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Sowing qualities and formation of yield of red fescue depending on foliar fertilizing

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ABSTRACT

The article presents the data of a scientific research aimed at increasing the seed productivity of the red fescue by optimizing the conditions of its nutrition at the critical phases of growth and development. It is established that foliar dressing in the phase of stem elongation of the red fescue of Ayra variety with the growth regulator "Amino Viks" (0.5 kg / ha) in combination with carbamide (5 kg / ha) against the background of the basic fertilizer ($N_{60}P_{45}K_{45}$) in the spring at the beginning of aftergrowing of seed sowings enable the formation of maximum productive plant stand (681 pieces / m²), the largest number of seeds on 10 shoots (945 pieces), the mass of 1000 seeds (1.22 g). This led to the formation of seed productivity of 480 kg / ha, which is 12 kg / ha higher in comparison with the N_{60} background and 164 kg / ha higher in comparison with the unfertilized plots.

KEY WORDS

Red fescue; Fertilizers; Water-soluble fertilizers; Growth regulators; Seed productivity; Sowing qualities.

INTRODUCTION

The main component of the improvement of cultivated pastures and haylands and the expansion of their areas is the provision of sufficient production of cereal grasses seeds, including red fescue.

Red fescue, in its biological characteristics, refers to crops with high potential seed productivity. On the one hand, its modern varieties are capable to ensure the seed yield at the level of 500 – 700 kg / ha, on the other hand, the level of seed productivity of red fescue significantly dependents on environmental factors and agrotechnical growing conditions, in particular, the agrocoenosis density, moistness, light and nutrients, depending on the stages of organogenesis[1-3]. Although 15–25% of seeds are physiologically complete in the seed formation, however, they are not standard in their biometric parameters (seed size, corcule volume, mass of 1000 seeds). Such seeds have low energy and spread, therefore, they are more sensitive to growing conditions.

The necessity for foliar feeding during the growing season, particularly during the stem elongation phase, appears due to the lack of individual nutrients during the formation of generative shoots in the stand, especially in rhizomatous grasses, in particular red fescue. Foliar feeding contributes to the better formation of fruit elements and does not allow thickening and lodging of crops, which are observed, as a rule, when high doses of nitrogen fertilizers are applied, especially in years with

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excessive water supply[4].

Important scientific research on the development of grassland science carried out by renowned scientists Bogovin A.V., Babich A.A., Makarenko P.S., Mashchak Y.I., Petrichenko V.F., Kurgak V., Kovtun K.P., Rak K.I. and others, but many of the issues of this problem are still not well explored. In this regard, the discovery of patterns in the formation of legume-cereal agrophytocenoses and the development of effective methods for increasing their productivity on the basis of improving the species composition of grass mixtures, modes of use and methods of fertilizing the grass stands acquires particular relevance.

According to Bogovin A.V.[5], when the content of the grass stand contain 50% of legumes, it is sufficient to apply only phosphate-potassium fertilizers to obtain 4 000-5 000 kg/ha of fodder units. Higher productivity of grasses (above 5 000-7 000 kg / ha) of feed units or 8 000-10 000 kg / ha of dry mass can be obtained only after the introduction of complete mineral fertilizer.

The effectiveness of the nitrogen influence is largely dependents on the presence of other nutrients in the soil. Research of Fisher F.L. and others[6] set that it depends on the phosphorus content in the soil, and in the experiments of Holmes W.[7] – on the content of potassium, as well as phosphorus and potassium taken together. Regular introduction of high doses of nitrogen fertilizers did not increase the yield, if both phosphorus and potassium were not applied at the same time.

In Italy, the introduction of 60-100 kg / ha of active calurea of phosphorus and potassium, and 80-150 kg / ha of nitrogen in 2-3 doses to the grass stand of beardless ryegrass (*Lat. Loliumperenne*), has proven itself best of all[7,8].

RESEARCH METHODS AND MATERIALS

The experiments were carried out at the Institute of Feed and Agriculture of Podolia of NAAS in the crop rotation of the department of seed farming and innovation transfer during 2014–2015. The soil is gray forest, characterized by the following indicators: pH – 5.2–5.5, hydrolytic acidity (Hr) – 1.75–2.14 mg-eq / 100 g of soil, cation exchange capacity – 12-13 mg-eq / 100 g of soil, in the arable layer of soil (0–20 cm), the humus content is 1.91-2.14%, lightly hydrolyzed nitrogen according to Cornfield – 6.3-6.8, mobile forms of phosphorus (P_2O_5) according to Chirikov and potassium (K_2O) – 14.5-16.0 and 9.3-10.5 mg / 100 g of soil, respectively.

