ID: 588

Seed scarification relieves weed seed dormancy in *Convolvulus arvensis*

Khawar Jabran[1]

[1]Department of Plant Production and Technologies, Faculty of Agricultural Sciences and Technologies, Nigde Omer Halisdemir University, Nigde, Turkiye
Email: khawarjabran@gmail.com

Abstract

Field bindweed (*Convolvulus arvensis* L.) is a perennial weed, which has a creeping growth habit and deep root system. This is one among the most troublesome and aggressive weeds around the world and infest a large number of field crops and orchards. The weed has a strong dormancy character, which makes working on this weed under laboratory conditions a difficult task. This study aimed to check the dormancy breaking impact of several hormones and scarification with sand paper in the seeds of *C. arvensis*. The results showed that the most effective treatment for removing weed seed dormancy in *C. arvensis* was the mechanical method i.e., scarification with sand paper. This method resulted in a 55% germination of the weed seeds, which was the highest among all the germinated seeds. None of the hormones was effective in improving the germination of *C. arvensis*. The most efficient among the hormones was kinetin that resulted only in 5% germination of the weed seeds, which was equal to the germination percentage observed in the control treatment. It is concluded that the mechanical scarification can act as a successful method to remove dormancy in the seeds of *C. arvensis*.

Key Words: *Dormancy, Field bindweed, Weeds, Weed control, Hormones*

Introduction

The discipline of crop protection includes protecting the crops from a wide variety of pests such as viruses, disease pathogens, nematodes, rodents, weeds and insect pests. Weeds hold a significance among the different crop enemies owing to their large number, high competitive ability and resilience (Ahmad et al. 2023). High seed production and dormancy in seeds are the other characteristics of weeds that make them a tough pest (Gaba et al. 2017; Batlla et al. 2020).

Several of the weed species have been recognized as noxious or troublesome due to the great degree of damage caused by these weeds. Field bindweed (*Convolvulus arvensis* L.) is one among such weeds that infests several crops and is highly difficult to control (Davis et al. 2018). This weed belong to the Convolvulaceae family, possesses a perennial life cycle and a creeping growth habit, and propagates both vegetatively and through seeds (Sosnoskie et al. 2020). The dormancy character of the seeds of this plant make it a resilient weed (Ma et al. 2023). The dormancy in the seeds of this weed is mainly caused by its hard seed cover that does not allow the movement of moisture into the seed (Jayasuriya et al. 2008). There is a possibility to apply scarification, which is a mechanical method of removing dormancy from any plant seeds (Rocha et al. 2022). The process of seed scarification can be done either through sand paper or using some other appropriate tools. Other than this, several hormones may also play a role in germinating the dormant weed seeds. A few among such hormones are indole-3-butyric acid (IBA), 6-benzylaminopurine, benzyl adenine (BAP), gibberellic acid and kinetin (Xiong et al. 2018).

The presence of dormancy in the *C. arvensis* seeds not only provides a persistence in the nature but also creates hurdles when researchers intends to use these seeds in their laboratory or greenhouse experiments. Hence, this study was aimed to evaluate different seed dormancy breaking methods to remove dormancy from the seeds of *C. arvensis*. Determing such methods will be helpful in germinating this weed easily under laboratory conditions for the subsequent research studies.

Materials and Methods

This study was conducted at the weed science laborator of the Department of Plant Production and Technologies, Faculty of Agricultural Sciences and Technologies, Nigde Omer Halisdemir University, Nigde, Turkiye.

The seeds of the weed *C. arvensis* were collected from environments such as apple orchards, potato fields and non-cropped areas during August to October 2024. The laboratory work was conducted during the months of January to February 2025. The weed seeds were surface sterilized with a deterjan at the start of the experiment. The dormancy status of the weeds seeds was checked through a germination test. This germination test was done by putting 10 weed seeds on a filter paper in three 9-cm diametered petri dishes (i.e., replicated thrice). The seeds were watered appropriately and allowed to germinate for two weeks in an incubator at 25 °C. As the *C. arvensis* seeds were found dormant after this initial experiment, subsequently the following experiment was conducted.

