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EFFECT OF SPECIES, NORMS AND TIMING OF NITROGEN FERTILIZERS ON STRUCTURAL ELEMENTS OF WINTER RYE HARVEST

The formation of content of structural elements of winter rye harvest depending on the types of fertilizers, norms and terms of nitrogen fertilizing is studied. It is proved that these indicators vary depending on the weather conditions and significantly increase by improving the mineral nutrition of winter rye plants. Winter rye is characterized by high weight of 1000 grains, but the number of grains and grain weight of one spike is low.
***Key words**: winter rye, fertilizers, structural elements of harvest*

Introduction. Optimized level of nitrogen nutrition of winter rye improves phytometrical indicators in the structure of plants as the basis for the production process and ultimately yield. Increasing mineral load in intensive technologies by improving norms of fertilizers on the background of integrated plant protection provides high gain of winter rye grain yield [1]. However, along with this fertilizers affect the productivity elements of winter rye, study of which can trace by the percentage of their participation in the formation of values and set the harvest reserves of its improvement [2].

Analysis of the last researches and publications. Nitrogen is one of the main elements of plant nutrition, lack of which in most soils requires constant applying to obtain high yields of crops and improving product quality. Under conditions of sufficient moistening nitrogen fertilizers give 50-60% total growth of yield [3].

One of the most important conditions for the growth and development of winter rye is plant supply with sufficient quantity of all elements of nutrition in optimal ratios [4-6]. The value of this factor increases also because it can be quite actively controlled. The problem of ensuring winter rye plants with essential nutrients at first glance may be theoretically reasonable, technologically simple, popular and easy to carry. However, such a serious question requires deep knowledge regarding the needs of plants in nutrients, their physiological role and meaning at certain stages of development. This problem is complicated by the necessity of identifying dynamics of contents of elements of nutrition in soil and related peculiarities of their supply into a plant, impact of environmental factors and interaction of elements of nutrition on the degree of their assimilation [7].

Aim of the research is the study of the main indicators of the structure of crops winter rye accordance with the norms and terms of application of nitrogen fertilizers and their relationship with the grain yield.

Materials and methods. Variety of winter rye Intensivnoe 95 was grown on loamy podzolic chernozem in field conditions of Uman National University of Horticulture during 2010-2012. Soil of the research field is podzolic hard loamy chernozem on loess. The content of humus in the arable layer is 3.2-3.3%, the degree of saturation by bases is 90-93%, the reaction of the soil solution is medium acidic (pH = 5.5), hydrolytic acidity is 1.9-2.3 mol/kg of soil, the content of mobile phosphorus and potassium compounds (for ISO 4115-2002) - 100-115 mg/kg, nitrogen of alkaline hydrolyzed compounds (Cornfield's method) – 100–110 mg/kg of soil [8].

Experience was laid according to the scheme shown in the tables. The total area of the experimental plot in the experiment was 72 m^2, accounting plot was 40 m^2, and three-time repetition of experience, site placement was consistent. Structural elements of winter rye crop were determined by the method described by M.A. Maisurian [9]. Mathematical processing of experimental data was monitored by method of analysis of variance of one-factor field experiment

using standard software package "Microsoft Excel 2003".

Research results. Improving conditions of mineral nutrition contributed to growing factor of productive tillering. But the major indicators were in case of separate applying of nitrogen fertilizers which on average over three years of research were 1,39-1,52, while in case of applying $N_{30–90}$ in early spring it was 1,31-1,46 (Table1). Applying $P_{60}K_{60}$ contributed to increase the coefficient of productive tillering from 1,22 in variant without fertilizers to 1,27.