According to the geomorphological zoning of Ukraine, the territory of the experimental field belongs to the Dnieper Upland of geomorphological region – Vinnitsa denudation-accumulative undulating plain and belongs to the subboreal (moderately warm) soil geographical zone in the forest-steppe zone. The soils of the experimental area are gray forest, which is typical of this agro-ground area with such agrochemical indicators.

There was no sustained and significant snow cover during the winter period. Precipitations fell in the form of rain, drizzle, snow and sleet. There was no significant soil freezing over the winter period of 2014-2015. The maximum depth of soil freezing was observed in the first decade of January and was 15-36 cm, so the moisture was easily absorbed by plants.

During the period from 28 October, 2014 to 10 February, 2015, 127 mm of precipitation fell, with a norm of 130 mm. The weather conditions for crops over-wintering were difficult due to unstable snow cover, slight soil freezing, alternating negative and positive temperatures, a decrease in temperature in the absence of sufficient snow cover, long thaws with positive daily temperatures (10 January-14 January; 19 January-24 January; 30 January-3 February). During periods of deep thaw, perennial grasses were on the verge of renewed vegetation, spent nutrients and reduced frost resistance.

The decrease in air temperature during April 2015 slowed down the processes of growth and development of agricultural crops, although at the same time the April weather conditions with temperature conditions were close to the long time average annual indicators, and the precipitation fell by 8 mm less than the long time average annual indicator. Hydrothermal conditions in May were characterized by increased average daily temperatures and a deficit of moisture in the soil. That month, the average daily temperature was 15.3 °C, which is 1.2 °C higher than the long time average annual indicator. In May, 35 mm of precipitation fell, which is half the long time norm (63 mm) this month.

June and July 2015 were characterized by increased

daily average temperatures and critically insufficient precipitation. The average daily temperatures in these months were 19.3 and 21.2 °C, respectively, which were 2.2 and 2.9 °C higher than the average long time average annual indicator. The deficit of precipitation was respectively 52 and 77 mm. Such weather conditions were not favorable enough for the formation of a high yield of grass seed. Vegetation periods 2013-2015 were different according to weather conditions. According to scientists, this forest-steppe zone is favorable for growing perennial grasses.

Sowing is spring, continuous, under the cover of spring barley with a seeding rate of 3.0 million viable seeds. The replication of the experiment is threefold; the area of the registration plot is 30 m^2.

The introduction of mineral fertilizers was carried out in the fall under the main tillage according to the research circuit. The growth regulator "Amino Viks" (0.5 kg / ha) was introduced according to the experimental scheme into the phase of red fescue stem elongation. "Amino Viks" contains more than 30% of amino acids, Cu – 1%, Fe – 2.3%, Mn – 3%, Zn – 2%. A water-soluble fertilizer "Plantafol" containing 5.0% of N, P_2O_5 – 15.0%, K_2O – 45%, B – 0.02%, Fe – 0.01%, Mn – 0.05%, Zn – 0.05%, Cu - 0.05%, was also used in the experiment, while Cu, Fe, Mn, Zn are chelates in the form of EDTA (ethylenediaminetetraacetic acid).1–2 days before harvest, test sheaves were taken to study the structure of seed grass and the biological yield of seeds.

In the year of the experiments, groups of agrometeorological indicators were analyzed. During the growing season of plants, the department of seed production and transfer of innovations conducted phenological observations on the main phases of the growth and development of grasses according to the "Methodology of state cultivar testing of agricultural crops" and "Methods of research in fodder production"[9-12]. At the same time, phases of growth and development of plants were noted. The beginning of the phase was noted when 10% of the plants reached it and the end of the phase was when 75% of the plants reached it.

Plant productivity and crop records were performed according to the "Guidelines for conducting field experiments with feed crops".

Yield records were carried out with all replications of experiments with subsequent after-cleaning of seeds and converted to a standard moisture content of 15%[13,14].

All the records and observations were carried out in experiments by the department of seed production and transfer of innovations in accordance with the "Guidelines for conducting research in the seed production of perennial grasses"[15-18].

The sowing qualities of seeds of perennial grasses (viability, germination ability) were determined according to GOST 4138-2002 "Crop seeds. Methods for quality determination".

