Abstract

The main aim of the dissertation was to assess the strength of competition and mutual influence of competing species (spring barley of *Mercada* variety and four species of segetal weeds: *Avena fatua, Galium aparine, Thlaspi arvense, Viola arvensis*) on their morphological and physiological features and on soil environment. The following hypothesis was made: the inter-species interactions which occur in the barley-weed system change the parameters of plant development at its various stages and the properties of the soil environment, and the strength and direction of this influence depends on the weed species and its density. The hypothesis was tested on the basis of a null hypothesis of the lack of influence of inter-species interactions on the plants in question and on the soil environment, regardless of the weed species and its density. The basis for solving the research problem was a pot experiment consisting of five independent series conducted between 2012 and 2016 (one series a year) at the Greenhouse Laboratory of the Faculty of Biology and Biotechnology *[Laboratorium Szklarniowe Wydziału Biologii i Biotechnologii]* of the University of Warmia and Mazury in Olsztyn. Vegetation tests were supplemented by lab analyses. The following experiment factors were taken into consideration:

– in the barley features tests: the species of competing weed (*Avena fatua, Galium aparine, Thlaspi arvensis, Viola arvensis* and combinations of said species) and the density of weeds: 0, 4, 8, 12 plants in a pot (density of 0 = no competing weeds – a common variant for all weed species)

– in the weed features test: the composition of the competing collection (for *Avena fatua*: *Avena fatua, Avena fatua* + barley, A*vena fatua* + a combination of the remaining weed species (a collection), *Avena fatua* + barley + a combination of the remaining weed species (a collection).

Similarly, the density for the remaining species of weed was: 4, 8, 12 plants per pot.

– in the total biomass test and the soil environment feature test: the composition of the competing collection and the density of weeds in a pot.

The research included: overground plant mass, morphometric features of barley plants and weed plants, the intensity of photosynthesis and plant transpiration, the macro-nutrient content in the plants (for a weed composition – the total biomass of all species), water content and soil temperature, total nitrogen (N) content and the assimilable forms of phosphorus (P), potassium (K) and magnesium (Mg) in the soil, the soil pH and the total number of heterotrophic bacteria and fungi in the soil. Three analysis dates were set for the researched material: end of development of barley leaves (BBCH 20, 2012-2013 series), full vegetation -

end of stalk shooting (BBCH 39, 2012-2016 series) and full grain maturity (2014-2016 series). On the basis of the aboveground dry matter of plants the following elements were calculated: relative yields (RY), relative yields total (RYT) and competitive balance indicators (CB), which were adopted as measures of inter-species interactions.

The experiment has led to the following conclusions:

1. The interactions between spring barley and weed plants of A. fatua, G. aparine, T. arvense, V. arvensis species as well as a composition of the above species were characterised mostly as inter-species competition.
2. Barley usually won the competition with the weeds, but it finally lost in the confrontation with A. fatua of high density (12 plants).
3. Competitive pressure of A. fatua on barley started at the beginning of the vegetation period and intensified during the vegetation as the density of the weeds increased. Barley started to feel the competitive nature of G. aparine at higher weed density levels and the pressure of this species intensified until the end of the vegetation period, especially in pots with a more significant presence of weeds.
4. A collection of weeds was a stronger partner in the competition against barley than T. arvense and V. arvensis, as well as G. aparine until the peak of vegetation and the collection was weaker than A. fatua alone since the beginning.
5. Barley reacted to competition from weeds with a deterioration of its morphological features at varying levels, depending on the competing species.
6. Weeds reacted to competition from barley with a deterioration of their morphological features including their generative reproduction. Dicot weeds, especially V. arvensis and T. arvense felt the pressure of barley stronger than A. fatua.
7. At peak vegetation barley reacted to the presence of any competing weed collections – even in the lowest density, but especially to those in which the A.fatua species was present – by reducing the intensity of photosynthesis and transpiration processes. The increase in weed density additionally weakened the rate of the cereal's photosynthesis.

Keywords: spring barley, competition, weed oats, bundles, sticky hugs, field violet, weed density, photosynthesis, soil properties, relative yield