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THE ALLELOPATHIC EFFECTS OF SOME ESSENTIAL OIL ON THE BIOTEST SPECIES *SINAPIS ALBA* L.

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Abstract

This paper study the allelopathic effects of allyl isothiocyanate, rosemary, clove, pine and eucalyptus essential oil dilution (0.2; 0.1; 0.02; 0.01; 0.002 and 0.001%) on seed germination ability and seedling growth of biotest species Sinapis alba L. The dilutions 0.2% and 0.1% of clove and allyl isothiocyanate essential oils totally inhibited the germination capacity of the white mustard seeds. The major component from the essential oil of clove named eugenol can be a natural herbicide. At Sinapis alba L. significantly inhibited the growth of hypocotyls. The descending order regarding the allelopathic inhibitory efficiency of the essential oils on seedling growth of biotest species Sinapis alba L. was the following: allyl isothiocyanate, clove, eucalyptus, rosemary and pine.

Key words: allyl isothiocyanate, rosemary, clove, pine and eucalyptus essential oil, *Sinapis alba* L., allelopathy

INTRODUCTION

The future research can be focused on developing a natural plant products as an environmentally safe herbicide in replacement to the harmful chemical herbicides.Thus is expected that the chemical herbicide will be strictly limited. The natural products with inhibitory allelopathic effects will be used for weeds control (Muhammad et al., 2019). The researches aim at using essential oils extracted from plants like herbicides raised (Sarić-Krsmanović et al., 2019). Many studies investigated the rosemary (Chen et al., 2013; Frabboni et al., 2019; Maccioni et al., 2020), clove (Mayer et al., 2008; Ahuja et al., 2015), pine (Ibánez et al., 2019) or eucalyptus (Aragao et al., 2015; Benchaa et al. 2018) essential oil allelopathic potential against weeds. Other paper study the allelopathic effects of different dilution with allyl isothiocyanate oil on caryopses germination ability and seedling growth of different cereal varieties (Șipoș et al., 2016; Bortiș et Șipoș, 2018).

MATERIAL AND METHOD

The experiments were carried out in the greenhouse of the University of Oradea and we used the seeds of *Sinapis alba* L. (white mustards). The mustard germinative faculty (FG) was tested and the value was above 80%. The oils with allelopathic effect were used: Sigma-Aldrich pure allyl isothiocyanate (mustard oil), rosemary, clove, pine and eucalyptus essential oils. The essential oils produced by Fares Laboratories had the following chemical composition:

Rosmarinus aetheroleum (rosemary oil from leaves and branches) - α - pinene, camphene, limonene, 1-8 cineole, camphor, linalool, bornyl acetate.

Caryophyllus aromaticus floris aetheroleum (clove oil from flowers) -eugenol 70-90%, caryophyllene, eugenyl acetate.

Pinus sylvestris aetheroleum (pine oil from leaves) - α - pinene, β - pinene, sabinene, myrcene, limonene, phallandrene.

Eucalyphtus globulus aetheroleum (eucalyptus oil from leaves) - 1-8 cineole, α - pinene.

These were dispersed in water by ultrasonication with the Emmi-04D device with frequency 40 KHz. A quantity of 100 ml of distilled water and an amount of 0.2 ml of essential oil were introduced in an Erlenmayer glass with a glass stopper. After the ultrasonication for 15 minutes at water temperature a solution with a concentration of 0.2% (V1) was obtained. With graduated cylinders and distilled water, dilutions of 0.1%, 0.02%, 0.01%, 0.002% and 0.001% were made. These represented the experimental variants (V2, V3, V4 , V5 and V6). Transparent and colourless plastic casseroles were used for germination. The filtered paper moistened with 30 ml of distilled water or the same amount with different dilutions of used oils was placed inside. For all experimental variants and control lots 50 mustard seeds were placed in each casserole. The germinators were kept at room temperature and semi-darkness (T = 21-23°C). The germination ability was determinate after 9 day. For seedling growth length of the embryonic root and hypocotyle of the *Sinapis alba* L. plantlet was determinate. Statistical analysis included: arithmetic media (M) and Student's test (SigmaPlot 2001 software). The control arithmetic media was considered 100%. Percentage differences relative to the control of the biotest species *Sinapis alba L*. grown on various dilutions (V1-V6) of essential oils and their statistical significance (a-significant $p < 0.05$; b-insignificant $p > 0.05$).

RESULTS AND DISCUSSION

The dilutions 0.2% (V1) and 0.1% (V2) of **allyl isothiocyanate** essential oil completely inhibited the germination of the white mustard seeds (Table 1). The 0.02% allyl isothiocyanate solution (V3) significantly inhibited the growth in length of the roots of white mustard seedlings. Other dilutions (V4, V5 and V6) also caused inhibitions but statistically insignificant. The growth in length of the hypocotyls in the experimental variant V3 were -10.21% ($p > 0.05$). The experimental variants (V4, V5 and V6) longer lengths of hypocotyls were recorded but these were statistically insignificant (see Table 2). The allelopathic substances at low concentrations cause an elongation of the vegetative organs of the seedlings. In conclusion, in the case of the allyl isothiocyanate, the concentration of 0.02% (V3) determined significant inhibitions of biotest seedling growth. The following dilutions (V4-0.01%; V5-0.002%; V6-0.001%) caused insignificant inhibitions of root growth and elongations of the hypocotyls.

