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AFFECT OF AGRICULTURAL SYSTEMS ON BIODIVERSITY

ODDZIAŁYWANIE SYSTEMÓW ROLNICZYCH NA BIORÓŻNORODNOŚĆ

Abstract: Biodiversity is understood as "diversifying of all living organisms existing on Earth in continental ecosystems, marine and freshwater, and in environmental groups, which are the part of them". This includes diversity within species, between species, and ecosystem diversity. According to many authors, biodiversity in the agricultural landscape and agroecosystems plays greater role than natural ecosystems. Disappearance of sensitive organisms is due to direct changes in biocenoses structure and indirect impact of humans on organisms trough affecting soil conditions, the quality of water and air. For the protection of biological diversity preventing species extinction in the wild state is a priority task. Over the past hundred years many wild species of plants have disappeared as well as their unique genotypes. Most of the genous stores of plants is within the populations of crop species assessed in terms of genetic diversity on the basis of the number of registered varieties. For example, the register of varieties of agricultural crops from the year 2008 shows more than 1100 varieties of plant crops, large part of which comes from outside of our country. In addition to this day, the fragmented and extensive agricultural economy has survived many local or old varieties of cereals, vegetables, fodder plants and fruit trees, among which there are also varieties with relict character (false flax, oily variety of common reddish, true millet).

Keywords: biodiversity, nature, cereals, weeds, meadow

Nowadays about 10 million species live on Earth, and perhaps many more existing species even do not have a name. This shows the multitude and variety of forms, which can be revitalized. There are many different definitions of biodiversity; however, the one which is the most commonly used, was proposed in the text of the Convention on Biological Diversity from the "Earth Top" in Rio de Janeiro from 5 June 1992. According to this concept biodiversity is "diversifying of all living organisms existing on Earth in continental ecosystems, marine and freshwater, and in environmental

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groups, which are the part of them". This includes diversity within species, between species and ecosystem diversity.

If you measure the biodiversity with a degree of conservation of species or communities originally found in Poland and forms of plants [1] as well as breeds of animals. our country can be considered as an area of a relatively high biodiversity. Highly endangered species in other countries, especially in Western Europe, are quite numerous animals (white stork, corncrake, beaver, otter) and plants (lung worth, forestry holy grass, cockle grasshopper). Many species of plants and animals in the area of Poland are on the edge of extinction [2]. It is due to the fragmentation of farming in Poland what reached many local varieties of plants and breeds of livestock.

Nevertheless, a significant part of our flora is threatened with extinction, and a red list of species has been getting longer almost from year to year [3].

Antropopresive and biodiversity

According to many authors [4, 5] biodiversity in the agricultural landscape. and agroecosystems plays greater role than natural ecosystems. Disappearance of sensitive organisms is due to direct changes in biocenoses structure, and indirect impact of humans on organisms through affecting of soil conditions and the quality of water and air. Antropopresive and biodiversity effects, thereby biodiversity reducing, it among other things, the successive: every year decrease the surface occupied by natural ecosystems and agroecosystems (Table 1) as a result of the impact of industry urbanization, expansion of communication networks, etc.

Table 1

Surface structure of soil utilization in Poland [%] [6, 7]

Specification	Years		
	1998	2008	2020
Arable land	59.4	60.9	51.5
Forests	29.0	30.3	33.4
Sweet water	2.7	2.0	2.8
Buldings	3.3	4.8	4.4
Others	5.6	2.0	7.9
Total	100.0	100.0	100.0

Maintaining the proper character of meadow communities, and therefore the maintenance of meadow biodiversity of flora and fauna requires an adequate prato-technics (care treatments, mowing, grazing, etc.). The research was carried out in the meadow communities on the fen soil of polder in Cedynski Park after 5 years' exclusion from showed that land expansion was by a few dicotyledonous species [8]. From stabilized, differentiated floristically communities has created a monoculture, such as tansy (*Tanacetum vulgare*).

On meadows, maintain biodiversity is very important. In other study [9] in regard to different biodiversity to be the richest community on the object cut with the height of 12 cm. on which there were 47–76 species of vascular plants (Table 2).

Table 2

The number of plants depending on the mowing height [9]

Mowing height [cm]	Number of plant species [no. · m^{-2}]	
	Rate	Mean
Initial evaluation	25–33	30 b
Without mowing	22–30	24 a
3	23–27	25 a
6	31–42	36 b
9	39–51	45 b c
12	47–76	62 c

It should be noticed that before the experiment was established the meadow species diversity had been maintained at a level between 25 to 33 species – despite the absence of any pratotechnical treatments. But, further stop-treatments (mowing), on control object, caused a reduction in the number of species to the level of 22–30 units.