Four hormones and one mechanical method were applied to check their efficacy to break dormancy in *C. arvensis*. The weed seed dormancy breaking treatments included the followings. (1) Control (no treatment) i.e., treatment only with distilled water, (2) Scarification of the weed seeds with sand paper, i.e., application of a mechanical method for removal of the weed seed dormancy. Further, the four hormonal treatments were: (3) Treatment of the weed seeds with indole-3-butyric acid (IBA), (4) Treatments of the weed seeds with 6-benzylaminopurine, benzyl adenine (BAP), (5) Treatment of the weed with gibberellic acid (GA3), and (6) Treatment of the weed seeds with kinetin. The sand paper used for mechanical scarification of the weed seeds was obtained from a local market. The solutions of the hormones used in the study were prepared in the laboratory and stored in a 500 ml conical flask until used in the study. The salts of these chemicals (IBA, BAP, gibberellic acid, kinetin) were dissolved in distilled water to obtain solutions with a strength of IBA = 20 mg/L, BAP = 20 mg/L, gibberellic acid = 8 mg/L, and kinetin = 8 mg/L.

The experiment was conducted according to the completely randomized design with four replication. The petri dishes were fitted with a double layer of filter paper and 10 weed seeds were arranged in each petri dish. The control treatment was applied with distilled water while others were applied with the relevant hormonal solution. A five ml of a solution was applied to the relevant petri dishes, which were checked thoroughly to top-up the solution if required.

The experiment was continued for a period of 15 days and the number of germinated seeds was noted upon the termination of the experiment. Any seed producing a radicle of >2 mm was considered as germinated seed. Germination percentage was calculated based on the number of germinated seeds. Moroever, the other parameters including shoot length, root length and seedling height were measured with meter rod. The seedling fresh weight was recorded by weighing the seedlings on a sensitive balance.

The data corrected were processed through Microsoft Excel. The program was used to calculated the means and standard errors of the replicated data. The mean data was represented as bar charts, which were fitted with their relevant error bars to be used to compare the significance of difference among the treatment means.

Results

None of the seeds of *C. arvensis* were germinated in a germination test conducted to check the dormancy of the weed seeds (data not presented). As all of the weed seeds were dormant, subsequently the dormancy breaking treatments were applied on *C. arvensis* seeds. The results showed that the effect of dormancy breaking treatments was significant on the germination of *C. arvensis*, and the treatments had a variable effect on the weed germination (Figure 1). Seed scarfication with sand paper was the most effective treatment, which resulted in the highest weed seed germination (55%) while none of the hormonal treatments were effective in improving germination in *C. arvensis* seeds. Kinetin and BAP were the only two hormonal treatments that resulted in some germination but this was only 5% or less than it, and was similar with the germination achieved in the control treatment.

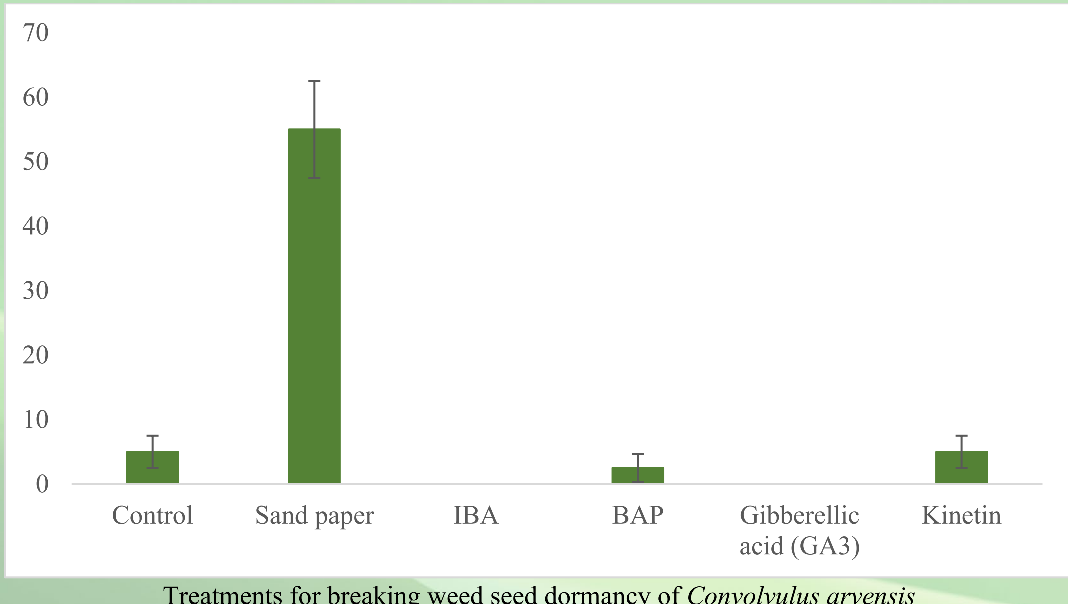
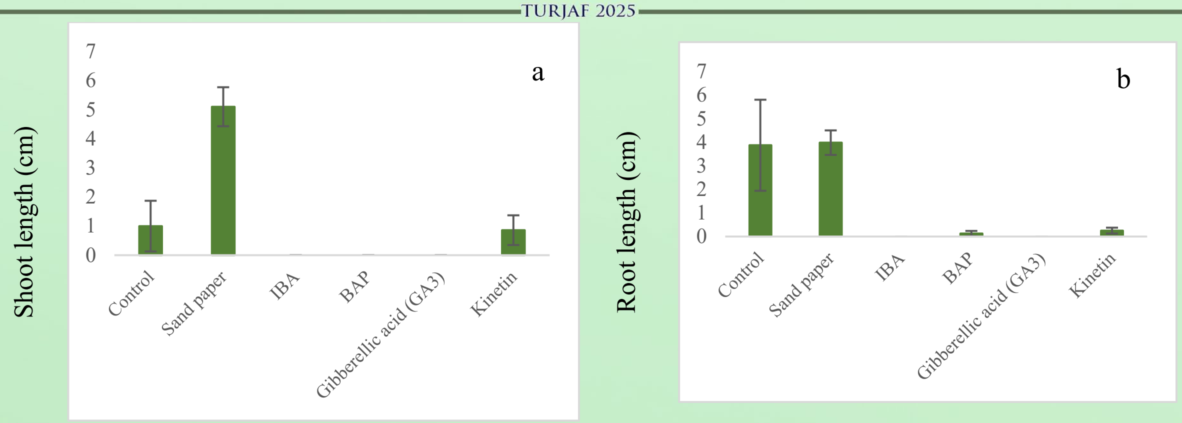