The strength of growth and viability of seeds were determined according to the "Method of determining the growth strength of seeds of feed crops"[19-21].

RESULTS AND DISCUSSION

The research results showed that the introduced mineral fertilizers influenced the growth and development of the red fescue of the Ayra variety. Thus, the average height of generative shoots in variants without the basic fertilizer ranged from 82 to 96 cm, and when the fertilizer N_{60} was added, it increased by 4–6 cm. With the introduction of complete mineral fertilizer ($N_{60}P_{45}K_{45}$), the average height of the shoots was 9–11 cm more compared with the variants without the basic fertilizer. Conducting foliar feeding in the phase of stem elongation with carbamide (5 kg / ha), Plantafol (2 kg / ha) and growth regulator Amino Viks (0.5 kg / ha) against the basic fertilizer (N_{60}) facilitated an increase in the height of the shoots, respectively, by 4; 3; 4 cm in comparison with similar variants without the basic fertilizer. With the introduction of complete mineral fertilizer ($N_{60}P_{45}K_{45}$) in combination with foliar fertilizing with the above mentioned preparations, the average height of the shoots increased additionally by 5–6 cm compared with the application of nitrogenous fertilizers N_{60} only. However, the greatest height of plants (105 cm) was noted in areas where against the mineral fertilizers ($N_{60}P_{45}K_{45}$) the foliar fertilizing with Plantafol (2 kg / ha) in conjunction with Amino Viks (0.5 kg / ha) in the phase of stem elongation were done.

However, the studied factors influenced the number of generative and vegetative shoots. It was the smallest

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in the variant without fertilizers (424 and 700 units / m^2, respectively) (TABLE 1). The most significant number of shoots grew against the basic fertilizer. Thus, the introduction of only nitrogenous fertilizers N_{60} increased the number of generative shoots by 121 units / m^2, vegetative ones – by 111 units / m^2.

These indicators increased by 180 and 225 units/ m^2, respectively, with the introduction of complete mineral fertilizer ($N_{60}P_{45}K_{45}$), compared with the variants without the basic fertilizer. Foliar fertilizing with carbamide (5 kg / ha), Plantafol (2 kg / ha) and growth regulator Amino Viks (0.5 kg / ha) contributed to the maximum increase in the number of generative shoots: at its introduction against the N_{60} and $N_{60}P_{45}K_{45}$ this indicator was 568–626 and 620–662 units / m^2, respectively. At the same time, the number of vegetative shoots increased by 22–67 and 23–132 units / m^2, respectively. The largest number of generative (681 units / m^2) and vegetative shoots (1110 units / m^2 was noted at applying the composition from carbamide (5 kg / ha) and Amino Viks (0.5 kg / ha) against the mineral fertilizers $N_{60}P_{45}K_{45}$. At foliar fertilizing with the same composition against theN_{60} and in areas without fertilizer, the number of generative shoots was less by 3.5 and 24%, and vegetative – by 6.4 and 23.3%, respectively.

The main influence on such an indicator of crop structure, as the number of seeds on 10 shoots, had the basic fertilizer. Thus, if in variants without fertilizers, this indicator was within 628–896 units, then with the introduction of N_{60} it increased to 762–924 units. The introduction of complete mineral fertilizer ($N_{60}P_{45}K_{45}$) contributed to an increase in the number of seeds per 10 shoots to 797–945 units (TABLE 1).

Foliar fertilizing with carbamide (5 kg / ha), Plantafol (2 kg / ha), Amino Viks growth regulator (0.5 kg / ha) and their compositions without the basic fertilizer contributed to an increase in the number of seeds per 10 shoots by 36; 81; 143; 215 and 268 units compared to control. Conducting foliar fertilizing on the background of fertilizer N_{60} increased the number of seeds per 10 shoots, depending on the variant, by 134; 141; 140; 116; 65 and 28 units compared with the corresponding variants without the basic fertilizer. Against the background of $N_{60}P_{45}K_{45}$, foliar fertilizing increased the number of seeds per 10 shoots by 169; 156; 149; 125; 98 and 49 units. However, the largest number of seeds per 10 shoots (945 units) was got at foliar fertilizing with a composition from Plantafol (2 kg / ha) and Amino Viks (0.5 kg / ha) against the background of the basic fertilizer ($N_{60}P_{45}K_{45}$).

