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The Effect of Pesticides and Albite on Growth, Development and Seed Yield of Eastern Galega (Galega Orientalis)

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Abstract.
The research was aimed at scientific substantiation of the possibility to form high productivity of Eastern galega by using pesticides and the Albite growth regulators. To achieve this goal, the effects of pesticides, duration and frequency of using the Albite growth regulator on the growth, development and seed yield were studied in 2012-2014 in course of field experiments and laboratory studies. As a result of the research, it has been found that the maximum number of generative shoots, compared to the reference, was against the nonpesticide and pesticide background, when Albite was introduced in the phase of spring aftergrowing + budding; by the moment of harvesting for the seeds, their height and the length of beans did not change significantly in terms of these factors; the maximum number of beans per shoot was observed against both nonpesticide and pesticide background when Albite was introduced during the phase of spring aftergrowing, and against the pesticide background of threefold use of the growth regulator, and in the phase of budding, compared to the reference; the number of seeds per legume prevailed against the pesticide background with the introduction of the growth regulator in the budding phase. Their highest weight per generative shoot has been observed against the pesticide background with the introduction of Albite in the phase of spring aftergrowing. The greatest seed yield was obtained against the nonpesticide background with the double use of growth regulator (598 kg/ha), and at the beginning of spring aftergrowing against the pesticide background (578 kg/ha); the excess over the reference being 55.3 and 50.1%, respectively.
Keywords: Albite, Eastern galega, pesticides, seeds per bean, seed weight per generative shoot, seed yield, shoot height and bean length, vegetative and generative shoots.

INTRODUCTION

In recent years, the share of grass feed in the total amount of feed has been growing everywhere, and on the average in Russia, it is 58%. This tendency is justified, since herbs are best adapted to the climatic conditions in most regions, and allow obtaining cheap feed. One of the main areas of intensifying field feed production is increasing the areas for sowing of perennial legume Eastern galega. It is possible through increasing the amount of its seeds' production.

In the Russian Federation, the volumes of using plant protection products, including domestic products, are annually growing. In choosing such products, one should bear in mind that it is important not only to preserve the harvest, but also to avoid damage to the environment. Therefore, it is necessary to observe the consumption rate and the deadlines of using pesticides. In order to reduce the cost of chemical treatments, it is recommended to use multicomponent products and tank mixes with growth regulators, biologically active substances, micronutrients aimed at increasing the immunity of plants and at combating pests [1, 2].

To reduce the negative impact of weeds on the productivity and the quality of galega products, many researchers recommend using herbicides [3, 4]. Three-year studies on leached black soils in the Penza region showed that treating galega seedlings with Bazagran at the rate of 1.5 kg/ha of active substance did not make it possible to completely destroy the dominating weeds, both monocotyledonous and dicotyledonous ones; the overall destruction of weeds was 53.5 to 56.3%, while 46.5 to 43.7% continued vegetating, thus reducing galega productivity. The highest values of the elements of galega yield structure were in plants from the variant where Treflan was introduced during sowing, and Bazagran - after germination. Reduced weed infestation resulted in increased traffic of bees and other pollinators to the flowering crops, as evidenced by the increased number of beans per pulse. This allowed to destroy more weeds, and to increase the yield of seeds over the years of use by 0.49–0.58 t/ha [5].

According to the researchers, fodder crops of galega do not get damaged by pests, only the crops for seed are exposed to their effects in severely arid years, especially in the southern regions [6, 7]. However, there is another opinion that in the arid conditions, this plant gets severely damaged by aphids, nodulating weevils, etc. The total of 50 phytophagans has been detected, which can reduce the yield of the green mass by 32 to 42%, and of seeds – by 15 to 30% [8-12].

According to the researchers, fodder crops of galega do not get damaged by diseases, only the crops for seed are exposed to their effects in severely arid years, especially in the southern regions [6, 7, 13]. It is damaged by ramularia, downy mildew, rust, cercosporosis, false mildew, which reduce the yield of green mass by 20-30%, and in the years with epiphytotics, losses reach 40%. Similar pattern is also observed in crops for seeds [11, 12, 14, 15].

