EFFECT OF PLANTING DENSITY ON THE AGROPHYTOCENOSIS STRUCTURE

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Abstract: *The reactions of barley agrophytocenosis components on coenotic stress in the conditions of forest-steppe in Kemerovo region are revealed. The studies were conducted at the experimental test site of the Department of Agriculture and Plant at Kemerovo State Agricultural Institute. The different situations of barley plants (variety Odessa -100, Luka), weeds and pathogens of root rot influence on each other due to the density of the cultural component: 4.5, 6.5, 8.5 million of grains germinating per unit area were simulated. Hydrothermal coefficient was 0.1 in 2012 and 0.7 in 2011 during the growing season, that had an impact on the growth reaction of the components and the development of root rot - Bipolaris sorokiniana. The study of weeds in barley agrophytocenosis showed that their community comprises 14 species belonging to 9 families. The share of anthropochore and apophytes in weed component is 50%. The abundance of weeds in cenosis of variety Odessa 100 depending on the density is 4.5 – 6.91%, 6.5 – 4.35% 8.5 – 7.36%. The variety Luka has an inverse relationship in the proportion of weeds. When planting density is 8.5, the share of weeds is 4.26% of the total number of plants per square meter. Thus, the sort of Luka confirms the competitive ability in relation to biotic factors. It was revealed that the cenosis density had almost no effect on diversity of weeds. There was the formation of a minor type of debris with the dominance of spring weeds (pikulnik beautiful - Galeopsis speciosa MILL. bedstraw Galium aparine L., pigweed white - Chenopodium album L). In Western Siberia the most common diseases in cereals cenoses are root rot, caused by fungi of the genera Fusarium, Helminthosporium, Alternaria. Under the conditions of the provocative background, those are the cenoses with high density, where the development of root rot increases significantly. The disease incidence of barley increases from the early stages of development to mature. The primary roots and stem base are infected the most. In terms of prevalence of the disease, different kinds of reactions and their dependence on the density of the cultural component were determined. Seeding density and stages of ontogeny affect the morphological parameters of the components (plant height, diameter of internodes). Weeds occupy presoil and medium tier at tillering and earing. Higher grade of competitiveness has the sort Luka with productivity of 640h/m^2. Productivity analysis let determine that an increase in the density of seeding reduces the productive tillering and grain size. A clear correlation of changes in the number of grains and the number of surviving plants per area unit under coenosis stress was not revealed. The two varieties of barley formed the maximum efficiency in the thickened seeding density such as 6.5 mln. of germinating seeds.*

Key words: *Agrophytocenosis, growth reactions, barley, productivity*

INTRODUCTION

Agrophytocenoses in ecology are characterized by specific floristic composition, structure, relationships of components to each other and the environment. Agrophytocenoses are artificially created and maintained by the efforts of man. They are simpler in structure and short-term in existence than the natural formations (KRASNOPEROVA, 2006).

The components of agrophytocenoses are crops and the corresponding weed flora. Weeds are a natural component of agrophytocenoses. This feature can be useful because of the ability to activate biochemical turnover in the deeper layers of the soil, to act as the store of minerals, to form useful connections with soil biota (SHPAAR, 2000). Weed community is the most stable and has the phenomenon of equilibrium biomass at the expense of the bank of seeds and vegetative primordiums (MARKOV, 1980).

The relationship of habitat-forming factors can lead to a change in the pace of growth, nutrition area, the number of components. The relationship between the cenosis components exacerbate when they are similar in nature of growth and the requirements to environmental conditions (BAZDYREV, 2004). Agrophytocenoses parameters are generated by a man who changes technology elements such as soil tillage system, the selection of crops and varieties, planting density.

The area of food affects the rate of ontogenetic development (DOLOTOVSKY, 2002). There is a well-known work of L. K. Uspenskaya (1929) about an earlier onset of buckwheat phenophases and reduction of their duration in dense crops, there is a work of V. N. MAKAREVICH (1960) about studying intravarietal and intervarietal barley relationships depending on the method of sowing and also affecting the duration of the interphase periods. The increase in density may lead to an increase in variation of characteristics due to increase tension of competitive relations. A. F. MEREZHKO (1994) showed the effect of density on the variability of plant height.

According to researchers of the Siberian region for the past 50 years, infestation of grain agrophytocenoses increased significantly. There is a change of the dominant weeds. It should be used limiting factors inherent to the ecosystem for regulating weed numbers (SINESCHEKOV, 2006; TURSUNBEKOVA, 2008).

Questions about the impact of seeding density not only on the dominant component of agrophytocenosis such as a cultivated plant but on weed components, their growth rate, layering, quantity are not studied enough and that was the purpose of our research. We have modulated various situations of barley relationships and weeds.

