general, the allelopathic effect of juglone is toxic to plants, although it is beneficial for some species. Previous studies have shown that seedling growth is significantly inhibited in plants such as tomato, cucumber, garden cress, and alfalfa by juglone or walnut leaf extracts [10]. However [11], revealed that muskmelon seedling growth increased by juglone treatment. It has been reported that, the walnut leaf extracts inhibited the seeds germination of dandelion by 55% over the non-treated control [12], also Bajalan et al., (2013) revealed that the percentage and the rate of germination root, shoot, and seedling length with increasing the concentration of walnut extract showed a significant decrease compared to the control treatment in wheat. In another study, walnut leaf extracts significantly prevented basil seed germination and growth indices, in this study, reported that Seed germination percentage, shoot and root length, shoot and shoot weight decreased with increasing walnut extract concentration [4]. The present study aimed to study the effect of walnut extract on germination characteristics and the growth of several species of weeds.
2. Materials and Methods

To study the effect of the walnut extract on germination characteristics and growth of several species of weeds, an experiment was conducted in factorial based on a completely random design with three replications in the laboratory of collage of applied science Sulaimani polytechnic university at 2019. The treatments of the experiment included two walnut cultivars (Hartly and Lara), four species of weeds (Shoufani, Rajal, Khardel, and Zivan) and four levels of aqueous extracts of walnut leaves (0, 10, 20 and 30 percent).

2.1 Extraction the plant parts

Drainage leaves of a three-year-old tree were used to extract walnut leaf extract. The leaves were draining in the shadow until they reached a stable weight. Then ten percent strong weight extract-a mass (50g with 500ml water) was prepared by putting it on the shaker machine for 24 hours. Four layers of cotton fabric were used to separate solid plant tissues and organs from leaf extract, then the extract was centrifuged at the speed of 2000 rpm for 15 minutes. In the next step, by adding distilled water to this strong extract, aqueous extra with zero (control), 10, 25, and 35% concentration was prepared [3].

2.2 Germination of weeds

Thirty seeds of four weed species were placed in each petri dish containing filter paper and three replicates were repeated for each treatment. According to this plan, 7 ml of aqueous extract prepared with different concentrations was added to petri dishes containing seeds. According to this plan, 7 ml of aqueous extract prepared with different concentrations was added to petri dishes containing seeds. The Petri dishes were placed inside the garments and at a temperature of 20°C. The first counting of germinated seeds was performed 48 hours later. Seeds that germinated for 2 ml were considered as grown seeds. At the end of the experiment, germination rate, germination percentage, root length, seedling and seed vigor were measured. The data were analyzed using statistical software of SAS (SAS 9.2) and Duncan groups were used for ranking of means.

3. Result and Discussion

The analyses of variance (ANOVA) indicated that there were significant differences among walnut extract, weed species, and interaction between two treatments for all studied traits (P< 0.01). (Table, 1). There was no significant difference between the two walnut cultivars and interaction between triple treatments of variety × walnut extract × weed species in terms of the studied traits.

| Table 1. Analysis of variance (mean of squares) for some germination characteristics and growth of several species of weeds. |
|---------------------------------------------------------------|
| **SOV** | **Df** | **Ms** | **Germination rate** | **Germination percent** | **Root length** | **Shoot length** | **Seedling length** | **Seed Vigor** |
| Variety | 1 | 0.093ns | 21.1ns | 0.062ns | 0.01ns | 0.12ns | 1586ns |
| Walnut extract | 3 | 91.48** | 20008.4** | 44.28** | 32.16** | 150.17** | 1581432** |
| Weed Species | 3 | 11.84** | 873.1** | 3.39** | 1.93** | 10.13** | 77491** |
| Variety × Walnut extract | 3 | 0.09ns | 1.5ns | 0.04ns | 0.002ns | 0.03ns | 352ns |
| Variety × Weed Species | 3 | 0.23ns | 2.6ns | 0.02ns | 0.0005ns | 0.004ns | 119ns |
| Walnut extract × Weed Species | 9 | 1.62** | 209.4** | 0.48** | 0.078** | 2.13** | 16022** |
| Variety × Walnut extract × Weed Species | 9 | 0.04ns | 3.1ns | 0.01ns | 0.003ns | 0.01ns | 75ns |
| Error | 64 | 0.55 | 7.6 | 0.07 | 0.06 | 0.19 | 1171 |
| CV | 19.98 | 3.98 | 11.92 | 12.40 | 10.32 | 9.74 |

ns, ** and * are no Significant, Significant at 1 and 5% probability levels, respectively.
3.1 Germination Rate

Mean comparisons of walnut extract with weed species interaction treatments (Fig. 1) showed that the highest germination rate was observed in Rajal species with control treatment of walnut extract with an average of 6.33, although there was no significant difference between this treatment and treatments of Rajal species white 10% of walnut extract and Khardel white control treatment and 10% of walnut extract. The lowest germination rate was observed in Shoufani, Rajal, and Zivan species Treated with 30% of the walnut extract with an average of 0.5, 1, and 1.16. Matok et al (2009) reported that the walnut leaf extracts inhibited the seeds germination of dandelion by 55% over the non-treated control also the walnut phenolics caused the least inhibition (14.6%) in seeds germination of winter wheat cv.

