STUDY REGARDING THE INFLUENCE OF SOME ALLELOPATHIC SPECIES IN WEED CONTROL ON A CLIMBING BEAN CROP

STUDIU PRIVIND INFLUENȚA UNOR SPECII ALELOPATICE ÎN CONTROLUL BURUIENILOR LA CULTURA DE FASOLE URCĂTOARE

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Abstract. *The aim of the present work was to evaluate the influence of some allelopathic species in weed control. Field experiments were conducted to assess the allelopathic potential of five species. Two experimental variants have been studied. The first variant was represented by the mix of species with allelopathic properties sown in the intercropping system with "Auria Bacăului" climbing bean (Phaseolus vulgaris). The species with allelopathic properties used were white clover (Trifolium repens), red clover (Trifolium pratense), birdsfoot trefoi (Lotus corniculatus) and parsley (Petroselinum crispum). The second variant was represented by the intercropping of barley (Hordeum vulgare) and climbing bean. Before mowing/ hoeing the degree of weed infestation was on average 59% for mixture variant, 23% for barley variant and 94% for control. After mowing/hoeing the results highlighted 21% weeds in mixture variant, 52% in barley variant and 82% for control.*

Key words: allelopathic properties, intercropping system, weed infestation, non-economic plants, natural competition

Rezumat. *Scopul prezentei lucrări a fost de a evalua influența unor specii cu efect alelopatic în controlul buruienilor. Experimentele în câmp deschis au urmărit potențialul alelopatic a cinci specii. Au fost studiate două variante experimentale. Prima variantă a fost reprezentată de amestecul de specii cu proprietăți alelopatice semănate într-un sistem intercropping cu fasole urcătoare (Phaseolus vulgaris), soiul „Auria Bacăului". Speciile cu proprietăți alelopatice utilizate au fost: trifoiul alb (Trifolium repens), trifoiul roșu (Trifolium pratense), ghizdeiul (Lotus corniculatus) și pătrunjelul (Petroselinum crispum). Cea de-a doua variantă a fost reprezentată de asocierea orzului (Hordeum vulgare) cu fasolea urcătoare. Înainte de a cosit/prășit, gradul de infestare cu buruieni a fost, în medie, de 59% pentru varianta cu amestec, 23% la varianta cu orz și 94% în cazul variantei martor. După cosit/prățit, rezultatele au evidențiat un grad de infestare cu buruieni de 21% în varianta amestecului, 52% în varianta cu orz și 82% la varianta martor.*

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Cuvinte cheie: propietăți alelopatice, sistem intercropping, infestare cu buruieni, plante fără valoare economică, competiție naturală

INTRODUCTION

Weeds are unwanted and non-economic plants that compete with cultivated crops for survival and reproduction. The natural competition for proper light, water and nutrition might lead to a decrease of plant growth and also, other elements and factors, such as allelopathy item could influence the growth and yield (Munteanu *et al*., 2008; Hassannejad *et al*., 2013; Sturm *et al*., 2018).

Indiscriminate and/or blind use of chemical herbicides often leads to crop loss, livestock and human hazards, soil and water pollution and weed resistance. Mechanical weed control requires extra soil turn-over, which can disturb soil structure and deplete soil fertility (Munteanu and Stoleru, 2012; Jităreanu, 2015).

Green manure and cover crops potentially can reduce soil erosion, improve soil quality, and improve succeeding crop yields (Stan *et al*., 2008; Călin, 2010). Additionally, they may be beneficial in disrupting the life cycle of insects, plant pathogens and weeds, thus decreasing the need for pesticides. Living crops may suppress weeds by vigorously competing for physical resources, and their decaying residues may suppress weeds through physical, biotic and allelopathic interactions (Weston, 1996; Stoleru *et al*., 2014).

Most plants contain chemical compounds which may inhibit or promote germination and these substances fall into a diverse range of chemical groups. For example, white clover extracts were capable of inhibiting the germination of legumes and grasses, including itself (Rice, 1974). Barley *(Hordeum vulgare)* is well known for its allelopathic compounds. Several phenols and terpenes have been reported in various cultivars of barley. Birdsfoot trefoi *(Lotus corniculatus)* has a significant tolerance to the allelopathic influence of alfalfa dodder (*Cuscuta epithymum)* (Valcheva *et al*., 2018).

The aim of the present work was to evaluate the the influence of five allelopathic species in weed control: white clover (*Trifolium repens)*, red clover *(Trifolium pratense)*, birdsfoot trefoi *(Lotus corniculatus)*, parsley *(Petroselinum crispum)* and barley *(Hordeum vulgare)*.