In turn. the fewest species of vascular plants were by mowing at a height of 3 cm. The falling number of plants was caused by the fact that not all species tolerate such low mowing.

The research [10] shows that the number of weeds (Table 3) existing in the crop rotation (58.3 units · m^{-2}) was approximately 60 % higher than that identified in the monoculture (37 units · m^{-2}).

Table 3

Weeds number in lowland of lentis [no. · m^{-2}] [10]

Year	Rotation		Monoculture		Mean		Mean [years]
	Full cultivation	Simple cultivation	Full cultivation	Simple cultivation	Full cultivation	Simple cultivation	
1997	24.3	25.9	31.9	26.9	40.8	54.5	27.3
1998	44.0	115.5	32.4	31.5			56.0
1999	62.1	90.2	46.8	41.5			60.2
2000	54.3	49.4	30.3	54.6			47.2
Mean for years	46.3	70.3	35.3	38.7			47.7
Mean	58.3		37.0				
$LSD_{0.05}$	For cultivation – 10.9 For years – 20.5						

Number of weeds on the objects with simplified tillage (54.5 units · m^{-2}) was about 33 % higher than on the objects with a full crop (40.8 units · m^{-2}) and therefore, the crop rotation and simplified farming increased slightly floras biodiversity infestation.

Biodiversity of agrophitocenoz was also increased by intercrops which reduced the adverse effects of a uncorrect rotation of crops, particularly in the cultivation of plants in monoculture. Intercrops fill ant erosion functions and are a part of biological sorption. It was also found that the plants positively affected the quantity, biodiversity and activity of soil microorganisms [11].

The antropopresive results in environmental agriculture are so strong that, in modern strategies for sustainable development of agriculture is necessary to occurrence in the agricultural landscape of enclaves with natural community, what is realized by actions of agroecosystems biodiversity promotion. Biodiversity of agrophitocenozes depends on a large scale of agriculture system. Ecological and sustainable agriculture aspire to maintain and even increase the potential production of habitats. It is possible while is maintaining a diversified agricultural landscape and maintain heterogeneous agrocenozes. Therefore the spatial and temporal diversity of crops plays significant role. The soil in these systems of management has greater microbial biomass and greater biological activity. Interspecies mixtures as well as intergenus and intervarieties ones are important for increasing biodiversity of crop lowland. In numerous studies [12–14] the appropriate selection of species and varieties of plants for such mixtures positively affect of the quantity and quality of yield.

In addition in agroecosystems apart from crops there are weeds and saprophytic organisms, pathogens, pests and others that affect their biocenosis shape. Weeds enrich biodiversity of the field and their unfavorable effects depend on the species composition and abundance, as well as habitat conditions. If the abundance of weeds is below the threshold of harmfulness and does not increase the supply of diasporas in the soil then they are a positive element of agroecosystems.

The agrochemical treatments performed influenced the number of occurring weeds. including the application of herbicides. Many studies [15] have shown that the use of increasing doses of Chwastox extra in the cultivation of spring barley (Table 4) resulted in a systematic decrease in the number of weeds, both from the group of monocotyledons and dicotyledons.

Table 4

Structure of spring barley infestation [no · m^{-2}] after herbicide application [15]

Weeds	Mechanical cultivation	Chwastox extra 300 l SL	Chwastox extra 300 l SL	Chwastox extra 300l SL
		2 l/ha	3.5 l/ha	3 × 3.5 l/ha
Monoacyledones	31.0	24.0	19.5	10.0
Dicotyledones	13.5	2.5	1.5	1.0
Other	1.0	2.0	0.0	0.5
Total	45.5	28.5	21.0	11.5

In compare to the mechanical control, the application of the herbicide greatly reduced the dicotyledonous weeds (from 13.5 to 1.0 no. · m^{-2}) the monocotyledonous ones (from 31.0 to 10.0 no. · m^{-2}). Similar dependencies were obtained in the other experiment [13]

on weed control in potato (Table 5), with increasing doses of Sencor 70WG herbicide. The number of the monocotyledons decreased from 52.0 to 21.5 no. · m^{-2} and among the dicotyledonous weeds from 5.5 to 0.5 n.o · m^{-2}.

Table 5

Structure of spring potato infestation [no. · m^{-2}] after herbicide application [15]

Weeds	Mechanical cultivation	Sencor 70WG	Sencor 70WG	Sencor 70WG
		0.5 kg/ha	1.0 kg/ha	1.5 kg/ha
Monoacyledones	52.0	24.5	17.5	21.5
Dicotyledones	5.5	3.03	1.81	0.5
Other	3.0	0.50	1.0	1.5
Total	60.5	28.03	20.31	23.5

Active substances of applied herbicides: Chwastox exstra 300 SL – MCPA; Sencor 70 WG – metrybuzyne.

