Herbicidal activity and inhibitory potency of two essential oils on weeds under natural condition

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Abstract: The unsuitable use of synthetic herbicides in agriculture along with their accumulation in soil and groundwater caused adverse effects on the environment and human health. For this reason, a particular attention have been paid over the world, to reduce the chemicals used in agriculture production by introducing biological and ecological methods. Therefore, using of alternative means, such as products-based essential oils to control herbaceous layer, is needed because of their high potential as natural herbicides more friendly to the ecosystems. This work focused on studying the inhibitory effect of two formulated essential oils; One based on cypress (Cupressaceae) collected from the region of Blida (north Algeria) and the other one based on Thuja (Cupressaceae) of the region of Tipaza (northern Algeria). The treatments were carried out in the field, dilutions prepared from a 10% concentrated stock solution to obtain respective doses: D1 = 0.1 g / l; D2 = 0.2 g / l and D3 = 0.3 g / l. The results showed that the bioproducts based on essential oil of the two plants had different actions on the germination of the herbaceous stratum according to the dose and the time. Indeed, for the cypress-based products, the strongest inhibition was obtained with the lowest dose (D1) at a rate of 33.87% whereas for that based on thuja, it was the maximum dose (D3) with the highest rate of inhibition (14%).

Keywords: Bioherbicide, cupress, essential oils, inhibition, thuja.

Introduction

The use of pesticides, herbicides and fungicides influences the environment. In order to minimize the use of synthetic products. New sciences have emerged in use natural molecules and biological means. It is therefore fundamental to design an integrated culture since building of protection strategy require a good biological understanding of disease or weed problems and effectiveness of different control methods. Depending on the choice of the subsequent control plan; the producer, as well as the company, ought to recognize the benefits and risks of each product.

The competition between weeds and crops also affects yield (Le Bourgeois et al., 1995) causing losses from 20 to 30%. Such a phenomenon leads to a very large monetary deficit, especially in cereal crops (Hussain et al., 2007). Thus, the sustainable development and the valorization of plants with phytosanitary characteristics of Algeria, is of a great interest. The main objective of this study is to test the vivo herbicidal activity of formulated bioproducts based on essential oils extracted from plants of the cupressaceae family.

Materials and methods

This work tested the biological activity of bioproducts at different doses in which their active ingredients were essential oils extracted from the Cupressaceae family, the experiment was carried out in vivo at the experimental station of biotechnology faculty, department of nature and life science. The extraction of the essential oils was done by hydrodistillation from cypress and hydro-vapo-distillation from thuja. Three repetition were perfomed in a square of 25cm of sides. The distance between each repetition was 50 cm and between the doses was 75 cm. The concentration of the stock solution of the bioproducts was 10%, the protocol established three doses D1 = 0.1 g / l; D2 = 0.2 g / l and

D3 = 0.3 g / l with three replicates for each dose. The treatments are carried out at the level of the plot using a backpack sprayer with a capacity of 10 liters. The doses and the control, as well, were sprayed in 5 liters/square. This quantity of 5 liters, allowed to moisten the soil to a depth of 10 cm, a daily monitoring was made during 16 days.