Fig. 1. Effect of different treatments on germination of *Convolvulus arvensis* seeds

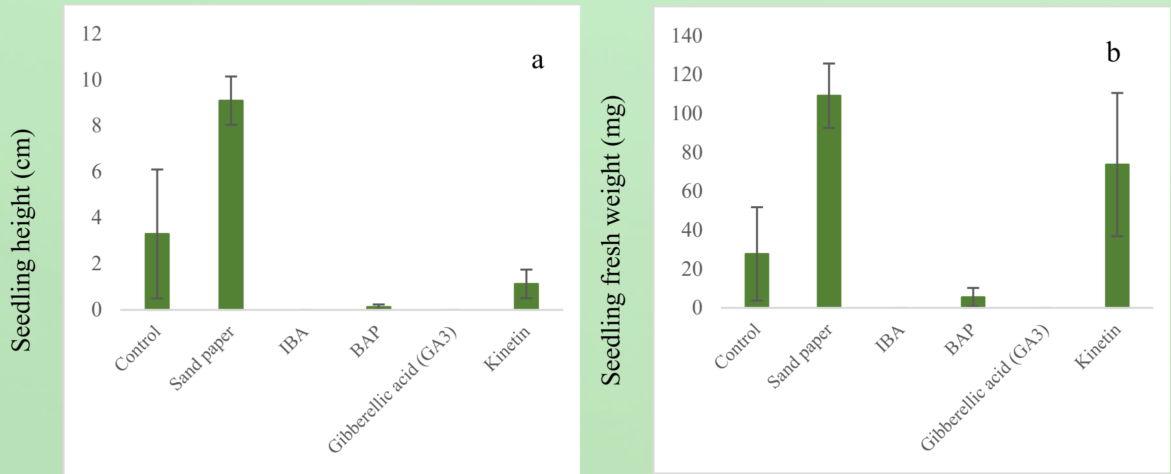
The highest shoot length was noted for the *C. arvensis* seedlings for which the seeds had been treated with sand paper (Figure 2a). The treatments including control and kinetin application were the only two other treatments where seedlings had developed some shoot, and the shoot length was statistically similar for thes two treatments. No shoot was observed in the weed seeds applied with IBA, BAP or gibberellic acid hormones. Both the control and scarification with sand paper had developed the longest root and the root length for these two treatments was statistically similar (Figure 2b). Kinetin and BAP applied weeds seeds had developed very short roots (< 1 cm).



Treatments for breaking weed seed dormancy of *Convolvulus arvensis*

Fig. 2. Effect of different treatments on germination of *Convolvulus arvensis* seeds

The longest seedlings were found for the *C. arvensis* seeds that were treated with sand paper followed by the control and kinetin (Figure 3a). The highest seedling fresh weight was recorded for the treatment where *C. arvensis* seeds for treated with sand paper followed by the seedling fresh weight with the kinetin treatment (Figure 3b).



