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EFFECT OF WATER EXTRACT OF ALOE VERA ON GERMINATION AND EARLY GROWTH OF DIANTHUS BARBATUS

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ABSTRACT

The Sweet William - *Dianthus barbatus* (L.) is a plant from *Caryophyllaceae* family. The germination and growth of the plant are important phenological stages, and plant survival depends on them. The seed that has better germination energy also has better vigor, so it is more resistant to stressful conditions during germination. The aim of this study was to examine the possibilities and effectiveness of water extracts of plant species *Aloe vera* on the seed germination and early growth of Sweet William seedlings - *Dianthus barbatus* (L.). The experiment was conducted in laboratory conditions at the Faculty of Agriculture, University of Banja Luka and consisted of control (distilled water) and treatment with water extract of *Aloe vera*. Water extracts were prepared from fresh leaves and experiments were conducted in Petri dishes at 5, 10, and 15%. The temperature in the laboratory was constant at 20°C and the light regime was set to 16h day/8h night. Water extracts of *Aloe vera* at a concentration of 5% had a positive effect on the seed germination and germination energy, while a concentration of 15% had a positive effect on shoot and root length, and fresh mass of *Dianthus barbatus* seedlings.

Key words: Aloe extract, germination energy, Sweet William

INTRODUCTION

Allelopathy is a biological phenomenon by which an organism produces one or more biochemicals that affect the growth, survival and reproduction of other organisms (Rice, 1984). These substances are known as allelochemicals and they can have a stimulating effect (positive allelopathy) or inhibiting effect (negative allelopathy) on the target organism (Bhowmik & Inderjit, 2003; Rice, 1984). Allelopathy components can reduce or completely stop the germination phase and plant development. On the other hand, allelochemicals with a positive effect can be used as bio stimulators and biofertilizers to improve crop growth, development and yield (Lin et al., 2004; Popa et al., 2008; Bhadha et al., 2014).

The genus *Aloe* belongs to the family *Alliaceae*, and includes more than 400 species, among which are the most famous in folk medicine *Aloe vera* (L.) Burm. f. or *Aloe arboresc*ens Miller. *Aloe vera* originated in the warm, dry climates of Africa, the plant is readily adaptable and grows worldwide (Steenkamp & Stewart, 2007). Although its shape looks like a cactus and is characterized by the possibility to store large volumes of water in its tissue. Aloe plants have green fleshy leaves covered by a thick cuticle or rind, under which is a thin vascular layer covering an inner clear pulp. The leaves are 30-50 cm in length and 10 cm in width at the base, pea-green in color and with bright yellow tubular flowers 25-35 cm in length (Boudreau et al., 2013). The main feature of the *Aloe vera* plant is its high water content, ranging from 99% to

99.5%, while the remaining 0.5–1.0% solid material is reported to contain over 200 different potentially active compounds, including vitamins, minerals, enzymes, simple and complex polysaccharides, phenolic compounds, and organic acids (Boudreau et al., 2013; Rodríguez et al., 2010).

Three types of *Aloe vera* extracts can be distinguished: gel extract, whole leaf extract, and decolorized whole leaf extract (Boudreau et al., 2013). This plant has many pharmacological properties including antioxidant, antibacterial, antifungal and immunomodulatory effects (Hosseinimehr et al., 2010). Use of *Aloe vera* gel extracts in health foods and beverages, and moisturizing cosmetics, began during the 1970s, starting in the USA and parts of Europe (Park & Jo, 2006). The gel is used in the cosmetics industry as a hydrating ingredient in liquids, creams, sun lotions, lip balms, hair tonic, shampoo, and skin-moistening gel (Newton, 2004). The aim of this study was to examine the possibilities and effectiveness of water extracts of plant species *Aloe vera* on the seed germination and early growth of Sweet William seedlings - *Dianthus barbatus* (L.).

MATERIAL AND METHODS

The investigation was conducted in September 2021 in the laboratory conditions at the growing chamber in the Faculty of Agriculture, University of Banja Luka, Entity of Republic of Srpska, Bosnia and Herzegovina. Flower seeds of *Dianthus barbatus* (L.) were used. The seeds were disinfected with 1% NaOCl for 20 minutes before the experiment and washed three times with distilled water. The water extracts of the plant species *Aloe vera* used in the experiment were prepared according to the method of Hanafy et al. (2012) from *Aloe vera* leaves. *Aloe vera* fleshy leaves were obtained, the two side margins were removed, and the remainder was cut to pieces and blended in a blender. The mixture was placed in a sterile strainer and squeezed. The juice was obtained in a glass beaker and various water extracts of Aloe were obtained by diluting the juice with distilled water.

The experiment was set up in Petri dishes sterilized with 96% ethanol and lined with filter paper which is sprayed with 3 ml of distilled water (control group) or with 3 ml of 5, 10, and 15% water extract of *Aloe vera* (treatment). Twenty seeds were counted and placed in each Petri dish on the wet paper. The experiment was set-up in four repetitions for each treatment. There were a total of 320 seeds in the experiment. Prepared Petri dishes with seeds were placed in the growth chamber under artificial white light for 16h a day and 8h per night. The temperature during the research was constant (20±1°C). Petri dishes were observed daily and additional distilled water or Aloe water extract was added if needed. Seeds were kept under these conditions for 14 days. After 7 days germination energy and after 14 days germination of the seeds were tested. Both values are expressed as percentages. The number of developed cotyledons was recorded during the research. At the end of the experiment shoot and root length (cm) was measured using graph paper, and fresh and dry mass (g) of Sweet William seedlings was obtained with an electronic scale. The data obtained were statistically analyzed (LSD, F-test, t-test) using standard computer programs and VV-Stat (Vukadinović, 2017).