Table 1

The germination faculties of the seeds of the biotest species *Sinapis alba L.* in control groups and various dilutions (V1-V6) of essential oils (allyl isothiocyanate, rosemary, clove, pine, eucalyptus)

Germination of *Sinapis alba L.* seeds	Control sample	V1 0.2%	V2 0.1%	V3 0.02%	V4 0.01%	V5 0.002%	V6 0.001%
Allyl isothiocyanate	80%			74%	62%	66%	64%
Rosemary	82%	68%	62%	72%	72%	68%	80%
Clove	82%			70%	72%	62%	78%
Pine	81%	72%	74%	70%	90%	70%	76%
Eucalyptus	82%	74%	84%	80%	78%	72%	80%

The germination of the seeds of the biotest species *Sinapis alba L*. was not significantly affected by any of the dilutions of **rosemary** essential oil used by us in the study (Table 1). Mustard roots growth were insignificantly inhibited in V1 dilution (0.2%). In the case of the dilutions V2 (0.1%), V3 (0.02%), V5 (0.002%) and V6 (0.001%) elongation of the roots were observed. In fact the V2-V6 dilutions of rosemary essential oil were not phytotoxic for the roots. The growth in length of hypocotyls of white mustard seedlings was not significantly influenced (see Table 2).

In the case of dilutions 0.2% (V1) and 0.1% (V2) of **clove** essential oil the germination of white mustard seeds was completely inhibited. The other dilutions considered in the study (V3-V6) did not substantially affect seeds germination (Table 1). Under the action of experimental dilutions V3-V6 of clove essential oil growth of roots of the mustard seedlings were

predominantly stimulated. The hypocotyls were inhibited. This result might be explained by the fact that the allelopathic substance eugenol (volatile phenolic constituent, 70-90% in the essential clove oil used by us) spread in the environment inside the germinators. The concentration of eugenol significantly inhibited the growth of hypocotyls (-47.47% in the case of experimental variant V3).

Table 2

Percentage differences relative to the control samples (considered 100%) regarding the growth in length of the embryonic roots and hypocotyls of the biotest species *Sinapis alba L.* in various dilutions (V1-V6) of essential oils (allyl isothiocyanate, rosemary, cloves, pine, eucalyptus) and their statistical significance (a-significant p <0.05; b-insignificant p> 0.05)

Essential oils	*Sinapis alba* L. - vegetative organs	V1 0.2%	V2 0.1%	V3 0.02%	V4 0.01%	V5 0.002%	V6 0.001%
Allyl isothiocyanat	Root	-	-	-28.91 % a	-12.21% b	-17.15% b	-14.23% b
	Hypocotyl	-	-	-10.21% b	+8.74% b	+15.46% b	+12.64% b
Rosemary	Root	-17.94% b	+2.65% b	+21.77% b	+26.37% b	+4.76% b	+11.96% b
	Hypocotyl	+3.19% b	-9.45% b	+6.6% b	-0.31% b	+4.23% b	-0.04% b
Clove	Root	-	-	+21.08% b	+11.11% b	+13.07% b	-1.82% b
	Hypocotyl	-	-	-47.47% a	-12.13% a	-21.27% a	-6.88% b
Pine	Root	-5.77% b	+15.29% b	+31.97% a	+23.57% a	+30.89% a	+52.30% a
	Hypocotyl	+7.87% b	+3.22% b	+11.71% b	-8.35% b	+1.24% b	+2.68% b
Eucalyptus	Root	-24.39% a	+10.22% b	-2.91% b	-15.19% b	-18.95% b	-12.85% b
	Hypocotyl	+7.63% b	-1.81% b	+8.79% b	+4.24% b	+0.14% b	-1.92% b

The germination of white mustard seeds was not affected by any of the dilutions of **pine** essential oil considered by us in the study (Table 1). The growth in the length of the mustard roots was insignificant inhibited (p>0.05) only in the case of V1 dilution (0.2%). The V2 (0.1%) and V3, V4, V5, V6 dilutions caused elongations of the roots (see Table 2). The growth

in the length of the hypocotyls of the white mustard seedlings was insignificantly influenced.

The germination of white mustard seeds was not affected by any dilutions of the **eucalyptus** essential oil (Table 1). Mustard seedling roots were significantly inhibited in the case of V1 dilution (0.2%). The influences were insignificant at the dilution of V2 (0.1%) solution of eucalyptus essential oil. The insignificant stimulation was observed at the dilutions V3, V4, V5 and at V6 the inhibition was insignificant. In the case of hypocotyls stimulations from dilutions (V1, V3, V4 and V5) and inhibitions from dilutions (V2 and V6) were insignificant.

CONCLUSIONS

1. The dilutions V1 (0.2%) and V2 (0.1%) of clove and allyl isothiocyanate essential oils proved to be phytotoxic. They totally inhibited the germination capacity of the white mustard seeds.
2. In the case of allyl isothiocyanate the concentration of 0.02% (V3) proved to be phytotoxic. It caused significant inhibitions of the roots.
3. The dilution of 0.02% (V3) of clove essential oil significantly inhibited the growth of hypocotyls (-47.47%). The volatile phenolic constituent eugenol (70-90% in the clove essential oil used by us) spread inside the environment of the germinators.
4. Mustard seedling roots were significantly inhibited at V1 dilution (0.2%) of eucalyptus essential oil. In the experimental variants V2-V6 (0.1%; 0.02%; 0.01%; 0.002%; 0.001%) the influences on the growth in length of the seedling organs were insignificant.
5. In the case of rosemary and pine essential oil dilution we observed that in V1 dilution (0.2%) mustard roots growth were insignificantly inhibited. The dilutions V2-V6 determined elongation of the roots. The growth in length of hypocotyls of white mustard seedlings was not significantly influenced.
6. The descending order regarding the allelopathic inhibitory efficiency of the essential oils on seedling growth of biotest species *Sinapis alba* L. was the following: allyl isothiocyanate, clove, eucalyptus, rosemary and pine.

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