ANNALS OF THE UNIVERSITY OF CRAIOVA

Series: ✓*Biology*
✓*Horticulture*
✓*Food products processing technology*
✓*Environmental engineering*

Vol. XXVII (LXIII) - 2022

EFFECT OF PEPERMINT AND OREGANO ESSENTIAL OIL ON OLIVE SEED GERMINATION

Kalorizou Helen[1], Giannoulis Paschalis[2], Kiritsaka Eirini[2], Papachatzis Alexandros[2]

[1]University of Patras, Department of Crop Science, Messolongi, 30200 Greece
[2]University of Thessaly, Department of Agriculture - Agrotechnology, Gaiopolis Campus, 41500 Larisa Greece
** Correspondence author*: E-mail: ekalorizou@upatras.gr

Keywords: *Olive seeds, essential oil, oregano, peppermint*

ABSTRACT

In the present study the allelopathic effect of oregano (Oregano vulgare) and peppermint (Menta piperita) essential oil on olive seed germination was investigated. Five different concentrations of each essential oil (0%, 0.1%, 0.3%, 0.5% and 1%) were used. The seed germination percentage were calculated to determine the essential oils effect. Results shows that different concentrations of oregano and peppermint essential oil had significant effect on seed germination. Essential oil of oregano had remarkable allelopathic effect in olive seed germination even in a low concentration. In contrast peppermint essential oil could reduce seed germination percentage at higher concentrations. At 1% essential oil concentration of both aromatic plants exhibits inhibitory effect.

INTRODUCTION

Olive plants can be propagated by several methods like seeds, cuttings and grafting. Seeds consist the basic propagation material in plant breeding programs or rootstock production (Ak et al. 2021). In olives grafting scions on seedlings is largely used in many Mediterranean countries (Fabbri et al. 2004). Several agrochemical products are used for rooting media disinfection and seeds protection during germination process. However, repetitive usage of chemical fungicides is linked to qualitative environmental deterioration and reflects a potential threat for human food reserves due plant pathogen resistance occurrence (Gikas et al. 2022). Adoption of novel environmentally friendly methods to regulate microbial loads while propagating trees remains in high priority (Mafakheri and Mirghazanfari, 2018).

Plant bioactive compounds like essential oil of aromatic and medical plants have been suggested as ecofriendly alternatives protectives and disinfectants to chemical compounds in addition to their allelochemical and herbicidal activity (Shokouhian et al 2016; Upadhyay et al. 2018, Atak et al. 2016; Mahdavikia and Saharkhiz, 2015; Mangalagiri et al. 2021).

Rates reduction in seed germination caused by essential oils have been recorded in several annual crop and weeds; however, the allelochemical effect of essential oils on fruit trees seeds of are still unknown (Atak et al., 2016; Yankova-

Tsvetkova et al. 2020; Mirmostafaee et al. 2020). The aim of present work was to investigate the effect of oregano and peppermint essential oil on olives seed germination.

MATERIALS AND METHODS

Seed preparation: Fruits from olive variety Chondrolia Chalkidikis were harvested at late November 2021 in Melissatika Magnesias GR (N 39.396378° E 22.901522°) when the skin color was changed from green-yellow to purple. The flesh was removed by hand and the stony seeds were cleaned with sand and water to remove any fleshy remnants. The woody endocarps were left to dry naturally at room temperature. Seeds were carefully separated from stone endocarp with a bench vice, were surface sterilized with 1% sodium hypochlorite and rinsed several times with distilled water. Sterilized seeds placed at petri dishes and kept at 4^{o} C for 10 days followed by 24h dip in 500 ppm GA_3 for breaking dormancy status.

Essential oil treatment: Two essential oils, oregano (*Oregano vulgaris*) and peppermint (*Mentha piperita*) were tested for their allelopathetic effect on olive seed germination. Three replications of 8 seeds were used in each treatment. Seeds were placed in petri dishes on three layers of paper moistened to saturation with water. 1.5 ml of oregano or peppermint essential oil at the concentration of 0%, 0.1%, 0.3%, 0.5% and 1% were injected in cotton which was surrounded by aluminum foil and placed in the middle of petri dishes above seeds. Plates were placed in 20^{o}C, monitored daily for germination and moistened with distilled water as needed. After 4 week the germinated and not germinated seeds were counted and the germination percentage were determined.

Data Analysis: Data were analyzed using the 95% confidence limit overlap protocol (Sokal and Rohlf, 1969), using software Prism 7.0 (GraphPad Software Inc.).

RESULTS AND DISCUSSION

The effect of oregano and peppermint essential oil on olive seed germination was determined. Both essential oils caused a significant reduction on seed germination compared to non-treated seeds. Decrease of germination rates was dose depended due to essential oil presence.

All treatments with oregano essential oil caused a significant decrease on olive seed germination percentage compared to control. At 0.1% and 0.3% oregano essential oil concentration the olive seed germination was reduced at 70% compared to control while concentration levels of 0.5% and 1% inhibited seed germination (Fig. 1).

