НАЦІОНАЛЬНА АКАДЕМІЯ АГРАРНИХ НАУК
ІНСТИТУТ ЗРОШУВАНОГО ЗЕМЛЕРОБСТВА

ЗРОШУВАНЕ ЗЕМЛЕРОБСТВО

Міжвідомчий тематичний
науковий збірник

Випуск 63

Херсон, 2015

ЗМІСТ

UDC 633.1:631.6:633.18:631.582

PROGAMMING OF CEREAL YIELDS UNDER CONDITIONS OF AGRO-MELIORATIONAL FIELD OF RICE CROP ROTATION

AVERCHEV O.V. – doctor of agricultural sciences
SHEI "Kherson state agrarian university"

The problem statement. The task of the development of a reliable process of programming and forecasting yields of agricultural crops consists in attempts to find out the elements of the arising future in contradicting conditions of the past and present state of the investigated object, and while investigating the basic trends and the most important factors it is necessary to work out the development process of the analyzed object in this prospect.

Investigation of the problem. Being regulated by agriculture laws, the influence of external conditions on yielding determines the possibility of forecasting and programming it. Forecasts are possible when more important regularities of a production process are designated. They make it possible to predict the yield of a given variety or hybrid in the specified meliorational and agro-technical conditions.

A forecast becomes a program when the levels of meliorational and agro-technical measures are determined in advance being calculated for the concrete yield and when they are combined with controlling the process of realizing the program and, when it is necessary, with correcting the conditions of water supply and plant nutrition. According to I. S. Shatylov's data (1986), programming should be considered as a scientific trend, and its task is to work out methods of purposeful development of crops for obtaining planned yields.

The research on programming yields can be found in the papers by such scientists as M. S. Savytsky - on grain crops (1938, 1948), G. P. Ustenko (1971), V. O. Ushkarenko (2001) and others. But there are no data on programming of growing buckwheat and millet in the agro-meliorational field of rice crop rotation. When changing from non-irrigated to irrigated agriculture there are favourable conditions for regulating the material conditions of life of plants according to their requirements. It is a reliable basis for forecasting and programming yields.

Tasks and methods of investigation. The task of the research is to work out and program agro-technical measures of growing buckwheat and millet in spring and summer crops in the agro-meliorational field of rice crop rotation (Kherson region, Skadovsk district).

The investigated factors:

Factor A – sowing period:

- basic;
- intermediate.

Factor B – mode of basic tillage:

- disking 10–12 cm deep;
- chisel tillage 20–22 cm deep.

Factor C – nutrition background:

- without fertilizers;
- $N_{45}P_{30}$;
- $N_{90}P_{60}$.

The repetition of the experiment is four times. The placement of the variants was organized using the method of split plots. The sown area of the third order plots is 213 and the registered area is 116.6 m^2.

Research results. The buckwheat yield of the summer growing season was much higher than the yield of the traditional spring season – 16.7 against 13.0 c/ha (Table 1).

For instance, in the variant where the tillage for sowing buckwheat was studied, the average indexes of the yields didn't differ much and were 14.0 c/ha on the plots with shallow tillage and 16.2 c/ha – with dipper tillage, but there were differences depending on the factor "growing season". In the spring season the yield of the variant with disking was 12.1 c/ha, whereas in the summer season – 16.0, and in the variant with ploughing – 14.9 and 17.6 c/ha respectively. On the whole the individual part of the influence of the factor "tillage" was only 4.79%.

The specific conditions of rice soils which are under water for a long period of time and formed at the expense of water, air and warmth regimes, are known to be determined by the availability of nutrients and soil conditions.

Despite the low fertilization sensitivity and phosphorization of rice soils, the efficiency of phosphor fertilizers for buckwheat on these soils is proved by numerous experiments. In addition there is information that in the conditions of saline soils phosphor reinforces the activity of nitrogen in the soil. On the saline rice soils of Kherson region which are characterized by high content of hard-soluble phosphates, nitrogen-phosphor nutrition for buckwheat of the summer sowing was very efficient. Every kilogram of nitrogen-phosphor fertilizers was recompensed by the additional grain of 4.7 kg.

It is necessary to underline that the hydrotechnical conditions were not identical in the growing seasons, though at the time of sowing the weather conditions were characterized by favourable air temperatures in April–May (11,2-15,8°C) and soil temperatures in 5 cm deep layer (12,2-14,5°C). Only in 2003 the average temperature of April was 8.2°C, that is 1,9°C less than the norm, but at the time of sowing it increased to 12°C. On the whole the index HTQ of the territory ranged from 0,2 to 0,8, the average long-term index for the region being 0,5.

Moisture-based irrigation that was applied before sowing in summer provided rapid sprouting and energetic plant growth. The action of high air temperatures and low relative humidity of air which is characteristic of the critical vegetation period was leveled by humid breezes from the sea. Thus, the relative humidity in the spring season was 74-83% and 77-78 % in the summer season.

Table 1. – The cereal yields of the basic and intermediate crops in the agro-meliorational field of rice crop rotation depending on the technological methods of growing, c/ha.