Results and discussion

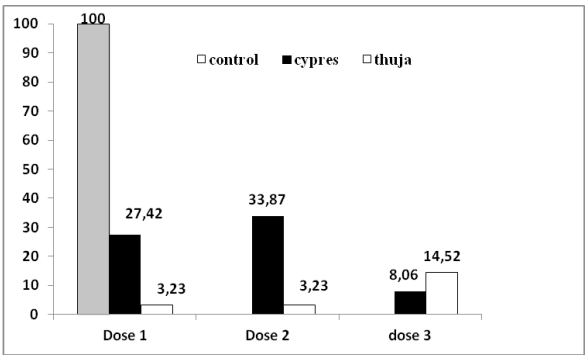

Figure 1: Overall germination rate of different treatments

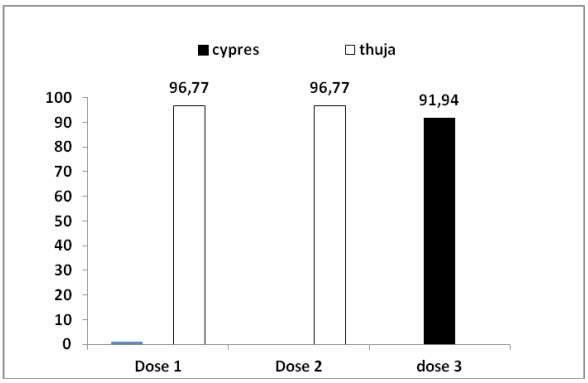

Figure 2 : Comparison of Effective Doses of Inhibition

From the results of Figure 1, it was observed an absence of the weeds under the effect of bioproducts based on various essential oils. Dose 2 of Blida cypress represented 33.87% of germination followed by dose 2 at 33.87%, then reduced to 8.06% with the dose 3 while the dose 1 and dose 2 from thuja reported 3.23% versus 14.52% for dose 3. The lowest percentage of germination was obtained in the cedar-based bioproduct since the lowest doses and the main doses have the same rate (3.23%). On the other hand; the cypress (with the highest percentage of inhibition) was obtained with a high dose. This phenomenon of allelopathy offers promising prospects for weed management. Allelopathy can be direct, through the cultivation of live plants or indirectly by the release of products during the decomposition of plants. The natural compounds presented in certain plants could be used successfully as bioherbicides (Da Mastro and al., 2006). By visualizing the overall percentage of germination. The present results marked the varabiabilty in the germination of the weeds according to the formulated bioproducts based on essential oils. All essential oils have demonstrated a potential to suppress the germination except for the

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bioproduct based on rosemary essential oil. The oils from cypress and rosemary had an overall intermediate repression whereas Thuja oil demonstrated more severe toxicity, so allelopathy effect is present and its impact on germination depends on the plant used. It was noted that dose 1 and dose 2 of cedar affected significantly on germination. On the other hand; for cypress, the efficiency was observed when the highest dose applied. The allopathic impact of aromatic plants was observed on bioproducts made from cypress, cedar with a very important anti-germinative power. Based on the hypotheses put forward, our results are consistent with the work already carried out or in progress. It is accepted that under natural conditions, seed germination is a biochemical and physiological process where, from the first contact of the seed with the stimulus exogenous (water), an amylase enzyme is synthesized and secreted to degrade starch (albumins) to provide the embryo with the energy needed for germination (Regnault-Roger et al., 2008).

Once secreted, embryonic growth begins and then intervenes by another physiological process, where the actors are the vegetable growth hormones including auxin (Lesuffleurs, 2007). According to De martino et al, (2010) some oxygenated monoterpenes showed strong inhibitory activity on germination and radicle lengthening of radish and garden watercress seeds: It is well-known that these compounds have phytotoxic effects which can cause anatomical and physiological changes in seedlings: reduction of certain organelles such as mitochondria, accumulation of lipid globules in the cytoplasm may be due to inhibition of synthesis of DNA or rupture of membranes.

Amri et al. (2014) demonstrated that *Cupressus arizonica* inhibited germination and seedling growth of *Lolium perenne* L. and *Poa pratensis* L., causing anatomical changes in seedlings and modification of the structure of the plant. Zeghada (2009) reports that some plants have an inhibitory effect on germination such as *T. articulata* (species with the strongest effect), *G. alypum*, *P. lentiscus* and *R. pentapylla* both on the *Lactuca sativa* and of *Rhaphanus sativus*. According to Asghar (2012) the results showed significant differences between the two species of grasses studied for percentage germination, germination index, germination inhibition rate, seedling inhibition rate, length seedling, root, shoot, and seedling dry weight. The means of comparison of *Lolium perenne* and *Poa pratensis* revealed that the percentage of germination, germination index, length of seedlings, root, stems and weight of dry seedlings of *Lolium perenne* were higher than those of *Poa pratensis*. However, the rate of inhibition of germination and seedling rate of inhibition *Poa pratensis* was greater.

Conclusions

Bioproducts based on essential oils could be exploited againest weed germination. All the bioproducts of the two plants showed an inhibition of germinative power for seven days to fifteen days after treatments. The treatments with Thuja led to the lowest germination percentage at the lowest dose compared to that with cypress which obtained the lowest rate of germination with the highest dose.

According to a rather conclusive results established by complementary studies, it would be interesting to characterize the essential oils used chemically to study the impact of its bioproducts on soil pedofauna and the selectivity of its bioproducts on weeds. Based on rather conclusive results, it would be interesting to investigate further in this area. The

chemical characterization of the essential oils used, the impact of its bioproducts on soil pedofauna and the selectivity of its bioproducts towards the herbaceous stratum in order to promote sustainable development and the preservation of ecosystems.

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