Efficiency of Albite for galega was shown in field experiments performed in the Vladimir and the Moscow region by the All-Russian Research Institute of Vegetable Breeding and Vegetable-Seed Industry, and the Vladimir Regional Plant Protection Station. The experiments were performed in 2011-2013 with the Gornoaltaysky variety – 87. The practical use of Albite for galega in recent years has become widespread in farms of the Vladimir, the Moscow, the Tula and the Lipetsk regions. According to the results of the experiments at the All-Russian Research Institute of Vegetable Breeding and Vegetable-Seed Industry (VNIISSOK) in the Moscow region, treatment with Albite increased the yield of green biomass of galega on the average by 14 t/ha (15.6%), and the seed yield - by 0.04 t/ha (16.2%) [16].

One of the elements of the technology that ensures high yield and quality of the seed is the use of plant protection products and Albite. However, no similar studies have been performed in the conditions of the Republic of Mordovia. Therefore, developing and improving the methods of galega seeds' cultivation is very timely and relevant, and help increase production of plant-based protein in the region.

The purpose of the research was to scientifically substantiate the possibility of obtaining high yields of good quality Eastern galega seeds based on the use of plant protection means and Albite in the Republic of Mordovia. The tasks of the research were the following:

– studying the characteristics of growth and development of Eastern galega plants depending on the plant protection means used and on the number of Albite uses; and

- identifying the effect of plant protection means and Albite on the seed yield of Eastern galega.

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Cultivating Agricultural Crops in Adaptive-Landscape Agriculture".

MATERIALS AND METHODS

For achieving the objectives, field experiments were laid in 2012-2014 at LLC Biosphera in the Staroshaigovsky region of the Republic of Mordovia in fodder crop rotation field No. 3 with galega of 12, 13, 14 years of life. Scheme of the experiment was as follows: Factor A. Plant protection means (Background of plant protection). 1. Without plant protection means (reference – background without pesticides). 2. Plant protection means (the background of using pesticides was spraying with insecticides in the phase of spring regrowing – Break 0.05 l/ha; in the budding phase - Sharpei 0.3 l/ha; processing with herbicides Bazagran 2.0 l/ha + Miura 1.5 l/ha - in the phase of spring regrowing; treatment with fungicide Rex - Duo 0.4 to 0.6 l/ha - in the phases of spring regrowing and budding). Factor B. The use of the Albite growth regulator. 1. Without treatment (reference). 2. Treatment in the phase of spring regrowing - 40 ml/ha. 3. Treatment in the phase of spring regrowing and budding (twice). 4. Treatment in the phase of spring regrowing, budding, and bean formation (three times). 5. Treatment in the budding phase. 6. Treatment in the phase of bean formation.

The area of first order plot was 60 m^2 (12 x 5 m), that of the second order – 10 m^2 (2 x 5 m). The experiment was repeated three times, with systematic arrangement. In accordance with the tasks, the experimental work was based on the method of laboratory and field studies. The object of the research was Yalga Eastern galega.

Field experiments were laid out, and observations and accounting were made according to B. A. Dospekhov [17]. Phenological observations, accounting for the density of shoots, defining the yield structure were made according to the methods of State Variety Testing of Agricultural Crops [18]. Seed yield was accounted for by cutting plants from 3 m^2 of each plot with three repetitions after browning of 100% of beans, followed by manual thrashing. The obtained data were processed by the method of variance analysis according to R. A. Fischer using statistical applications for PC [17].

The research was performed in the second agropedological region in the third natural economic area. The soil of the experimental area was dark gray forest soil with clay of particle size distribution. The content of humus was 5.1%; pH_{KCl} - 5.0; hydrolytic acidity - 5.2 mg • equiv. per 100 g of the soil; mobile phosphorus - 97 mg/kg of soil, and exchangeable potassium - 144 mg/kg of soil. The content of microelements was the following: Mo - 0.12 mg/kg (low), B - 1.4 mg/kg (high), Mg – 41 mg/kg; Cu – 7.9 (high) mg/kg; and Co - 1.0 mg/kg (low).

Agrometeorological conditions in the years of the study differed by years. In 2012, in the periods from the beginning of the vegetation to budding, and before flowering, they were very arid (hydrothermal index = 0.44 and 0.57). From budding until flowering, and from flowering until pod formation, they were hyperhumid (hydrothermal index = 1.88 and 1.54); from pod formation to seed ripening (hydrothermal index = 0.94), and from the beginning of spring vegetation until seed ripening - slightly arid (hydrothermal index = 0.89).