Table 1

Structural elements of winter rye harvest depending on the norms and timing of nitrogen fertilizers, 2010-2012

Variant of experiment		Coefficient of productive tillering	Number of grains, unit	Weight of grains, gram	Weight of 1000 grains, gram	Spike length, cm	Number of spikes, unit
Control (without fertilizers)		1,22	0,53	35,2	18,0	8,6	26,8
$P_{60}K_{60}$ – ground		1,27	0,58	35,4	19,6	8,7	27,0
K_{60}+ $N_{60\ (II)}$		1,37	0,64	36,0	20,9	9,2	27,5
P_{60}+ $N_{60\ (II)}$		1,38	0,66	35,9	21,5	9,2	27,6
Ground + $N_{30\ (II)}$		1,31	0,66	36,2	21,4	9,1	27,2
Ground + $N_{60\ (II)}$		1,40	0,67	36,7	21,4	9,5	27,9
Ground + $N_{90\ (II)}$		1,46	0,66	37,0	21,1	10,0	28,6
Ground + N_0 + $N_{30\ (IV)}$		1,29	0,63	35,8	20,6	9,0	27,0
Ground + N_0 + $N_{60(IV)}$		1,32	0,64	36,1	20,9	9,4	27,5
Ground + $N_{30\ (II)}$+ $N_{30\ (IV)}$		1,39	0,71	36,4	22,6	9,6	28,4
Ground + $N_{60\ (II)}$+ $N_{30\ (IV)}$		1,50	0,71	37,0	22,3	10,2	28,9
Ground + $N_{30\ (II)}$+ $N_{60\ (IV)}$		1,48	0,76	36,6	24,0	10,0	28,9
Ground + $N_{60\ (II)}$+ $N_{60\ (IV)}$		1,52	0,73	37,3	22,8	10,5	29,5
HIP_{05}	*2010*	*0,07*	*0,03*	*1,8*	*1,0*	*0,4*	*1,4*
	2011	*0,08*	*0,05*	*2,0*	*1,3*	*0,5*	*1,6*
	2012	*0,06*	*0,04*	*2,1*	*0,9*	*0,3*	*1,3*

On average over three years of research weight of grains of one spike of winter rye in the control variant was 0.53 g and increased to 0,66-0,67 g or at 25-26% by introducing $N_{30\text{-}60}$ in early spring, though it was the greatest in case of separate applying of nitrogen fertilizers – 0,71-0,76 or more at 34-43%. It should be noted that a single fertilization of winter rye with norm N_{90} did not contribute to increase the mass of the grain, but carrying 30-60 kg/ha of nitrogen fertilizers was less than in variants where nitrogen fertilizers were applied in early spring.

1000 grain weight of winter rye varied depending on the norms and timing of nitrogen fertilizers and weather conditions. Thus, on average, over three years this indicator varied from 35,2 g variant without fertilizers to 36,2-37,0 g per fertilization of $N_{30\text{-}90}$ in early spring. In variants ground + N_0 + $N_{30\ (IV)}$ and ground + N_0 + $N_{60(IV)}$ 1000 grain weight was respectively 35,8 and 36,1 g, which was less compared to variants where nitrogen fertilizers were contributed on the second stage of organogenesis.

In case of separate applying the largest indicator of weight of 1000 grains was formed in variant ground + $N_{60\ (II)}$+ $N_{60\ (IV)}$ – 37,3 g and in other variants this indicator was lower compared to single fertilizing in early spring.

Number of grains of one spike on average for three years in variant without fertilizers was 18.0 units and increased to 24.0 units in variant ground + $N_{30\ (II)}$+ $N_{60\ (IV)}$. In case of separate applying of nitrogen fertilizers number of grains in one spike was higher in comparison with a single applying. The highest level of this indicator was in variant ground + $N_{30\ (II)}$ + $N_{60\ (IV)}$ – 24,0 units versus 21,1 units in variant ground + $N_{90\ (II)}$. But carrying 30-60 kg/ha of nitrogen fertilizers did not contribute to increase the number of grains in one spike, where the levels were 20,6 and 20,9 units respectively.

On the basis of the correlation analysis we found that the correlation between the height of winter rye and the number of productive stems, grain weight of one spike and plant, yield, weight of 1000 grains, natura connection was defined as severe (Table2). The correlation between plant height and spike length, number of grains of one spike had average connection and was respectively r = 0,62 and r = 0,64. Indicators of plant height and number of spikelets in the spike had a weak positive correlation (r = 0,03).

Indicators of spike length and number of grains in the spike had a strong relationship between (r = 0,99). Between spike length and number of spikelets in the spike, the number of productive stems, grain weight of one spike, yield, weight of 1000 grains, natura a direct correlation was strong. Length spikelets and spike density had average inverse correlation as r = –0,55.