Mentha piperita essential oil had an inhibitory effect on seed germination at high concentrations only. No statistical differences were found between control and 0.1% and 0.3% essential oil concentration level. By increasing the essential oil concentration to 0.5% the olive seed germination decreased more than 70%. The seed germination was completely inhibited with 1% essential oil (Fig. 2).

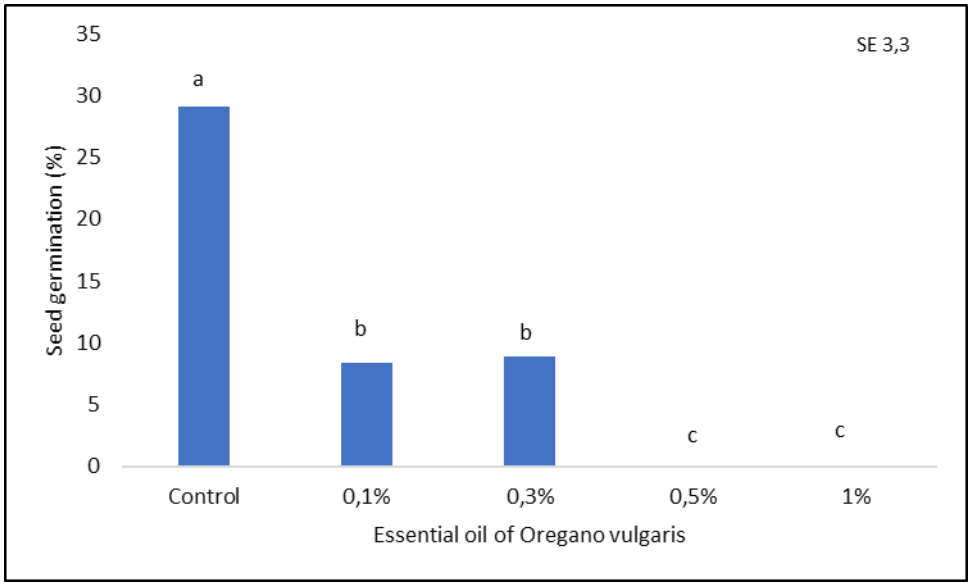

Figure 1. Effect of *Oregano vulgaris* essential oil effect on olive seed germination (Means followed by the same letter are not different according to LCD test).

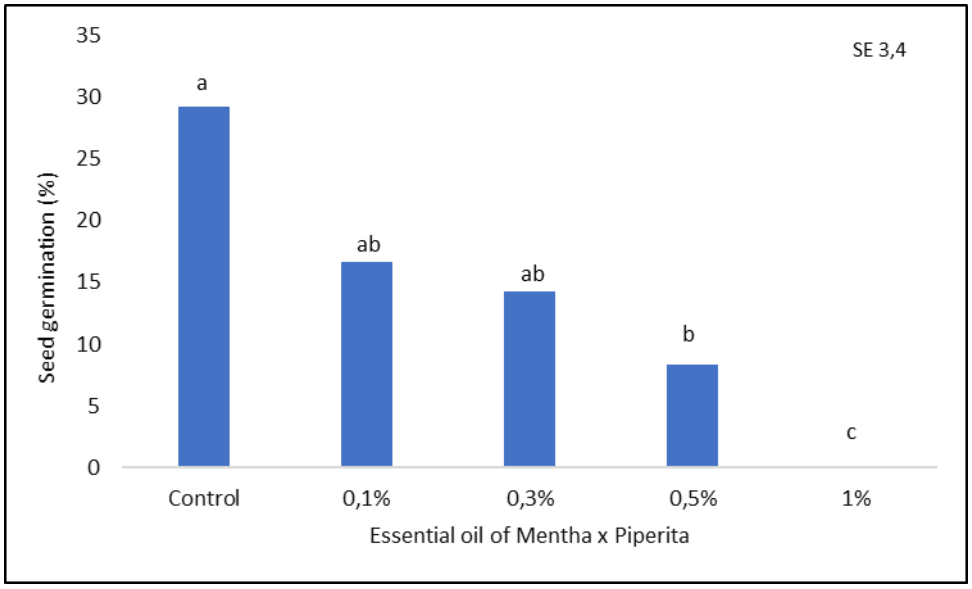

Figure 2. Effect of *Mentha piperita* essential oil effect on olive seed germination (Means followed by the same letter are not different according to LCD test).

The allelochemical effect of essential oils of aromatic and medical plants on seed germination of annual crops and weeds have determined by several authors (Możdżeń et al., 2018; Turgut & Coskun, 2021; Atak et al., 2016;

Shokouhian et al., 2016). The essential oil used and the doses applied in our experiment confirms the results of other researchers. Peppermint and oregano essential oils have been found to exhibit strong inhibition effect on seed germination while the crops susceptibility depends on oil concentration and its chemical components (Mahdavikia & Saharkhiz, 2015; Mirmostafaee et al., 2020; Turgut & Coskun, 2021).

