MULCHING EFFECTS ON YIELD AND QUALITY OF LAVANDIN (*Lavandula intermedia*)*

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Original scientific paper

Summary

Lavandin (*Lavandula intermedia*) is a perenal aromatic plant from Lamiaceae family. Aromatic plants' qualitative and quantitative properties, including lavandin, depend on variety, environmental factors, and cultivation practices. This paper aimed to examine the impact of different mulch types on yield and bioactive compounds of lavandin. The treatments included different types of mulches (straw, alfalfa, agritela and control/without mulch). The field experiment had a split-plot design. Each plot contained ten replications. The tested traits were yield of inflorescences, contents of essential oil, contents of total phenols and total flavonoids, and antioxidant activity. The lowest amount of essential oil was recorded in the ″agritela″ treatment (5.0 mL/100g), and the highest in the ″straw″ treatment (6.4 mL/100g). The treatments with ″straw″ had the highest level of flavonoids contents (17.13 mg g^{-1} CAE), followed by the treatments with ″alfalfa″ (14.03 mg g^{-1} CAE), ″agritela″ (12.25 mg g^{-1} CAE), and ″control″ (10.32 mg g^{-1} CAE).

Key words: *lavandin, mulch, quality, essential oil, antioxidant capacity*

INTRODUCTION

Lavandin (*Lavandula intermedia*) is a perenal aromatic plant from Lamiaceae family. It is mostly cultivated for its essential oil, which is valued in the toiletry industry, agro-industry, agrifood sector, and herbal medicine (Wells *et al*., 2018; Komnenić *et al*., 2020). The quality of lavandin depends on the presence of various bioactive components and their content in the plant (Gavrić *et al*., 2024). Inherited genes regulate the type of bioactive compounds in aromatic plants, while environmental conditions and cultivation practices affect their content (Gavrić *et al*., 2023). The concentration of total phenols, flavonoids and essential oils in lavandin often serves as a reliable indicator of its quality (Zareen *et al*., 2014). During cultivation, various ecological factors such as fertility of the soil, soil and ait temperature, moisture, light and microorganisms can affect plants and their synthesis of phenolic compounds and essential oil (Sharma, 2019; Šamec *et*

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al., 2021). On the other hand, different agricultural techniques, such as tillage, fertilization, watering and mulching change the ecological conditions, directly affecting plant growth and bioactive compound synthesis (Gavrić *et al*., 2023). Mulching is an agricultural practice that is most commonly used in vegetable crops. Mulch primarily retains moisture in the soil and prevents the development of weeds (Šakonjić *et al*., 2023). Therefore, its application leads to changes in ecological conditions that can affect aromatic plants' qualitative and quantitative properties.
Considering all the above, the aim of this work was to determine the effects of mulching on yield, essential oil contents and antioxidant capacity of lavandin.

MATERIALS AND METHODS

Field Experiment. A field experimental site is located at Butmir, Bosnia and Herzegovina (B&H). The experiment was set up during the growing season of 2024. A lavandin cultivar "grosso" was used. The treatments included different mulches (straw, alfalfa, agritela and control/without mulch). The field experiment had a split-plot design. Each plot contained ten replications. The lavandin crop was one year old, that is, it was in its first year of cultivation.
Extraction and determination of essential oil content. The extraction of oils from lavandin inflorescence was carried out according to the previously described protocol by Clevenger (1928). In brief, 20 grams of dry materials were measured and transferred into a 250 mL flask containing 125 mL of distilled water. The samples underwent distillation for 120 minutes, after which the volume of essential oil was quantified.
Preparation of ethanol extracts for determination of bioactive compounds. To make the extract, 0.5 g of each pulverised sample was put into a 50 mL volumetric flask. The flask was then filled with 60% ethanol and mixed thoroughly. The extracts were later filtered and refrigerated until analysis.
Determination of bioactive compounds. The total phenolic content, standards and each ethanolic extract of lavandin were determined using the method by Gavrić *et al.* (2024). Results were expressed as mg GAE g^{-1}. Each ethanolic extract's total flavonoid content was assessed using a method previously documented by Gavrić et al. (2023). The results were expressed as mg CAE g^{-1}. The total antioxidant activity was determined using the FRAP method previously reported by Benzie and Strain (1996). The results were expressed as μM Fe^{2+} g^{-1} of dry matter.
Statistical analysis. All measures were performed ten times, and the findings were presented as the mean. Statistical analysis was conducted using SPSS software (IBM, Armonk, USA). An analysis of variance (ANOVA) accompanied by Tukey's multiple comparison tests was used or performed to compare the mean values of the results.

RESULTS AND DISCUSSION

Table 1 presents the impact of different types of mulch on fresh inflorescence yield, dry inflorescence yield, and essential oil content. The research results suggest two things. First, low yield was observed in all treatments. That is, the yield in this research is lower

compared to other research (Minev *et al*., 2022; Caccialupi *et al*., 2022). The reason for such a low yield is that the lavandin plantation was only one year old, in fact in its first year of cultivation. Second, mulch treatment significantly affected the investigated traits. The use "Alfalfa" mulch resulted in the highest inflorescence yields, measuring 27.7 g for fresh yield and 9.0 g for dry yield. This was followed by the "Straw" treatments at 19.3 g and 2.8 g, respectively, and the "Agritela" treatments at 19.2 g and 2.8 g. The control group exhibited the lowest yields, with 6.7 g fresh and 2.4 g dry yields. Observing results for the essential oil content, it can be said that there were some differences here as well. The lowest amount of essential oil was recorded in the ″agritela″ treatment (5.0 mL 100 g^{-1}), and the highest in the ″straw″ treatment (6.4 mL 100 g^{-1}). Our research indicated that mulch can influence the yield of inflorescences and essential oil content. Variations in these traits were likely due to changes in soil temperature resulting from mulch application. Namely, earlier research by Ning et al. (2021) found that soil with black mulch film is warmer than soil without mulch (the control). In contrast, Palada *et al*. (2000) noted that soil under straw mulch is cooler than soil without mulch (the control).