![Figure 1. Mean comparisons of walnut extract with weed Species treatments in term of Germination Rate.](image)

3.2 Germination percent

Fig. 2 showed the mean comparisons of walnut extract with weed species treatments showed that control treatment of Walnut extract in all four weeds Species (Shoufani, Rajal, Khardel, and Zivan ) showed the highest germination percentage by 88.83, 89.16, 90.83 and 91.83 percent. It should be noted that there was no significant difference between the mentioned treatments and treatment of Khardel specie with 10% of walnut extract. The lowest germination percentage with an average of 17.83 and 20 percent, was observed in Shoufani and Zivan species which treated with 30% walnut extract (Fig 2). The walnut extracts contained a variety of the phenolic compounds, including soluble and condensed tannin-like compounds, phenolpropanoids and phenolic acids. On the other hand, some quercetin glycosides and quinic acid derivatives were also found in tissues of walnut leaves collected [13,14]. Likely, phenolic compounds inhibited seeds' germination of weed seeds in the present study. On the other hand phenolics are also allelopathic to other plant spp. [15]. It has been reported with increasing the concentration of walnut extract reduced the percentage and germination rate in wheat compared to the control significantly [1]. In this study, Khardel specie had a high germination percentage compared to other seeds in the treatment of 30%, walnut extract compared to other species, it can be said that the seeds of this species were more resistant to walnut extract.

3.3 Root length

The highest root length (3.81 cm) was gained from Rajal specie with control and 10 percent of walnut extract treatment with and averages 3.81 and 3.76 cm, which had no statistical difference with Khardel specie with control treatment. The least root length was observed in Shoufani, Rajal and Zivan species with 30 percent of walnut extract (Fig. 3). Allelopathic compounds can be effective on hairy roots and other roots of the plant and this phenomenon is a reason for the reduction of water uptake in the plant and this material damaged the tissue of the root cap [2]. In an experiment proved that Juglone and the extract of the walnut leaf have a deterrent effect on photosynthesis, respiration, growth speed of the root and the stem in corn and soya plants that are cultivated in hydroponic environments [16,17].
Figure 2. Mean comparisons of walnut extract with weed Species treatments in term of germination percent.

![Figure 2](image2)

Figure 3. Mean comparisons of walnut extract with weed Species treatments in term of root length.

![Figure 3](image3)

3.4 Shoot length

The shoot length was highest in Rajal, Khardel, and Zivan specie with control of walnut extract treatment with an average 3.50, 3.23 and 3.35 cm, while the lowest one was recorded from Shoufani, Rajal and Zivan species with 30 percent of the walnut extract with an average of 0.23, 0.37 and 0.33 cm respectively (Fig. 4). In study of Kocacë Aliskan and Terzi [10], seed germination and seedling growth of tomato, cucumber, garden cress and alfalfa were inhibited strongly by both walnut leaf extracts and juglone. Bajalan et al., [1,18] found that the extract of walnut tree's organs significantly reduced the length of the roots and shoot in wheat.

![Figure 4](image4)
3.5 Seedling length

The highest seedling length was gained from Rajal, and Zivan specie with control of walnut extract treatments with an average 7.31 and 6.83 cm, while the lowest one was recorded Shoufani, Rajal and Zivan species with 30 percent of the walnut extract with an average of 0.41, 0.81 and 0.82 cm respectively (Fig. 5).

![Figure 5. Mean comparisons of walnut extract with weed Species treatments in term of seedling length.]

3.6 Seed Vigor

The highest seed vigor was gained from Rajal and Zivan specie with control of walnut extract treatment, the least seed vigor was observed in Shoufani, Rajal and Zivan species with 30 percent of the walnut extract treatment (Fig. 6).