TABLE 1: Fertilizers influence on seed productivity and sowing qualities of red fescue of Ayra variety

Basic fertilizer Factor (A)	Foliar fertilizing in the phase of stem elongation, kg/ha Factor (B)	Seed yield, kg/ha			Spread, %			Viable, %		
		2014	2015	average	2014	2015	average	2014	2015	average
Without Fertilizers (control)	Without fertilizers (control)	121	178	150	36	42	39	69	71	70
	Carbamide – 5	164	196	180	43	46	45	71	71	71
	Plantafol – 2	193	255	224	47	49	48	72	70	71
	Amino Viks – 0,5	241	263	252	51	54	53	72	71	72
	Carbamide – 5 + Amino Viks – 0,5	245	387	316	56	58	57	75	73	74
	Plantafol – 2 + Amino Viks – 0,5	253	341	297	62	63	63	75	74	75
N_{60}	Without fertilizers (control)	310	380	345	58	59	59	74	73	74
	Carbamide – 5	321	457	389	63	65	64	76	74	75
	Plantafol – 2	347	462	405	67	68	68	76	75	76
	Amino Viks – 0,5	384	501	443	69	71	70	78	76	77
	Carbamide – 5 + Amino Viks – 0,5	395	541	468	72	73	73	78	77	78
	Plantafol – 2 + Amino Viks– 0,5	410	538	474	74	75	75	78	77	77
$N_{60}P_{45}K_{45}$	Without fertilizers (control)	338	436	387	66	69	68	79	77	78
	Carbamide – 5	354	467	411	68	71	70	80	78	79
	Plantafol – 2	375	472	424	71	73	72	82	81	81
	Amino Viks – 0,5	401	516	459	74	75	75	82	81	82
	Carbamide – 5 + Amino Viks – 0,5	412	548	480	77	79	78	85	83	84
	Plantafol – 2 + Amino Viks – 0,5	424	530	477	78	81	80	85	84	85

HIP0,05kg/ha; 2014 – A – 12,6; B – 17,9 AB – 12,7; 2015 – A – 12,9; B – 18,1; AB – 14,2

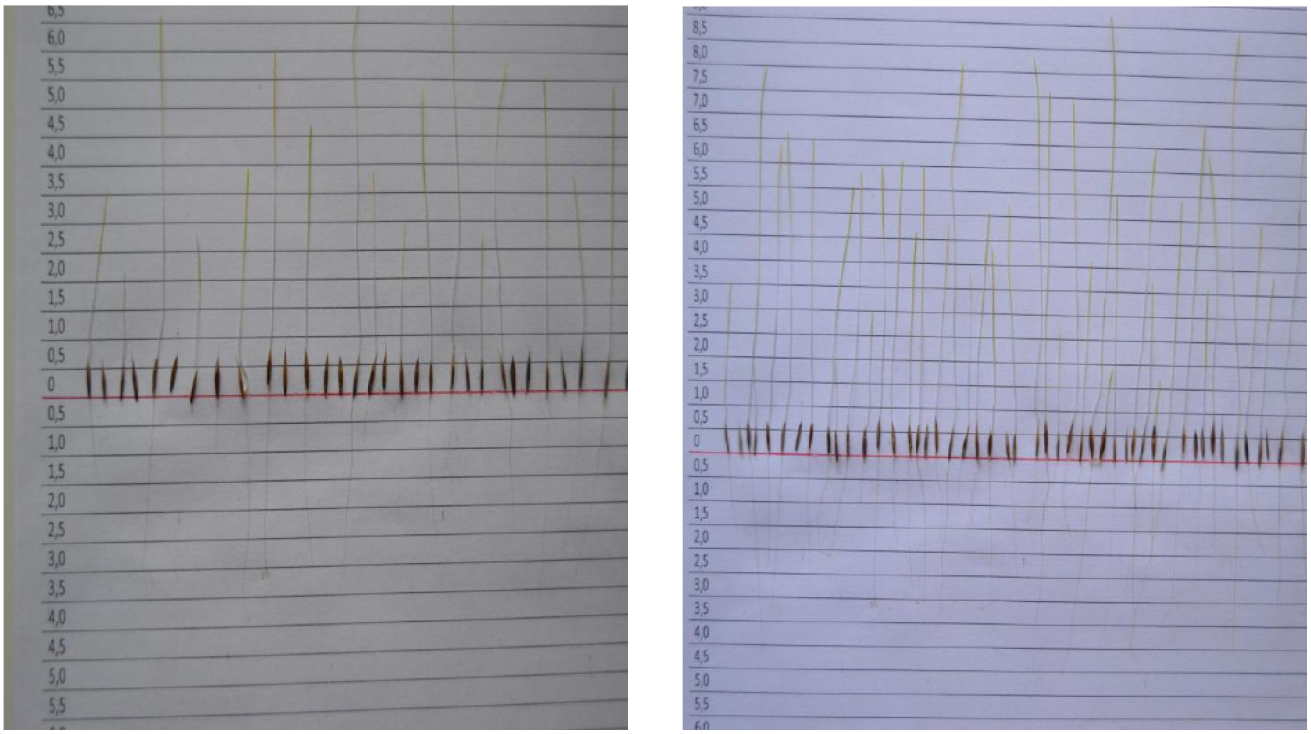
In our studies, an increase in the mass of 1000 seeds by 0.04–0.08 g from the introduction of N_{60} and by 0.08–0.16 g from the fertilizer ($N_{60}P_{45}K_{45}$) was observed. The largest mass of 1000 seeds (1.22 g) was at introducing the foliar fertilizing of Plantafol (2 kg / ha) and Amino Viks (0.5 kg / ha) against the background of the basic fertilizer ($N_{60}P_{45}K_{45}$).