Sowing period (Factor A)	Method of basic tillage (Factor B)	Nutrition bachground (Factor C)		
		Without fertilizers	$N_{45}P_{30}$	$N_{90}P_{60}$
Buckwheat				
Basic sowing	Disking 8-10 cm deep	8,7	12,9	14,8
	Chiseling 20-22 cm deep	10,5	14,5	16,8
Sowing after harvest	Disking 8-10 cm deep	12,7	16,4	18,8
	Chiseling 20-22 cm deep	14,4	17,8	20,6
Millet				
Basic sowing	Disking 8-10 cm deep	14,2	22,5	26,6
	Chiseling 20-22 cm deep	18,9	26,4	29,7
Sowing after harvest	Disking 8-10 cm deep	13,2	20,9	24,1
	Chiseling 20-22 cm deep	15,7	22,5	26,1

Notes. HIP_{05} for the years of the research was by factors, c/ha:
for buckwheat crop: factor A and B – 0,51-0,74; C – 0,63-0,91; the interaction AB – 0,72-1,05, AC i BC – 0,88-1,29, the complex interaction ABC – 1,25-1,82.
for millet crop: factor A and B – 0,68-1,10, C – 0,83-1,35, the interaction AB – 0,96-1,56, AC i BC – 1,18-1,91, the complex interaction ABC – 1,66-2,70.

The conducted mathematic analysis of the obtained data provides the evidence of the interaction of the investigated factors with the yields of buckwheat and millet (Table 2).

Table 2. – The indexes of correlation and regression analysis of the data on the cereal yields depending on the investigated factors.

The reference of the data to X_i	R – multiple and r_i – double correlation coefficient	D – general and d_i – partial determination coefficient	b_0 i b_i – regression coefficient	t – criterion	
				factual	0,05
Buckwheat					
$X_1X_2X_3$	0,993	0,987	-5,670	-	
X_1	0,572	0,327	0,025	13,93	2,02
X_2	0,262	0,069	0,143	6,38	
X_3	0,769	0,591	0,041	18,73	
Millet					
$X_1X_2X_3$	0,976	0,952	23,238	-	
X_1	0,260	0,068	-0,017	-3,36	2,02
X_2	0,292	0,085	0,247	3,79	
X_3	0,894	0,799	0,074	11,60	

Notes. X_1 – the sum of effective temperatures for the critical period, °C; X_2 – the depth of the basic tillage, cm; X_3 – the norm of mineral fertilizers, kg/ha of the active substance.

The force of the correlation link X_1 – the sum of effective temperatures for the critical period and X_3 – the norm of applying mineral fertilizers with the yield of buckwheat is strong 0,572 i 0,769 respectively, and with X_2 – the depth of the basic tillage is weak – 0,262. The direction of all the determination factors is straight. The multiple correlation coefficient was 0,993, which is the evidence of the strong, almost complete interrelation of the investigated factors with the yields of buckwheat and millet.

The regression coefficient shows that the increase of the sum of effective temperatures for the critical period by 1°C increases the buckwheat yield by 2,5 kg/ha, the depth of the basic tillage by 1 cm – by 14,3, and the norm of applying mineral fertilizers for 1 kg/ha of the active substance – by 4,1.

The correlation links of millet differed considerably from the analogous ones obtained for buckwheat. The weak force of the correlation link of the millet yield was with X_1 – the sum of effective temperatures for the critical period and X_2 – the depth of the basic tillage – 0,260 і 0,292 respectively. The strong connection was only with X_3 – the norm of applying mineral fertilizers – 0,894, and also the multiple correlation coefficient of all the determination factors – 0,976.

According to the obtained data, sowing after harvest decreases the yields as compared with the basic one, the regression coefficient indicates it. For instance, the increase of the sum of effective temperatures results in decreasing the millet yield by 1,7 kg/ha, and the depth of the basic tillage and the norm of applying mineral fertilizers conversely increase it by 24,7 and 7,4 kg/ha respectively.

According to the obtained data (Table 2, figure 1), the buckwheat yield by 59,1 and the millet yield – by 79,9% depend on the norm of applying mineral fertilizers, which is the maximum amount. The least influence on the variation of the dependent variable Y is caused by the action of the factor "the sum of effective temperatures for the critical period" – 32,7 for buckwheat and 6,8% for millet, the depth of the basic tillage being 6,9 and 8,5% correspondingly.

The mathematical model of the cereal yield was made on the basis of the regression coefficients and the free element.