MATERIAL AND METHODS

The studies were conducted in 2011 and 2012 on the pilot test site of the Department of Agriculture and Plant at Kemerovo State Agricultural Institute. Soil pilot area was represented by podzolized chernozem (humus was 8.9%, the content of mobile phosphorus (P_2O_5) was 109 mg / kg, potassium (K_2O) was 115 mg / kg; pHsol was 6.5. Content of the structural aggregates was 83.2%. The preceded crops were cereals. Experience in the study of the species composition and abundance of weeds held by small plot method. Plot area was of 1 m^2, repetitiveness was 4-fold, arrangement was systematic. Sowing dates were early according to the biological characteristics of culture. In order to simulate different densities of agrophytocenosis we used various barley seeding rate such as 4.5, 6.5, 8.5 million germinating seeds per hectare that allowed to form an optimal, dense and thickened cenosis.

The weather conditions in the study years were characterized by a variety of hydrothermal regime. The hydrothermal coefficient characterizing the supply of moisture zone (HTC) was 1.0 in 2011 and 0.7 in 2012. These conditions made it possible to fully reveal the influence of agrophytocenosis components depending on seeding density. Calculation of correlation dependence showed that weather conditions affect the weed component. The correlation coefficient was from 0.501 to 0.506. Relationships of weed component depending on the number of weeds and a specific variety of cultural component were not found. The

infestation of agrophytocenosis largely depended on the availability of moisture during the growing season (r ± 0,502).

The objects of the study were:

1. barley agrophytocenosis with different densities of 4.5; 6.5; 8.5 million germinating seeds per hectare;

2. spring barley (Hordeum sativum L.) varieties such as Odessa 100 and Luka;

3. segetal flora of barley agrophytocenosis.

During investigations the following surveys and observations using generally accepted methods were carried out: (M., 1989; I.P. VASILIEVA, A.M. TULIKOVA, G.I. BAZDYREVA, 2013; V.A. CHULKINA, 2000; B.A. DOSPEHOV, 2011).

RESULTS AND DISCUSSIONS

The harmfulness of weeds in cenosis is characterized by a high intake of nutrients from the soil. This leads to inhibition of cultivated plants and reduction of their productivity by 25-30% (CHULKINA, 2000). It is known that the root system of the weeds releases the physiologically active substances in the soil such as colins affecting the composition of the soil biota and constraints seed germination and plant growth (GRODZINSKIY, 1989; TULIKOV, 2005). Biochemical interaction such as allelopathy may be a regulator of competitive relations between agrophytocenosis components (GRODZINSKIY 1965; SHAJI, 2012). Several researchers have noted a stimulating effect on the growth of the length of the roots of wheat germ, barley, oat extracts derived from white pigweed (Chenopodium album L.), field bindweed (Convolvulus arvensis L.) (TURSUNBEKOVA, 2008).

The spread of weeds is determined by environmental conditions, especially by moisture character (PROTASOVA, 2002; TURSUNBEKOVA, 2006). The study of weeds in barley agrophytocenosis showed that their community comprised 14 species belonging to 9 families. Share of anthropochores and apophytes in weed component was of 50% each.

The abundance of weeds in cenosis of variety Odessa 100 depending on the density was 4.5 – 6.91% 6.5 – 4.35% 8.5 – 7.36%. The variety Luka had an inverse relationship in terms of the proportion of weeds. At a seeding density of 8.5 the proportion of weeds was 4.26% of the total number of plants per square meter. Thus, variety Luka confirmed the competitive ability in relation to biotic factors (ZAUSHINTSENA, 2001).

Indirect interaction between weeds and cultivated plants may happen due to phytogenic influence as well as edaphic factor (that is the interaction of plants and soil). These changes result in different response of components to abiotic factors and predisposition to disease and damage. Reaction of agrophytocenosis components to these factors is ambiguous that changes their competitiveness (SHPAAR, 2003). The main link in the management of the pathological process is the resistance of plants and improving its methods of correction due to habitat functions of culture in agrophytocenosis (Shutko et al., 2011).

In Western Siberia the most common disease in cereals cenoses are root rot caused by fungi of the genera Fusarium, Helminthosporium, Alternaria. Nature of root rot such as wide species composition, the volatile nature of the pathogens in cenoses prevents effective protection of plants. The development of root rot is connected with the difference of temperature and humidity which cause a partial extinction of plant organs and which are actively colonized by pathogens (ZAUSHINTSENA, 2001). The cenoses with higher density were the conditions of the provocative background where the development of root rot increased substantially. The incidence of barley increased from the early development stages (tillering phase) to mature. The primary roots and stem base were the most susceptible to disease. It was

found the different reaction of varieties and their dependence on the density of the cultural component in terms of prevalence of the disease (Table. 1).