The research carried out on the permanent meadow and connected with common dandelion control [16] showed that the number of dandelion per 1 m^{-2} of meadow in regrowth was from 132 to 207 plants. However, after various treatments of the dandelion control showed significant reduction of this species up to 57 no. · m^{-2}. Dandelion was eliminated from the sward after the use of herbicides, and it's number reached about 60 %. But, the mechanical methods eliminated the plant species in the share 34–36 %. Therefore, in order to maintain the common dandelion in meadow sward with a partial reduction of occurrence primarily mechanical methods should be used, because the chemical methods can eliminate this species from the sward in a very short time.

Table 6

The degree of elimination of the common dandelion from meadow sward as a result of different methods application in weed control [16]

Method of control	Number of plants per 1 m^2 I regrowth	Number of plants per 1 m^2 II regrowth	Efficiencies of control [%]
Starane – herbicide	207	82	60.3
Bofix – herbicide	204	83	60.0
Mniszek – herbicide	145	57	60.4
Ranczo – herbicide	185	78	58.1
Method by cuutting	161	103	36.0
Method by drawing	132	87	34.0

In numerous studies [17–19] it was presented that weeds protect the soil against wind and water erosion and losses of nutrients not used by plants, and their biomass increases the amount of organic matter in soil.

For the protection of biological diversity a priority task is to prevent the species existing in the wild state from existing. Over the past hundred years many wild species of plants have disappeared as well as their unique genotypes. Most of the genous stores of plants is within the populations of crop species assessed in terms of genetic diversity on the basis of the number of registered varieties. For example the register of varieties of agricultural crops from the year 2008 shows more than 1100 varieties of plant crops, large part of which come from outside of our country [1]. In addition, the fragmented and extensive agricultural economy has survived to this day, many local, old varieties of cereals, vegetables, fodder plants and fruit trees. among which there are also varieties with relict character (false flax, oily variety of common redish, true millet.

Conclusion

Disappearance of sensitive organisms is due to direct changes in biocenoses structure, and indirect impact of humans on organisms by affecting soil conditions and the quality of water and air.

On the number of occurring weeds influenced the agrochemical treatments performed, which include the application of herbicides. In compare to the mechanical control, the application of the herbicide reduced greater the dicotyledonous weeds than monocotyledonous.

In order to maintain the common dandelion in meadow sward with a partial reduction of the occurrence should be used primarily mechanical methods, because the chemical methods in a very short time can eliminate this species from the sward.

The fragmented and extensive agricultural economy has survived to this day, many local, old varieties of cereals, vegetables, fodder plants and fruit trees, among which are also a variety with relict character.

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ODDZIAŁYWANIE SYSTEMÓW ROLNICZYCH NA BIORÓZNORODNOŚĆ

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Abstrakt: Jeżeli różnorodność biologiczną mierzyć stopniem zachowania pierwotnie występujących na danym terenie gatunków oraz zbiorowisk a także form roślin i ras zwierząt użytkowych, nasz kraj można uznać za obszar o relatywnie wysokiej bioróżnorodności. Gatunki silnie zagrożone w innych krajach, zwłaszcza Europy Zachodniej występują u nas dość licznie. Wiele gatunków roślin i zwierząt osiąga na obszarze Polski granicę zasięgu występowania. To właśnie na skutek rozdrobnienia gospodarki rolnej zachowało się w Polsce jeszcze sporo lokalnych odmian roślin oraz ras zwierząt gospodarskich. Mimo to, znaczna część naszej flory jest zagrożona wyginięciem, a czerwone listy gatunków wydłużają się niemal z roku na rok.

Zdaniem wielu autorów bioróżnorodność krajobrazu rolniczego, jak i agroekosystemów, jest mniejsza niż ekosystemów naturalnych. Ustępowanie organizmów wrażliwych na antropopresję wynika z bezpośrednich zmian struktury biocenozy, jak również pośredniego oddziaływania człowieka na organizmy poprzez kształtowanie warunków glebowych oraz wpływ na jakość wody i powietrza.

Na liczbę występujących chwastów duży wpływ mają wykonywane zabiegi agrochemiczne, do których należy stosowanie herbicydów. Stosowanie wzrastających dawek Chwastoxu exstra w uprawie jęczmienia jarego powodowało systematyczny spadek liczby chwastów zarówno z grupy jednoliściennych, jak i dwuliściennych. Z kolei celu zachowania mniszka pospolitego w runi przy częściowym ograniczaniu jego występowania należy stosować przede wszystkim metody mechaniczne, gdyż metody chemiczne w bardzo krótkim czasie mogą wyeliminować ten gatunek z runi.

Słowa kluczowe: bioróżnorodność, chwasty, użytki zielone