Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 20, Issue 3, 2020
PRINT ISSN 2284-7995, E-ISSN 2285-3952

AGRO-CLIMATIC SUBSTANTIATION OF GROWING AGRICULTURAL CROPS IN CROP ROTATION

Roman STUPEN, Oksana CHERECHON, Oksana STUPEN, Olga SOLTYS

Lviv National Agrarian University, Ukraine, 1, V. Velykoho str., Lviv Region, 80381, Ukraine, Phones: + 38 067 33 27 875, + 38 032 22 42 961; E-mails: romomas@ukr.net, okcherechon@gmail.com, oksanashufryn@ukr.net, soltysog@gmail.com

Corresponding author: romomas@ukr.net

Abstract

The paper studied the methodical foundations of the organization of dynamic crop rotations in economic formations with narrow specialization of production in the article. Taking into account the suitability of agricultural production groups of soils for growing crops, one has developed agro-climatic substantiation of their location on the studied land plots of LLC "LUHY-2", located in the Forest-Steppe zone. It was proposed to develop and implement in the production of crop rotation for rapeseed cultivation on the territory of the studied farm to increase the gross yielding capacity. There were presented schemes of soil-protective crop rotations for different ecological and technological groups of lands of the Forest-Steppe zone, where the object of research is located, taking into account the suitability of land for growing crops, soil and climatic conditions and production specialization on the example of model economy.

Key words: *agro-climatic substantiation, agricultural crop cultivation, crop rotation, ecological suitability of lands*

INTRODUCTION

In modern agriculture, the role of crop rotation is growing due to the improvement of the processes of specialization and concentration of production. After all, increasing soil fertility is a necessary condition for the introduction of advanced agricultural technologies with the local soil and climatic resources rational use, means of intensification and crop rotation system [1]. It is because neither fertilizers nor irrigation and pesticides used in the cultivation of crops, provide an opportunity to get rid of weeds, pests, and diseases completely. Moreover, the better one uses fertilizers and irrigation on lands, the more favorable conditions are created for the development of weeds or diseases.

Yielding capacity reduction of plenty of crops concerning the absence of crop rotations are the result of unilateral soil nutrient application, accumulation of pests and pathogenic organisms, as well as various toxic substances – products of the plant life cycle and soil microorganisms. One can violate the determined requirements for the crop sequence in crop rotations or even permanent sowings because of the market situation of agricultural products, which dictates the production, primarily of "profitable" crops.

Having analyzed the above-mentioned information, one should pay attention to considerable research of D. Dobriak [2; 3], P. Kazmir [4], V. Kryvov [5], M. Stupen [9] concerning the organization of crop rotations in different economic formations with a narrow specialization of production in diverse areas of land use with short rotations.

MATERIALS AND METHODS

It was applied the method of more flexible crop rotations (dynamic) due to the dynamism of the production situation, which we observe nowadays, in the transition to diversified management forms, the annual search for a suitable structure of sown areas, the need to increase land use with less energy consumption [4]. Their major agronomic value is the correct consistency of crop sequence in each field. Concerning such a sequence, each crop, located in the best conditions for growth and development, has a beneficial effect on the growing conditions of the next crop and thus helps to increase crop

productivity. The proper sequence is multivariate. Therefore, crop rotation has a dynamic character with the prospect of applying the best techniques of agricultural technology, the implementation of new varieties and crops, as well as changes, if necessary, the previously adopted order of crop sequence, the area they occupy. This is due to the dynamic economic situation, weather conditions, and so on.

According to the method, it was adapted the dynamic crop rotation to the prevailing conditions, in particular economic ones, which allows taking into account the soil and climatic, biological conditions of each land plot. Simultaneously, it does not contradict the principles of building agro-technically correct crop rotation with scientifically sound and consistent crop sequence over the years. However, according to the method, there is no single correct sequence of crop rotation. There is a very wide range of good, medium, and bad (unacceptable) precursors for each culture [2]. Therefore, it is possible to provide agro-technically correct schemes of crop sequence on each ecologically homogeneous field, which is formed at the introduction of a dynamic crop rotation system.

This is the basis of the second methodological approach in the organization of crop rotations, in which one considers the field unit as its initial unit, which is formed taking into account constant factors, in particular the conditions of the territory, the requirements of cultivation technology and soil protection. The number and area of fields do not depend on the structure of sown areas and the period of crop rotation but on natural and territorial conditions.

RESULTS AND DISCUSSIONS

We have applied the method of organizing dynamic crop rotations on the example of land plots in LLC "LUHY-2". Taking into consideration the suitability of agricultural groups of soils in the crop cultivation, one has developed agro-climatic substantiation of their location on the studied land plots.

In Table 1, there were provided detailed proposals for the development of dynamic crop rotations [5].

Table 1. Recommendations for the introduction of dynamic crop rotations for the object of study

Area, ha	Suitability class	Crop rotation system
1.2557	I	Field crop rotation
1.2557		
0.7501		
0.2130	II	Field crop rotation
0.2390		
0.1718		
0.1635	III	Soil-protective crop rotation: Grass and grain
1.2601	IV	I version - soil-protective crop rotation, three-course rotation II version – prairie restoration
0.7859		

Source: it is done by the author on the basis of data [5].

The specialization of LLC "LUHY-2" is crop production, where a small list of crops, including rapeseed, barley, wheat, and soybeans is set up. Appropriate crops are sufficient to introduce field crop rotations, but not to protect soils from disposal and erosion, which requires the sowing of perennial grasses.