MATERIAL AND METHOD

The experiments were carried out at the Vegetable Research and Development Station, during 2021 vegetation season, within a series of experiences on climbing bean crop under ecological farming conditions. Soils from experimental field are characterised by a medium loamy-clay texture in the first 150 cm and coarse below this depth. Soil density is 2.67g/cm^3, in arable layer and below 2.79 g/cm^3, under 50 cm. The field capacity for water is 24-25%. The soil reaction is weak acid in the first 75-80 cm (pH 6.2-6.8). The humus content is 2.0-2.5%, in the first 60-cm and then slowly drops to the bottom. The C/N ratio is between 10-12 with a downward trend towards depth (https://legumebac.ro/).

Only one experimental factor has been studied. It was represented by species with allelopathic properties sown in intercropping system with "Auria Bacăului" cultivar of climbing bean. The seeds of species with allelopathic potential used in the experiment were: white clover 12 kg/ha, red clover 20 kg/ha, birdsfoot trefoi 20 kg/ha, parsley 6 kg/ha and barley 180 kg/ha. These species were sown on 4th of June 2021.

Two experimental variants have been studied. The first variant was represented by the mix of species with allelopathic properties, sown in the intercropping system with climbing bean. The mix of species with allelopathic properties used were white clover, red clover, birdsfoot trefoi and parsley. The second variant was represented by the intercropping of barley and climbing bean.

Three replicates were performed for all variants. The allelopathic species were sown in rows of 1 m width and 23.3 m length (23.3 m^2) for mixture variant. In case of barley variant, each replicates was sown in rows of 1 m width and 7.5 m length (7.5 m^2).

Before sowing, the land was prepared with a milling for tillage. Mowing was performed on 5th of August 2021 with a garden strimmer. The soil on control variant was tillaged (hoed) three times mechanically (between rows) and twice manually (on rows) in order to control weeds.

The research methods used

Data on the degree of weed infestation were obtained by the visual method. The abundance of weeds was determined by European Weeds Research Society - scale and Maltsev's eye scale (1962) from score 1 (low infestation degree) to score 4 (high infestation degree) (https://www.ewrs.org/).

The identification of weed species has been done through weed descriptor from Gurău (2007) and mobile application available at https://identify.plantnet.org/.

OPTI-SCIENCES Chlorophyll Content Meter and OPTI-SCIENCES Anthocyanin Content Meter were used to measure the level of chlorophyll and anthocyanins. Leaves used for all measurements were randomly sampled from three plants in each replicates.

RESULTS AND DISCUSSIONS

The main weed species identified in climbing bean crop were: cockspur (*Echinochloa crus-galli*), pigeon grass (*Setaria pumila*), pale knotweed (*Persicaria lapathifolia*), canada thistle (*Cirsium arvense*), groundsel (*Senecio vulgaris*), bindweed (*Convolvulus arvensis*), prickly lettuce (*Lactuca serriola*), red-root amaranth (*Amaranthus retroflexus*), guasca (*Galinsoga parviflora*) and dandelion (*Taraxacum officinale*).

Cockspur was the dominant species in all variants. Both Golebiowska (2006) and Sekutowski and Rola (2010) reported that cockspur is a dangerous weed in cultivated crops, due to their frequency of occurrence and damage potential. The damage done by cockspur depends not only on its density, but also on the time of emergence.

Before mowing/hoeing, the degree of weed infestation was, on average, 59% in mixture variant, 23% in barley variant and 94% in control. After mowing/hoeing, the results highlighted 21% weeds in mixture variant, 52% in barley variant and 82% in control (Fig. 1).

The weeds have emarged especially in the free spaces between rows. At the start of the experiment, the mixture variant was most affected by weeds, but after mowing, the clover grew massively and covered the ground, managing weed control eficiently.