The essential oil of oregano had remarkable inhibitory effects even in low concentrations on olive seed germination. In contrast, allelopathic potential of peppermint essential oil revealed a scale response to the treated material. Oregano and peppermint essential oil have been suggested as naturally agrochemical for plant disease and weed control (Bounar et al., 2020; El-Shoraky & Shala 2018). However, their potential usage during seed germination period needs further investigation for applied dose determination.

Inhibitory and/or retardancy effects of essential oils in olive seed germination can be used as a model tool to expand the time window of physiological phenomenon (e.g., germination). Slow mode of developmental changes in seed germination of olive trees can provide valuable insights in basic and fundamental research (Richardson 2020). Therefore, treating olive seeds with essential oils is not only useful due to need for safer agrochemical use, but also for studying germination in a different time perspective. Different germination time perspectives in addition to the mechanical thickness and biochemical composition of olive seed endocarp could provide crucial information of time positioning of olive seed germination in nature.

CONCLUSION

Oregano and peppermint essential oils were exhibited allelopathic effect on olive seeds germination. According to the results of this work low concentrations of oregano essential oil (0.1 to 0.3%) reduce at 70% the seed germination, while oil concentrations equal or higher to 0.5 % inhibit seed germination. Peppermint essential oil exhibited milder effect on olive seed germination as only concentrations above 1 % inhibit seed germination. Further research is needed to define the use of essential oils on olive seed protection and differential time perspectives related to its developmental biology.

REFERENCES

Ak B., Hatipoğlu İ., Dikmetaş B. 2021. Propagation of Fruit Trees. In: Recent Headways in Pomology. Edition: Iksad Publishing House, pp.398.

Atak M., Kazım M., Ilhan U. 2016. Bio-Herbicidal effects of oregano and rosemary essential oils on germination and seedling growth of bread wheat cultivars and weeds. Romanian Biotechnological Letters, 21, 11149-11159.

Bounar R., Krimat S. Boureghda H., Dob T. 2020. Chemical analyses, antioxidant and antifungal effects of oregano and thyme essential oils alone or in combination against selected Fusarium species. International Food Research Journal. 27, 66-77.

El-Shoraky F., Shala A., 2018. Antifungal activity of spearmint and peppermint essential oils against Macrophomina root rot of cotton. Journal of Plant Protection and Pathology, 9, 775-781.

Fabbri A., Bartolini G., Lambardi M., Kailis S. 2004. Olive Propagation Manual. CSIRO publishing, pp. 158.

Gikas G. D., Parlakidis P., Mavropoulos Th., Vryzas Z. 2022. Particularities of fungicides and factors affecting their fate and removal efficacy: A review. Sustainability, 14, 7: 4056.

Mafakheri H., Mirghazanfari S. M. 2018. Antifungal activity of the essential oils of some medicinal plants against human and plant fungal pathogens. Cellular and Molecular Biology, 64, 13.

Mahdavikia F., Saharkhiz M. J. 2015. Phytotoxic activity of essential oil and water extract of peppermint (*Mentha* × *piperita* L. cv. Mitcham). Journal of Applied Research on Medicinal and Aromatic Plants, 2, 146-153.

Mangalagiri N. P., Panditi S. K., Jeevigunta NL.L. 2021. Antimicrobial activity of essential plant oils and their major components. Heliyon, 7(4), e06835.

Mirmostafaee S., Majid A., Yoshiharu F. 2020. Study of Allelopathic interaction of essential oils from medicinal and aromatic plants on seed germination and seedling growth of lettuce. Agronomy, 10 (2), 163.

Możdżeń K., Barabasz-Krasny B., Stachurska-Swakoń A., Zandi P., Puła J. 2018. Effect of Aqueous Extracts of Peppermint (*Mentha* × *piperita* L.) on the Germination and the Growth of Selected Vegetable and Cereal Seeds. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 47(2), 412–417.

Richardson A. (2020). Plant Development: Coordinating across space and time. Current Biology, 30: R1492-R1494.

Shokouhian A., Habibi H., Agahi K. 2016. Allelopathic effects of some medicinal plant essential oils on plant seeds germination. Journal of BioScience and Biotechnology, 5, 13-17.

Singh P, Pandey A. K. 2018. Prospective of essential oils of the Genus Mentha as biopesticides: A Review. Front Plant Sci., 10, 1295.

Turgut T., Coskun Y. 2021. Chemical composition of essential oils of peppermint and spearmint dry leaves and their allelopathic effects on wheat species. Journal of Essential Oil Bearing Plants, 24:4, 772-785.

Upadhyay N., Dwivedy A. K., Kumar M., Prakash B., Dubey N. K. 2018. Essential oils as eco-friendly alternatives to synthetic pesticides for the control of Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae), Journal of Essential Oil Bearing Plants, 21, 282-297.

Yankova-Tsvetkova E., Nikolova M., Aneva I., Stefanova T., Berkov S. 2020. Germination inhibition bioassay of extracts and essential oils from plant species. Comptes Rendus de l'Académie Bulgare des Sciences: Sciences Mathématiques et Naturelles, 73, 1254-1259.