RESULTS AND DISCUSSION

Statistically analyzed obtained results of seed germination, germination energy, number of cotyledons, shoot and root length, and fresh and dry mass of *Dianthus barbatus* (L.) seedlings under influence of Aloe water extracts were given in table 1.

Table 1: Influence of water extracts of *Aloe vera* (L.) Burm.f. on the seed germination, germination energy and number of cotyledons of Sweet William seedlings - *Dianthus barbatus* (L.) (means marked with different letters (a,b,c) significantly differ at p = 0.05)

Treatment variant	germination energy %	germination %	No. of cotyledons
Control K	71.25[a]	86.25[a]	17[a]
Treatment T_1	71.25[a]	80[b]	14.75[b]
Treatment T_2	67.5[b]	70[c]	11.75[c]
Treatment T_3	65[b]	70[c]	10[c]
Average	68.75	76.56	13.38
Analysis of variance - F	0.33	4.27[*]	6.89[**]
LSD	germination energy %	germination %	No. of cotyledons
0.05	ns	11.92	3.65
0.01	ns	ns	5.12

ns= not significant

The average values of germination energy of Sweet William seeds were the same in T_1 treatment and in the control variant with 71.25%, which is 5.55% more in comparison with treatment T_2 and 9.62% more in comparison with treatment T_3, but these values were not sufficient to be statistically confirmed. The same ratio was in seed germination, where the best result had the control group with 86.25%, then treatment T_1 with 80%, while with increasing concentration of other water extracts of Aloe the energy of seed germination decreased. The highest average number of developed cotyledons was 17 in the control group, then in treatment T_1 with 14.75, while the lowest average number of developed cotyledons was 11.75 in treatment T_2 and treatment T_3 with 10 developed cotyledons (Table 1.).

Table 2: Influence of water extracts of *Aloe vera* (L.) Burm.f. on the growth of Sweet William seedlings - *Dianthus barbatus* (L.) (means marked with different letters (a,b,c) significantly differ at p= 0.05)

Treatment variant	shoot length (cm)	root length (cm)	fresh mass (g)	dry mass (g)
Control K	0.98[b]	3.61[b]	0.12[a]	0.01[a]
Treatment T_1	1.05[a,b]	3.36[b]	0.13[a]	0.01[a]
Treatment T_2	1.08[a,b]	4.16[a]	0.14[a]	0.01[a]
Treatment T_3	1.13[a]	4.34[a]	0.15[a]	0.01[a]
Average	1.06	3.87	0.13	0.01
Analysis of variance - F	3.74[*]	3.53[*]	1.02	1.89
LSD	shoot length (cm)	root length (cm)	fresh mass (g)	dry mass (g)
0.05	0.10	0.76	ns	ns
0.01	ns	ns	ns	ns

ns= not significant

In the Table 2. data showed the influence of water extracts of Aloe on the growth of Sweet William seedlings: shoot length (cm), root length (cm), fresh mass (g) and dry mass (g).
The highest average value of shoot and root length was observed in treatment T_3 (1.13 cm; 4.34 cm). The lowest average value of shoot length was in the control variant with 0.98 cm, and the lowest average value of root length was in treatment T_1 with 3.36 cm. The highest average value of fresh mass was in treatment T_3 with 0.15 g and the lowest in the control variant with

0.12 g but these values were not sufficient to be statistically confirmed. The average values of dry mass were the same in all treatments with 0.01 g. (Table 2.).

The positive influence of extracts from species of the genus Aloe on the growth and development of plant species has been noted by many authors, so according to El-Shayeb (2009) extracts of *Aloe vera* species in concentrations of 25, 50 and 75% increased height, number of branches, number of leaves, fresh and dry mass of leaves, and the fresh and dry mass of the stem common evening-primrose (*Oenothera biennis*). Hanafy et al. (2012) report a positive effect on growth parameters in flowering and ornamental species. *Aloe vera* leaf gel is a very excellent source of plant nutrients: calcium, iron, magnesium, potassium, phosphorous and zinc (Dagne et al., 2000); amino acids: alanine, glycine, leucine and proline (Reynolds & Dweck, 1999); vitamins-B complex, C, β-carotene and α-tocopherol (Vinson et al., 2005) and other organic compounds: triglycerides, triterpenoid, gibberellin, potassium sorbate and salicylic acid (Hamman, 2008). The importance *Aloe vera* water extract as a biostimulant in plant production has been confirmed by numerous studies. Leaf extracts of species Aloe can be useful as natural growth regulators (Lin et al., 2004), and the allelopathic effect can be attributed to the presence of allelochemicals, such as tannins, flavonoids and phenolic acids (Alipoor et al., 2012). Zeljković et al. (2020) reported positive effect of 10% Aloe water extract in the transplantation phase, where it can be used as biostimulant, to enhance shoot and root length of scarlet sage - *Salvia splendens* L.

CONCLUSIONS

Based on the obtained results we can conclude that the treatment with a certain percentage of water extract of Aloe can enhance seed vigor and early growth of Sweet William seedlings - *Dianthus barbatus* (L.) Water extracts of *Aloe vera* at a concentration of 5% had a positive effect on the seed germination and germination energy, while a concentration of 15% had a positive effect on shoot and root length, and fresh mass of *Dianthus barbatus* (L.) seedlings, and can be used after transplantation phase like bio stimulants, to enhance early growth and development of seedlings. The observed positive effects of the presence of allelochemicals may be the subject of further research in the form of a plant stimulator of crop growth and development.

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