Seed productivity of Ayra red fescue in areas without fertilizers on average for 2014–2015 amounted to 150 kg / ha. Foliar fertilizing with carbamide (5 kg / ha), Plantafol (2 kg / ha), growth regulator Amino Viks (0.5 kg / ha) and their compositions compared to mineral fertilizers increased the yield of seeds depending on the variant 30–147 kg. Against the background of N_{60} fertilizer, the yield increased up to 195–324 kg / ha. At the introduction of complete mineral fertilizer ($N_{60}P_{45}K_{45}$), the yield increased by 237–327 kg / ha compared to areas without fertilizers (TABLE 1).

The effectiveness of foliar fertilizing decreased with increasing background of the basic fertilizer. At application of a chelate-based water-soluble fertilizer and plant growth regulators, nutrients are obtained through the leaves that can cause significant changes in growth and development, including metabolism, increasing vital activity, and save water for plants. As a result, the flowering and formation of the ovary goes favorably, plant overgrowing is restrained, the sowing qualities of seeds are improved. The weather conditions of 2014 were unfavorable for the formation of the seed yield due to high temperatures and lack of precipitation during the growing season. The difference compared to 2015 was 57–146 kg / ha (the parameter was 37–47% less). At the same time, foliar fertilizing with a growth regulator, carbamide or Plantafol reduced the negative impact of adverse conditions on the formation of the red fescuefruit elements.

Laboratory studies of the sowing qualities of seeds showed that the plants spread and seed germination depended on the fertilizer variant. Most of all, this dependence is manifested in the growth rate, since this indicator is more objective and is influenced to a greater degree not by the number of germinated seeds, but by its quality indicators, such as the development value of seedling and root system.

The nominal spread of the plants was 39–63%in the variants without mineral fertilizers, and the highest (68–80%) with the introduction of complete mineral fertilizer $N_{60}P_{45}K_{45}$. In all variants of the experiment,



Without fertilizers $N_{60}P_{45}K_{45}$

Figure 1: Sowing qualities of red fescue of Ayra variety depending on fertilizer application

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conditional seeds were obtained, however, the germination rate was different – from 70% at the control to 84% in variants where against the basic fertilizer $N_{60}P_{45}K_{45}$ the foliar fertilizing with carbamide (5 kg / ha) or Plantafol (2 kg / ha) in combination with growth regulator "Amino Viks" (0.5 kg / ha) took place.

CONCLUSIONS

Conducting foliar fertilizing into the phase of stem elongation of red fescue of Ayra variety by growth regulator Amino Viks (0.5 kg / ha) in combination with carbamid (5 kg / ha) against the background of the basic fertilizer ($N_{60}P_{45}K_{45}$) in the spring at the beginning of regrowth of seeds contributed to the formation of the maximum productive plant stand (681 units / m^2), the largest number of seeds per 10 shoots (945 units), the mass of 1000 seeds (1.22 g), which led to the formation of seed productivity of 480 kg / ha, which is 12 kg / ha higher in comparison with the background of the N_{60} and 164 kg / ha higher in comparison with the unfertilized plot.

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