Table 1.

Effect of the density of the cultural component in the development and spread of root rot, %

Density of cenosis	Development of the disease, R			Prevalence of disease, P		
	primary roots	secondary roots	stem base	primary roots	secondary roots	stem base
Odessa 100						
4.5	11.7	1.0	7.6	72	1.0	22.0
6.5	9.7	0	13.4	79	0	35.0
8.5	12.9	0	8.6	57	0	32.0
Luka						
4.5	14.6	3.0	10.0	47	3.0	37.0
6.5	7.2	0	13.1	79	0	69.0
8.5	18.3	0	16.1	93	0	89.0

The variety Luka and optimal density of the cultural component such as 4.5 million germinating seeds were the corrective actions to reduce the development and spread of root rot. They were in the first place in this case.

Reduction of agrophytocenosis productivity can be also caused by lodging of plants. This phenomenon leads to disruption of metabolic processes, to enhanced development of fungal infections. Lodging can be caused by excessive moisture, excess of nitrogen in the soil and cenosis density. The specificity of the variety reactions when thickening is shown in studies of L. N. KOVRIGINA (2001), who noted the changes in the characteristics of response of the individual fitometers.

It is known that the number of shortened internodes can vary under the influence of the environment. As a result the stretched-out internodes of the basal area can be included in the straw in its measurement. Internodes of first four leaves are included in the basal zone, next leaves are included in preflora zone and inflorescence is included in floral zone. In the rarefied cenosis E. P. SARANCHYN (2005) confirmed the medium variability of the diameter of the basal internodes.

Having compared the morphological parameters of components (height) we observed the following: weed component tended to extend the length of the plant, especially in the phase of barley earing (Table 2.) at the optimal and thickened crops. Apparently, this was due to increased activity of intercalary meristem of internodes and in connection with the precipitation during this period. As for the cultural component there was no clear response to the thickening. The maximum height of the plant of variety Odessa 100 was 86.7 cm at maturity and in the same agrophytocenosis the abundance of weeds was observed.

Statistical processing showed the dependence of the growth processes of components by density. Figures 3 - 6 display the height of plants of variety Odessa 100 and Luke, stunted and tall weeds. Planting density and stages of culture ontogenesis affected the layering of weeds. In the phase of tillering and earing weeds occupied presoil and middle tiers.

It was found that the optimal growth indicators in Odessa 100 agrophytocenosis were formed at a seeding density of 6.5. The dependence of the plant height and weeds on seeding density in cenosis of variety Luka was not revealed.

Against the background of coenosis stress the importance of selection of varieties having resistance values of the individual parameters of the shoot can be confirmed selection of varieties having resistance value of the value of certain parameters of the shoot can be confirmed on the background coenosis stress. A.V. ZAUSHINTSENA (2001) studied the nature of inheritance of stem length, the length of the basal area, basal internodes, length of the first and second prefloral internodes and diameters in diallel crosses . With the participation of selected sources the cultural component of agrophytocenosis of variety Luka was created. During the two years of research the variety was characterized by a better competitive ability against harmful objects.

Table 2

Effect of the density of the cultural component on the growth indicators

Density of sowing	Plant height, cm	Stem length, cm	Diameter of the 1st internode, mm	Diameter of the 2nd internode, mm	Diameter of the last internode, mm	Ratio of length to diameter of the 2nd internode
Odessa100						
4.5	69.6	53.6	2.16	2.51	1.66	213
6.5	73.7	60.3	2.20	2.45	1.73	246
8.5	76.9	59.0	2.36	2.56	1.70	230
Luka						
4.5	76.3	60.6	2.56	2.72	1.88	223
6.5	80.1	63.3	2.63	3.08	2.22	206
8.5	85.1	65.9	2.65	2.93	2.21	225

The productivity analysis revealed that an increase in seeding density resulted in a decrease in productive tillering and grain size. A clear correlation to change the number of grains and the number of surviving plants per unit area under coenosis stress was not revealed. Two varieties of barley formed the maximum efficiency with thickened planting density such as 6.5 mln. germinating seeds.

CONCLUSIONS

Cenosis density does not affect the species composition of cenosis. There is formation of a minor type of infestation. The development and spread of root rot depends on the variety of cultural component. The variability of morphological parameters of cenosis plants depending on the density was revealed. Variety Luka has an optimal ratio of stem height to diameter stability. Varieties of barley are formed the maximum productivity at high density of cenosis.

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