Buckwheat – $Y = 0{,}025X_1+0{,}143X_2+0{,}041X_3-5{,}670$;

Millet – $Y = 23{,}238-0{,}017X_1+0{,}247X_2+0{,}074X_3$

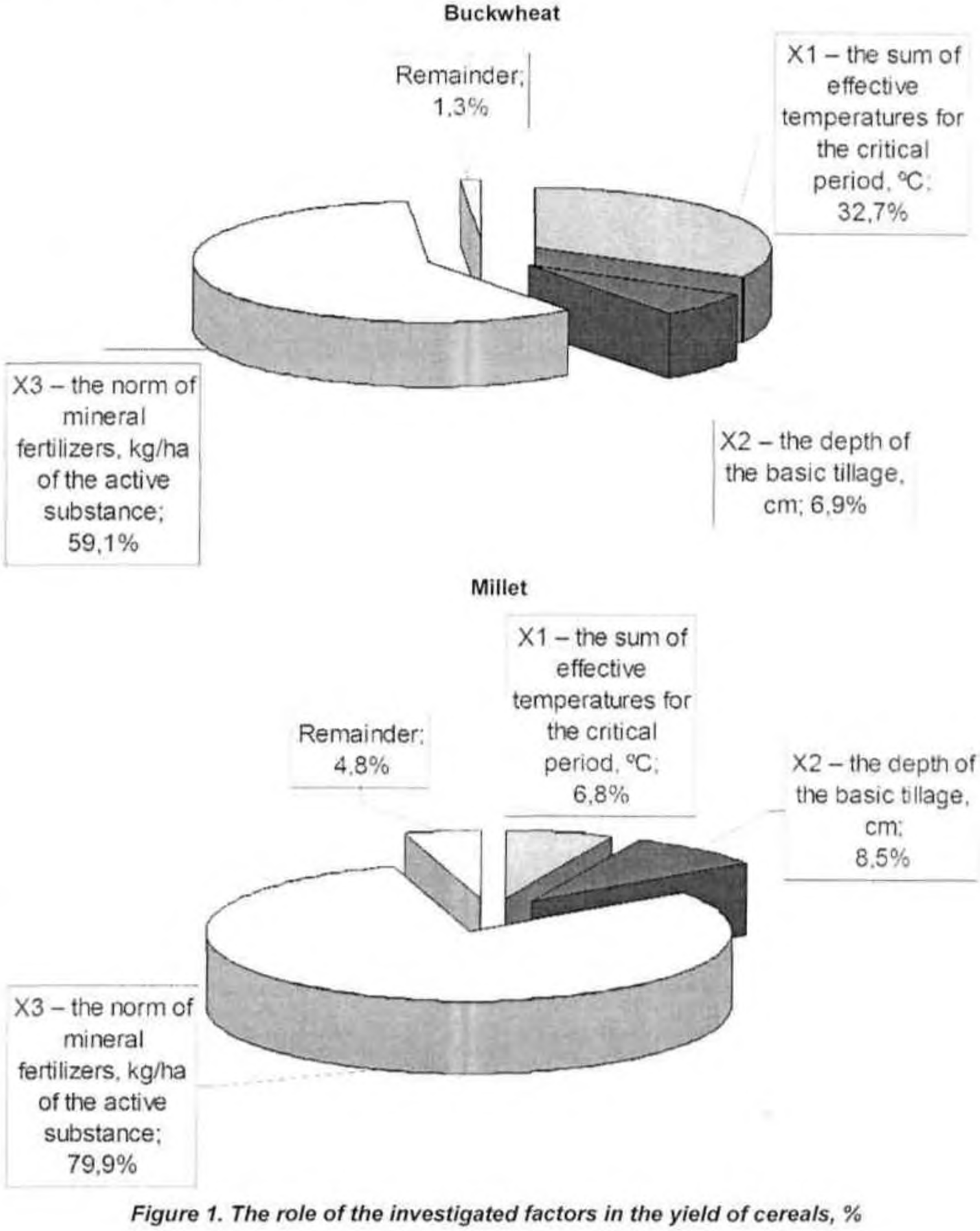

Figure 1. The role of the investigated factors in the yield of cereals, %

Conclusions. According to the data of correlation and regression analysis the connections of the determination factors are not linear and it is necessary to set nonlinear relations from the variables and the yield in order to solve the problems connected with forecasting yields in production.

The obtained equations show that the coefficient of determination for buckwheat is 0,987 and for millet – 0,952, which is the evidence of a possible use of the model in production.

REFERENCES:

1. Дисперсионный и корреляционный анализ в растениеводстве и луговодстве [Монография] / В.А.Ушкаренко, Н.Н.Лазарев, С.П. Голобородько, С.В. Коковихин. – М.: Изд. РГАУ–МСХА им. К.А. Тимирязева, 2011. – 336 с.
2. Лысогоров С.Д. Факторы урожая повторных посевов кормовых культур в условиях Ингулецкой оросительной системы / С.Д. Лысогоров, В.А. Ушкаренко // Научные основы программирования урожаев с.-х. культур. – 1975.
3. Ушкаренко В.А. Орошаемое земледелие / В.А. Ушкаренко. – К.: Урожай,1993.
4. Аверчев А.В. Пайова участь досліджуваних факторів у врожайності гречки повторних посівів на зрошуваних землях півдня України / А.В. Аверчев, Ю.В. Аверчев // Збірник наукових праць Уманської державної академії. – Вип. 53. – Умань, 2001. – С. 40-43.
5. Аверчев О.В. Екологічне обґрунтування технології вирощування гречки в умовах рисової сівозміни / О.В. Аверчев, В.П. Ружицький // Вісник аграрної науки Причорномор'я. – Спец. вип. 3 (12). – Т. 1. «Соціально-економічні проблеми природокористування та екології». – Миколаїв, 2001. – С. 482-486.