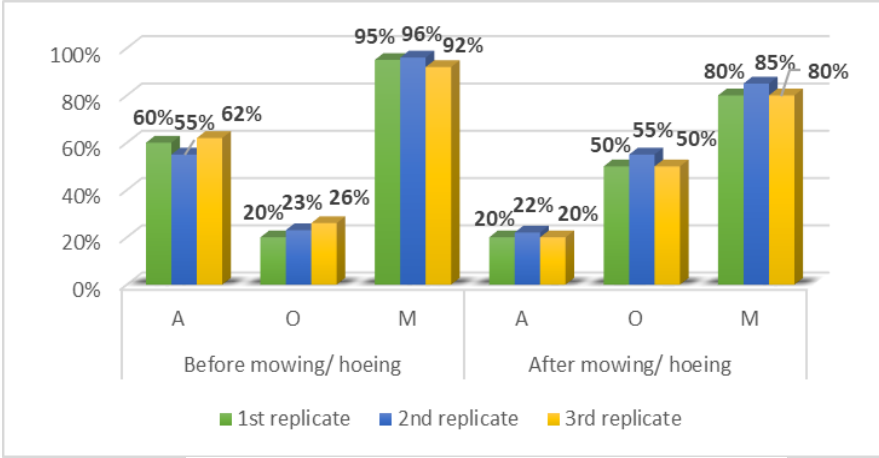

Fig. 1. The presence of weeds before and after mowing/ hoeing
Note: A – mixture – climbing bean, O - barley – climbing bean, M - control;

It was observed that the allelopathic species had no negative effect on the climbing bean crop. A major factor on plant growth is chlorophyll content. According to analysis with the OPTI-SCIENCES Chlorophyll Content Meter device, it was found that the level of leaf chlorophyll content was between 14.1 and 17.5 CCI (Fig. 2).

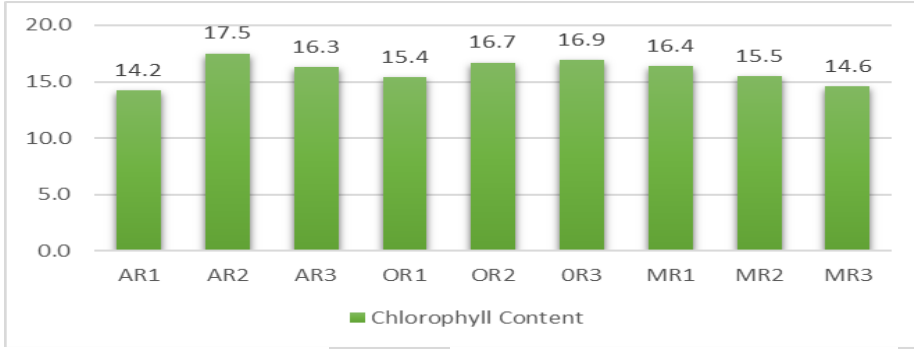

Fig. 2. Chlorophyll content index (CCI) at climbing bean ''Auria Bacăului'' cultivar
Note: R - replicate

Chlorophyll is the light energy receptor that comprises nitrogen. It also has a significant role as a plant growth index and in organic matter production (Lahai *et al*., 2003).

According to analysis with the OPTI-SCIENCES Anthocyanin Content Meter device, it was found that the level of anthocyanins was between 5.9 and 7 ACI (Fig. 3).

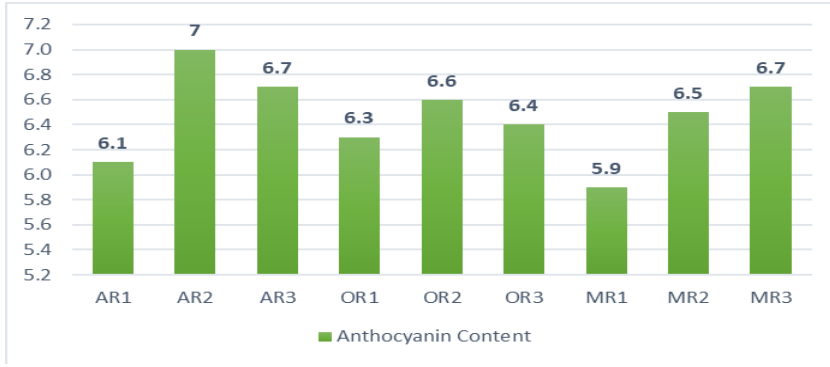

Fig. 3. Anthocyanin content index (ACI) at climbing bean "Auria Bacăului" cultivar

Solovchenko and Chivkunova (2011) highlighted that the function of anthocyanins in leaves is the absorption of excessive solar radiation, preventing photosynthetic apparatus from photoinhibition and photodamage. The quantification of chlorophyll and anthocyanins content would provide some important information about plants and environmental relationships.

CONCLUSIONS

1. The degree of weed infestation was significantly reduced by the intercropping of barley and climbing bean variant, before mowing.

2. After mowing, the mixture variant was superior in terms of weed control.

3. The plant species with allelopathic potential did not have a negative impact on the climbing bean crop. According to analysis with the OPTI-SCIENCES Chlorophyll Content Meter device and OPTI-SCIENCES Anthocyanin Content Meter, it was found that there is no significant difference in the level of antocyanin and chlorophyll content.

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