Treatments for breaking weed seed dormancy of *Convolvulus arvensis*

Fig. 3. Effect of different treatments on germination of *Convolvulus arvensis* seeds

Discussion

In this study, scarification with sand paper was the most effective treatment in breaking the dormancy in *C. arvensis* while the different hormones proved to be ineffective. The most important reason for this may be the presence of hard seed coat in *C. arvensis* seed (Sosnoskie et al. 2020). The mechanical treatment with sand paper was able to damage the hard seed coat of the weed that ultimately lead imbibition of water and ease in the excahange of gases by the weed seeds (Rocha et al. 2022). As the imbibition of water is the first step in germination of viable plant seeds, damage to hard coat by sand paper helped water movement into the seed (Orozco-Segovia et al. 2007). Similarly, the damage to the seed coat is also expected to facilitate the exchange of gases. The effectivenss of the sand paper also imply that the type of dormancy in *C. arvensis* was primary and physical dormancy.

The hormonal treatments were ineffective in removing the dormancy from *C. arvensis* seeds that implies that the dormancy in these weed seeds was not because of hormonal imbalance (Shu et al. 2006) while the mechanical damage to the seed coat of *C. arvensis* can help in removal of dormancy in this weed. These results have implications for practical weed control under field conditions. This means that the *C. arvensis* seeds present in a field may be exposed natural or artificial factors so that their seed coat is damage. The damaged and weakened seed coat will lead to germination of the weed and the weed seeds will not become a part of soil weed seedbank.

Acknowledgements

Thanks to Fatma JABRAN for her help in this work.

References

Ahmad, T., Jabran, K., Cheema, Z. A., Bajwa, A. A., & Farooq, M. (2023). A global perspective of education in weed science. Weed Science, 71, 536–548.

Batlla, D., Ghersa, C. M., & Benech-Arnold, R. L. (2020). Dormancy, a critical trait for weed success in crop production systems. Pest Management Science, 76, 1189–1194.

Davis, S., Mangold, J., Menalled, F., Orloff, N., Miller, Z., & Lehnhoff, E. (2018). A meta-analysis of field bindweed (*Convolvulus arvensis*) management in annual and perennial systems. Weed Science, 66, 540–547.

Gaba, S., Perronne, R., Fried, G., Gardarin, A., Bretagnolle, F., Biju-Duval, L., Colbach, N., Cordeau, S., Fernández-Aparicio, M., Gauvrit, C., & Gibot-Leclerc, S. (2017). Response and effect traits of arable weeds in agro-ecosystems: a review of current knowledge. Weed Research, 57, 123–147.

Jayasuriya, K. G., Baskin, J. M., & Baskin, C. C. (2008). Dormancy, germination requirements and storage behaviour of seeds of Convolvulaceae (Solanales) and evolutionary considerations. Seed Science Research, 18, 223–237.

Ma, X., Wu, H., Ren, X., Hu, H., Wang, L., & Ma, Y. (2023). Seasonal changes in germinability, dormancy and viability of field bindweed (*Convolvulus arvensis*) seeds as affected by storage and duration. Advances in Weed Science, 41, e020220082.

Oliveira, M. C., Osipitan, O. A., Begcy, K., & Werle, R. (2020). Cover crops, hormones and herbicides: Priming an integrated weed management strategy. Plant Science, 301, 110550.

Orozco-Segovia, A., Márquez-Guzmán, J., Sánchez-Coronado, M. E., Gamboa de Buen, A., Baskin, J. M., & Baskin, C. C. (2007). Seed anatomy and water uptake in relation to seed dormancy in *Opuntia tomentosa* (Cactaceae, Opuntioideae). Annals of Botany, 99, 581–592.

Shu, K., Liu, X. D., Xie, Q., & He, Z. H. (2016). Two faces of one seed: hormonal regulation of dormancy and germination. Molecular Plant, 9, 34–45.

Sosnoskie, L. M., Hanson, B. D., & Steckel, L. E. (2020). Field bindweed (*Convolvulus arvensis*): "all tied up." Weed Technology, 34, 916–921.

Rocha, R. L., Khalil, Y., Maity, A., Beckie, H. J., & Ashworth, M. B. (2022). Mechanical scarification technique breaks seed coat-mediated dormancy in wild oat (*Avena fatua*). Weed Technology, 36, 152–159.

Xiong, R., Wang, Y., Wu, H., Ma, Y., Jiang, W., & Ma, X. (2018). Seed treatments alleviate dormancy of field bindweed (*Convolvulus arvensis* L.). Weed Technology, 32, 564–569.