The current market is in demand for the sale of oilseeds, where rapeseed occupies one of the first places in this group. Ukrainian agro-climatic resources fully meet the biological needs of rapeseed, and therefore its productivity is quite stable. At the same time, one maintains an interest in rapeseed at a high level due to good liquidity of products and low level of production costs, which today average is 520–560 UAH/ha [6], which is significantly less than for other crops. The consequence was an expansion of sown areas, an increase in gross rapeseed yielding capacity. However, its yielding capacity remains low and is 14 kg/ha. This is a rather modest achievement, considering that in Western Europe the average yielding capacity exceeds 30 hundredweight per hectare [10]. The reason for this situation is primarily the imperfection of technology and the imbalance of rapeseed in the structure of sown areas.

In recent years, a lot of researchers have improved the technology of rapeseed cultivation, and one should note that this work has been effective [2; 3]. In particular, the one has studied existing varietal hybrid composition as well as worked out the system of tillage, fertilizers, and elements of the sowing complex, features of crop care, and plant protection. Even experts in the technology of storage and processing of rapeseed products have not ignored it. Nevertheless, rapeseed production has not become stable, as it is sporadic and random [8].

It is advisable to develop and implement new crop rotations with rapeseed on the territory of the studied farm to achieve certain stability. Due to modern conditions, the average area of agricultural enterprises has mostly decreased, so we recommend introducing crop rotation with a short rotation of 3-5 years. Analyzing the work of the most profitable farms in Lviv region, we concluded that we can recommend such crop rotations with winter oilseed rape, which is shown in Table 2 [7].

Table 2. Proposals of field crop rotations with winter rapeseed for the studied farm

The number of fields in crop rotation	**Crop sequence**		
	The Ist suitability class		**The IInd suitability class**
3	Pea	Winter barley	
	Winter rape	Winter rape	
	Winter wheat	Winter wheat	
4	Soybean	Winter wheat mixture	Perennial grasses
	Winter barley	Winter wheat	Winter cereals
	Winter rape	Winter barley	Soybean
	Winter wheat	Winter rape	Spring cereals with sowing of perennial grasses
5	Black fallow	Pea, soybean	Meadow clover
	Winter wheat	Winter wheat	Winter wheat + post-harvest sowing
	Pea, soybean	Winter barley	Pea, soybean
	Winter rape	Winter rape	Barley + winter crops between crop
	Winter wheat	Winter wheat	Annual grasses with sowing of annual ryegrass and meadow clover

Source: it is done by the author on the basis of data [5].

We propose to focus on growing the most common crops today, which are the foundation of an agrarian business. In all cases, in crop rotation, winter rape is either after pea (soybeans) or after winter barley. Both crops are harvested early, so there is a possibility of high-quality soil preparation.

It is clear that pea (soybean) for winter rape is the best precursor, but not all growers have it in the structure of their sown areas.

Its presence in crop rotations significantly improves the composition of precursors and increases protein output.

Table 3 shows the schemes of soil-protective crop rotations for different ecological and technological groups of lands in the Forest-Steppe zone, where the object of study is located.

Table 3. Schemes of soil-protective grain-grass crop rotations for the second (slopes 3-5˚) ecological-technological group (III class of suitability) of the lands of the Forest-Steppe zone (I version).

The IInd suitability class	
Alfalfa	Еспарцет
Alfalfa	Winter wheat
Пшениця озима	Pea (soybean), гречка
Pea (soybean), гречка	Winter wheat
Winter cereals for green fodder + summer sowing of slafalfa	Oats, barley with sowing of sainfoin
The IInd suitability class	
Alfalfa	Sainfoin
Alfalfa	Winter wheat
Winter wheat	Barley and pea mixture for fodder
Winter wheat	Winter wheat
Pea (soybean)	Oats, barley with sowing of sainfoin
Oats, barley with sowing of alfalfa	

Source: it is done by the author on the basis of data [5].

Table 4. Schemes of soil-protective grain-grass crop rotations for the second (slopes 3-5˚) ecological and technological group (III class of suitability) of the lands of the Forest-Steppe zone (II version).

The IInd suitability class	
Alfalfa or clover	Alfalfa + cereals, буркун + cereals
Alfalfa or clover	Alfalfa + cereals
Alfalfa or clover	Alfalfa + cereals
Oats, barley with sowing of grasses	Winter cereals for green fodder with summer sowing of alfalfa and cereals
The IIIrd suitability class	
Mixtures of perennial grasses	
Mixtures of perennial grasses	
Mixtures of perennial grasses	
Mixtures of perennial grasses	
Winter cereals for green fodder + summer sowing of perennial cereals or annual grasses with over complementary seeding of perennial grasses	

Source: it is done by the author on the basis of data [5].

In addition, one can withdraw the lands of the IIIrd ecological and technological group from cultivation and from the composition of arable land with the subsequent siltation, including natural one, or afforestation.

CONCLUSIONS

Insufficient amount of information and scientifically substantiated explanation of the reasons for the negative consequences of crop rotation, which leads not only to reduced yield capacity but also to the deterioration of agricultural products, caused the preparation of scientific proposals to justify the suitability of land for growing crops. It was taken into account the soil and climatic zone of Ukraine and specialization on the example of the model farm of LLC “LUHY-2”.

These developments will be useful for use in agricultural enterprises, which focus on the latest technologies for growing cereals, including winter wheat, corn, barley, and oilseeds (sunflower, soybeans, winter, and spring rapeseed), etc.

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