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The Concept of Synergism in the Farming Systems.

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ABSTRACT

The strategy of synergism is actively applied in management, but this theory can be applied to other difficult multi-component systems as well, in particular to agriculture and plant growing. Contemporary farming is characterized as a difficult dynamic system functioning with the active interaction of its separate links. The productivity of crops is determined not only by soil and climatic conditions, but also by the level of the organization of the farming system and intensification of agrotechnologies. Crop rotation stands out as a key element of the farming system, and its synergism is manifested during the formation of high productivity, improvement of the produce quality, decrease in production costs, preservation of soil fertility and ecological improvement of agrolandscapes. Cop rotation gives the possibility to diversify and manage the production in farming systems. Our studies conducted on the basis of a long-term field experiment to study crop rotations, various tillage systems of the soil and organic and mineral fertilizers showed that by interacting the elements of the farming system (a crop rotation, soil tillage, fertilizers)the productivity of crops is increased at the expense of crop succession, productivity of the symbiotic nitrogen fixation is increaed at the expense of leguminous rhizobial symbiosis. The rational combination of the farming system elements increases the volume of the organic matter accumulation in the soil in the form of straw and other vegetable remains, and also permits to reproduce other indicators of soil fertility. The synergetic efficiency of elements of the farming system increases the economic efficiency of cultivation of crops.

Keywords: synergism, crop rotation, soil tillage, fertilizers.

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INTRODUCTION

Any difficult dynamic complete system strives to gain the maximum effect due to the cumulative interaction of separate elements [1-4].

Contemporary farming systems are characterized by complexity and existence of a set of the interdependent and interacting elements [5-7]. Crop rotation stands out as a key element of the farming system, and its synergism is manifested during the formation of high productivity, improvement of the produce quality, decrease in production costs, preservation of soil fertility and ecological improvement of agrolandscapes [8]. Cop rotation gives the possibility to diversify and manage the production in farming systems[9, 10].

MATERIALS AND METHODS

The studies are conducted on the basis of a long-term stationary three-factorial field experiment of the department of farming of FSEIHPE "The Ulyanovsk SAA named after P. A. Stolypin" in the 4 6-course crop rotations (factor A): 1 grain and fallow crop rotation: complete fallow - winter wheat –spring wheat – peas – spring wheat - spring wheat; 2 grain and fallow with brome grass: peas - winter wheat – spring wheat – brome grass – brome grass - spring wheat; 3 grain and grass with lucerne: lupine - winter wheat - spring wheat – lucerne – lucerne – spring wheat; 4 grain and grass with grass mix: + lupine (peas + barley) - winter wheat – spring wheat – brome + lucerne+esparcet peas –brome grass + lucerne+esparcet– spring wheat.

In each crop rotation the 2 systems of the basic soil tillage are studied (factor B): 1) combined in a crop rotation (2 times plowing for one rotation) 2) minimized (1 time plowing for one rotation).

Besides, in crop rotations 2 systems of organic and mineral fertilizers are studied (factor C): 1) straw of grain and leguminous crops + NPK on yielding capacity of crop rotation of 2,5-3,0 thousand fodder units 2) straw of grain and leguminous crops + NPK on yielding capacity of crop rotation of 3,5-4,0 thousand fodder units.

The soil of the experimental plot is leached, medium textured black soil, average clay loam.

RESULTS AND THEIR DISCUSSION.

The assessment of yielding capacity of crop rotations as their synergetic interaction with soil tillage and fertilizers showed that grain and grass crop rotations (tab. 1) had an advantage according to the output of fodder units.

In grain productivity the grain and fallow crop rotation with a share of grain and leguminous crops - 83,3% had an advantage, where the grain yield per 1 hectare amounted to 2,44 t., whereas in the grain and grass crop rotations with a share of grain and leguminous crops of 66,7% – 1,68-1,72 t/hectare.

Crop rotations with leguminous crops (peas, lupine, lucerne, esparcet), thanks to leguminousrhizobial symbiosis, provided a crop with the minimum monetary costs of nitrogen fertilizers and high level of profitability.

The assessment of soil tillage systems showed that according to grain crops productivity and yielding capacity of the studied crop rotations, the combined system had an advantage in comparison with the minimized. On crop rotations the increase averaged 0,20 thousand/hectare of fodder units or 0,12 t/hectare of grain. The advantage of the combined soil tillage especially was shown in crop rotations with perennial grasses which reduced productivity in the absence of plowing.

Fuller fertilizer application was observed in the first organic and mineral fertilizers system, which had been planned for the crop rotation productivity of 2,5-3,0 t/hectare of fodder units. The use of the raised doses of fertilizers from the soil and fuller realization of the productivity potential were limited to droughty conditions of the spring and summer periods. We discovered a direct link of crop rotations' yielding capacity with the hydrothermal coefficient for May-June by years (r=0,518-0,744).

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The dispersive analysis allowed to evaluate a contribution of the studied factors to the formation of arable land capacity. It has been found that the crop changes accounted for 15,0% of productivity changes, the advantage of grain and grass crop rotations is noted here. The share of soil tillage amounted to 40,4% with advantage of the combined system in a crop rotation, and organic and mineral of fertilizers accounted for 31,8% of arable land capacity changes.

Table 1: Yielding capacity of crop rotations depending on the main type of soil tillage and organic and mineral fertilizers (for 2009-2014 the second rotation), one thousand/hectare fodder units

Crop rotation (factor A)	Soil Tillage Factor B	Nutrition system		±in systems of fertilizers	Mean on factors	
		1st system of fertilizers	2nd system of fertilizers		A	B
Grain and fallow	1	2,88	3,05	+0,18	2,87	3,08 1,95
	2	2,69	2,87	+0,18	2,44	
Grain and grass with brome grass	1	3,03	3,23	+0,20	3,01	
	2	2,82	2,97	+0,15	1,72	
Grain and grass with lucerne	1	3,03	3,23	+0,20	3,03	2,88 1,83
	2	2,85	2,99	+0,14	1,74	
Grain and grass with grass mix	1	3,00	3,17	+0,17	3,01	
	2	2,84	3,01	+0,17	1,68	
Mean values on factor C		**2,89**	**3,07**	**+0.18**	-	-
LSD05 for particular mean=0,16 f.u.				0,08	0,10	0,08

*- over the line – fodder units of one thousand/hectare, below the line - t/hectare of grain exit

The concept of synergism in relation to farming can be connected with diversification of structure of cultivated areas , adaptation of soil tillage, thus it is necessary to consider the possibility of use of organic and mineral fertilizers and enrichment of the soil with organic matter at the expense of the biogenous resources reproduced in agroecosystems, and also reinforcement of leguminous and symbiosis that will help to use more fully the bioclimatic potential of productivity, to reproduce soil fertility and to increase payback of material inputs.

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