Table 2

Correlation between indicators of productivity of winter rye

Indicator	Spike length	Number of spikelets in the spike	Spike density	Number of productive stems	Number of grains in the spike	Grain weight of a spike	Yield	1000 grain weight	Grain natura
Plant height	0,62	0,03	-0,98	0,99	0,64	0,70	0,89	0,88	0,78
Length of spike		0,80	-0,55	0,71	1,00	0,99	0,91	0,92	0,97
Number of spikelets in the spike			0,05	0,16	0,79	0,73	0,49	0,51	0,65
Spike density				-0,98	-0,57	-0,64	-0,85	-0,84	-0,73
Number of productive stems					0,73	0,79	0,94	0,93	0,85
Number of grains in the spike						1,00	0,92	0,93	0,98
Grain weight of a spike							0,95	0,96	0,99
Yield								0,97	0,98
1000 grain weight									0,98

The correlation between the number of spikelets in the spike and indicators of grain number in the spike, grain weight of a spike is noticed as strong positive (r = 0,79; r = 0,73). Average connection was observed between the number of spikelets and yield (r = 0,49), 1000 grain weight (r = 0,51), natura of grain (r = 0,65). Between the number of spikelets in the spike and indicators of spike density, the number of productive stems the strength of connection was weak and the connection was direct. Correlation between the density of spike and the number of productive stems, yield, weight of 1000 seeds, natura is defined as a strong and inverse (r =–0,73 ...–0,98). Average inverse correlation was noted between the density and the number of spikelets in the spike (r =–0,57); weight of grain of a spike (r = 0,64).

Between the number of productive stems and indicators of number of grains in the spike, grain weight of a spike yield, weight of 1000 grains and natura a strong correlation was found (r = 0,73-0,98).

The number of grains in the spike and indicators of grain weight of a spike, yield, weight of 1000 grains, grain natura had a strong correlation, between a number of grains in the spike and grain weight of a spike a positive relationship was found.

The correlation between the grain weight of a spike, yield, 1000 grain weight and natura is strong (r=0,89…0,99).

Indicators of yield and weight of 1000 grains had a strong correlation. Between grain yield and natura it is strong (r = 0,98). Correlation of 1000 grain weight and grain natura is strong and was r = 0,98, and between 1000 grain weight and vitreuesness the connection is strong and inverse (r =–0,74).

Conclusions. The coefficient of tillering, number, grain weight of one spike and weight of 1000 grains of winter rye depend on norms and timing of nitrogen fertilizers. Among all the types of fertilizers nitrogen fertilizers have the most effect on these parameters. Thus, due to improvement of phosphate and potash regime structural elements are increased by 1.10%, while nitrogen - by 10-45% compared with areas where no fertilizers were applied. Defined correlation coefficients make it possible to use coefficient of productive tillering, weight and number of grains of one spike for predicting crop of winter rye.

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Аннотация

Господаренко Г.Н., Пташник М.М.

Влияние видов, норм и сроков внесение азотных удобрений на элементы структуры урожая ржи озимой

Исследовано формирование содержания элементов структуры урожая ржи озимой в зависимости от видов удобрений, норм и сроков азотных подкормок. Доказано, что эти показатели меняются в зависимости от погодных условий и существенно возрастают за улучшение минерального питания растений ржи озимой. Рожь озимая характеризуется высокой массой 1000 зерен, однако количество зерен и масса зерна одного колоса низкая.

***Ключевые слова**: рожь озимая, минеральные удобрения, элементы структуры урожая*

Анотація

Господаренко Г.М., Пташник М.М.

Вплив видів, норм і строків внесення азотних добрив на елементи структури врожаю жита озимого

Досліджено формування вмісту елементів структури врожаю жита озимого залежно від видів добрив, норм і строків азотних підживлень. Доведено, що ці показники змінюються залежно від погодних умов та істотно зростають за покращення мінерального живлення рослин жита озимого. Жито озиме характеризується високою масою 1000 зерен, проте кількість зерен і маса зерна одного колоса низька.

Ключові слова: *жито озиме, мінеральні добрива, елементи структури врожаю*