![Figure 6. Mean comparisons of walnut extract with weed Species treatments in term of seed vigor]

Conclusion

In this study, there was no significant difference between extract of the two cultivars of walnut in terms of the studied traits, it can be concluded that the content of extracted from the two varieties was almost similar, also the use of walnut extract, especially the 30% level, significantly reduces germination and weed seed growth indicators, Therefore, use this extract after supplementary experiments, is recommended to control weeds.

References

[1] Bajalan, I., Zand, M., & Rezaee, S. (2013). Allelopathic effect of various organs of walnuts (Juglans regia) on seed germination of wheat. American-Eurasian Journal of Agricultural & Environmental Sciences, 13(9), 1293-1297.
[2] Chon, S. U., Jang, H. G., Kim, D. K., Kim, Y. M., Boo, H. O., & Kim, Y. J. (2005). Allelopathic potential in lettuce (Lactuca sativa L.) plants. Scientia Horticulturae, 106(3), 309-317.
[3] Chung, I. M., Kim K. H., Ahn, J. K., Lee, S. B., Kim S. H., & Hahn, S. J. (2003). Comparison of allelopathic potential of rice leaves, straw, and hull extracts on barnyardgrass. Agronomy Journal, 95(4), 1063-1070.
[4] Dadi, M., Bakhshi, D., Peyvast, G., & Balouchi, Z. (2013). Effects of Persian walnut leaf extracts on seed germination, seeding
growth, and some physiological characteristics of the basil (Ocimum basilicum L.) cultivar ‘Genovese’. The Journal of Horticultural Science and Biotechnology, 88(4), 433-438.

[5] Einhellig, F. A. (1986). Mechanisms and modes of action of allelochemicals. The science of allelopathy, 171-188.

[6] Harborne, J. B. (2014). Introduction to ecological biochemistry. Academic press.

[7] Jose, S., & Gillespie, A. R. (1998). Allelopathy in black walnut (Juglans nigra L.) alley cropping. II. Effects of juglone on hydroponically grown corn (Zea mays L.) and soybean (Glycine max L. Merr.) growth and physiology. Plant and soil, 203(2), 199-206.

[8] Keating, K. I. (1999). Allelopathy: principles, procedures, processes, and promises for biological control. Advances in agronomy, 67, 141-231.

[9] Kocaç Aliskan, I., & Terzi, I. (2001). Allelopathic effects of walnut leaf extracts and juglone on seed germination and seedling growth. The Journal of Horticultural Science and Biotechnology, 76(4), 436-440.

[10] Kocaç Aliskan, I., & Terzi, I. (2001). Allelopathic effects of walnut leaf extracts and juglone on seed germination and seedling growth. The Journal of Horticultural Science and Biotechnology, 76(4), 436-440.

[11] Liu, J., Meng, M., Li, C., Huang, X., & Di, D. (2008). Simultaneous determination of three diarylheptanoids and an α-tetralone derivative in the green walnut husks (Juglans regia L.) by high-performance liquid chromatography with photodiode array detector. Journal of Chromatography A, 1190(1-2), 80-85.

[12] Shakir, A.A., Salman, E.F., Shakir, A.J., Mohammed, M.A., Abdulridha, W.M., Almayahi, B.A. , (2019), , Optical properties of polyvinyl alcohol membrane with n-HAp for bio-medical applications, Prensa Medica Argentina, 105 (11), pp. 836-841.

[13] Oliveira, I., Sousa, A., Ferreira, I. C., Bento, A., Estevinho, L., & Pereira, J. A. (2008). Total phenols, antioxidant potential and antimicrobial activity of walnut (Juglans regia L.) green husks. Food and chemical toxicology, 46(7), 2326-2331.

[14] Pereira, J. A., Oliveira, I., Sousa, A., Ferreira, I. C., Bento, A., & Estevinho, L. (2008). Bioactive properties and chemical composition of six walnut (Juglans regia L.) cultivars. Food and chemical toxicology, 46(6), 2103-2111.

[15] Reigosa, M. J., Souto, X. C., & Gonz, L. (1999). Effect of phenolic compounds on the germination of six weeds species. Plant Growth Regulation, 28(2), 83-88.

[16] Rizvi, S. J. H., & Rizvi, V. (1992). Exploitation of allelochemicals in improving crop productivity. In Allelopathy (pp. 443-472). Springer, Dordrecht.

[17] Terzi, I. (2008). Allelopathic effects of Juglone and decomposed walnut leaf juice on muskmelon and cucumber seed germination and seedling growth. African Journal of Biotechnology, 7(12).

[18] Terzi, I., & Kocaçalışkan, İ. (2010). The effects of gibberellic acid and kinetin on overcoming the effects of juglone stress on seed germination and seedling growth. Turkish Journal of Botany, 34(2), 67-72.