Table 1. Effect of mulch type on fresh inflorescence yield, dry inflorescence yield and essential oil content

Mulch type	**Fresh inflorescence yield, g plant^{-1}**	**Dry inflorescence yield, g plant^{-1}**	**Essential oil contents, mL 100 g^{-1}**
Agritela	19.2^{ab}	2.8^{ab}	5.0
Straw	19.3^{ab}	2.8^{ab}	6.4
Alfalfa	27.7^{a}	9.0^{a}	6.0
Control	6.7^{b}	2.4^{b}	6.3
Average	**18.2**	**4.2**	**5.9**

Different small letters (a and b) indicate significant differences between treatments at the 0.05 level

Different mulch types did not significantly affect phenolic content (Table 2), which ranged from 39.03 GAE g^{-1} (straw) to 46.50 GAE g^{-1}(control). However, mulch treatment significantly affected flavonoid content and antioxidant capacity. The treatments with ″straw″ had the highest level of flavonoids contents (17.13 mg g^{-1} CAE), followed by the treatments with ″alfalfa″ (14.03 mg g^{-1} CAE), ″agritela″ (12.25 mg g^{-1} CAE), and the ″control″ (10.32 mg g^{-1} CAE). A similar influence of mulch with differences was recorded with antioxidant capacity. The antioxidant capacity varied from 31.27 mM Fe^{2+} g^{-1} (alfalfa) to 37.71 mM Fe^{2+} g^{-1} (control). The findings were similar to the research of Šakonjić *et al*. (2023). They noted that mulching changes the content of bioactive compounds in medicinal plants. The same researchers state that different types of mulch change the growth conditions, which causes plants to react

differently to synthesize secondary metabolites. The content of flavonoids in our research is in line with Bajalan *et al*. (2016). The authors studied 30 different lavender cultivars and found that the flavonoid content was between 28.19 and 71.62 mg CAE g^{-1}. The authors highlight the importance of identifying lavender cultivars with high flavonoid content because of their beneficial therapeutic impact on human form and health.

Tabele 2**.** Effect of mulch type on total phenolic, flavonoid, and antioxidant capacity

Mulch type	**Total phenols contents, mg GAE g^{-1}**	**Flavonoid contents, mg CAE g^{-1}**	**Antioxidant capacity, mM Fe^{2+} g^{-1}**
Agritela	41.85^{ns}	12.25^{ab}	35.61^{ab}
Straw	39.03^{ns}	17.13^{a}	35.36^{ab}
Alfalfa	40.30^{ns}	14.03^{ab}	31.27^{b}
Control	46.50^{ns}	10.32^{b}	37.71^{a}
Average	**41.92**	**13.43**	**34.98**

Different small letters (a, b and c) indicate significant differences between treatments at the 0.05 level; GAE is the equivalent of gallic acid, and CAE is the equivalent of cathetin acid.

CONCLUSIONS

The experiments' results have demonstrated that mulching can affect lavandin's inflorescence yield and bioactive compounds. Alfalfa mulch had a significantly higher yield of fresh and dry inflorescence than other mulch types (straw, agritela, and control). Furthermore, the mulch used significantly affected the quality of lavandin. Given that the relatively low inflorescence yield was recorded, it is recommended to continue the research in the following years after the plant's development, that is, in the years when the plant fully matures.

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UTJECAJ MALČIRANJA NA PRINOS I KVALITET LAVANDINA (*Lavandula intermedia*)

Rezime

Lavandin (*Lavandula intermedia*) je aromatična biljka iz familije Lamiaceae. Prinos i kvalitet aromatičnog bilja, pa tako i lavandina, ovise o kultivaru, ekološkim faktorima i tehnologiji uzgoja. Cilj ovog rada bio je ispitati utjecaj različitih vrsta malča na prinos cvasti, sadržaj eteričnog ulja i antioksidativni kapacitet lavandina. Istraživanje je sadržavalo tri vrste malča i to: pšeničnu slamu, lucerku i agritelu, te kontrolnu varijantu (bez malča). Eksperiment je imao split-plot dizajn, a unutar svakog plota obavljeno je po deset mjerenja. U istraživanju su evidentirani prinos cvasti, sadržaj eteričnog ulja, ukupnih fenola, flavonoida i antioksidativni kapacitet. Najmanji sadržaj eteričnog ulja zabilježen je sa malčom od agritele (5,0 mL/100 g), a najveći sa slamom (6,4 mL/100 g). U tretmanu sa slamom evidentiran je najveći sadržaja flavonoida (17,13 mg g^{-1} CAE), a zatim su slijedili tretmani sa lucerkom (14,03 mg g^{-1} CAE), agritelom (12,25 mg g^{-1} CAE), te kontrola (10,32 mg g^{-1} CAE).

Ključne riječi: *lavandin, mulč, kvalitet, eterično ulje, antiokidativni kapacitet*