In 2013, in the periods from the beginning of spring regrowing until budding and until flowering, they were arid (hydrothermal index = 0.72 and 0.75). From budding until flowering, the conditions were normal humid (hydrothermal index = 1.04); and from flowering until bean formation - strongly arid (hydrothermal index = 0.15). The period from flowering to seed ripening was slightly arid (hydrothermal index = 0.89), and from bean formation to maturity – normally moist (hydrothermal index = 1.09), from the beginning of the spring regrowing to seed ripening – slightly arid (hydrothermal index = 0.84).

RESULTS AND DISCUSSION

In 2014, the periods from the beginning of spring regrowing until budding and until flowering of galega were strongly arid (hydrothermal index = 0.69 and 0.57). Significant lack of moisture was observed in the interphase periods of budding - flowering (hydrothermal index = 0.32) and flowering – bean formation (hydrothermal index = 0.33). The period from bean formation until seed ripening proceeded in the conditions of mild drought (hydrothermal index = 0.80). The reproductive period of galega was very arid (hydrothermal index = 0.63). The same was the period from the beginning of spring regrowing until seed ripening (hydrothermal index = 0.61).

The agricultural practices used in the experiment were common for the Republic, in addition to the studied variants. In the autumn, mineral fertilizers were introduced at the rate of $P_{60}K_{60}$ (double granulated superphosphate – 1.3 kg/ha, potassium chloride – 1.0 kg/ha), in the spring, harrowing was made. Crops were treated with pesticides and Albite with the use of a manual backpack sprayer, according to the scheme of the experiment.

Phenological observations have shown that the time of occurrence of development phases and the duration of the interphase periods did not change by the studied factors, they changed over the years. On the average, in 2014-2015, the period from the beginning of spring vegetation to budding over the years of the research was 25-36 days, from budding until flowering - 3 to 5 days, from flowering until pod formation - 10 to 14 days, and complete ripeness of the seeds was reached in 36 to 46 days after bean formation. The period from spring regrowing until seeds' full ripeness ranged between 78 and 96 days.

It has been found that on the average for 2012 through 2014, plant protection means and Albite did not contribute to increasing the number of all shoots of Eastern galega (Table 1).

Negative interaction of factors was observed. The greatest number of all galega shoots (135 pcs./m^2) was observed in 2013. If this value is taken for 100%, then in 2012, it was 54%, and in 2014 – 76% from this level.

The use of plant protection means did not affect the number of vegetative shoots of galega. Introduction of Albite contributed to decreasing their number (Table 2).

Table 1 – Number of shoots of galega (generative + vegetative), pcs./m^2 (average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	111	103	115	102	95	100	104
With pesticides	106	112	100	101	103	102	104
On the average by factor B, LSD_{05}=7	108	107	107	102	99	101	104
LSD_{05} A=4; LSD_{05} for individual differences = 10							

Table 2 – The number of vegetative shoots of galega, pcs./m^2 (on the average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	52	41	45	42	35	39	42
With pesticides	48	49	35	41	40	41	42
On the average by factor B, LSD_{05}=4	50	45	40	42	38	40	42
LSD_{05} A=2; LSD_{05} for individual differences = 5							

Table 3 – The share of vegetative shoots,% of the total number (average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	47.0	40.3	40.1	42.7	36.4	38.2	40.8
With pesticides	46.2	44.0	35.2	41.7	40.5	41.6	41.5
On the average by factor B, LSD_{05}=2.1	46.6	42.2	37.6	42.2	38.4	39.9	41.2
LSD_{05}=1,2; LSD_{05} for individual differences = 3.0							

Similar regularity was observed for individual differences. Negative interaction of factors was observed. The greatest number of vegetative galega shoots (34 pcs./m^2) was observed in 2013. If this value is taken for 100%, then in 2012, it was 67%, and in 2014 – 80% from this level.

On the average for 2012 through 2014, plant protection means did not affect the share of vegetative shoots from their total number (Table 3).

It was maximum in the variant without the use of Albite. In considering individual differences, it can be noted that this figure did not grow due to the studied factors. Negative interaction of factors has been determined. The maximum share of vegetative shoots of galega from their total number (46.9%) was observed in 2012, 37.6% - in 2013, and 39.0% - in 2014.

By the moment of harvesting for seeds, the height of generative shoots did not significantly change by the studied factors (Table 4).

It was the highest (112.4 cm) in 2014, 106.5 cm - in 2013, and 90.3 cm – in 2012. The average inverse correlation between the height of generative shoots and the seed yield (r = – 0.40), leafiness (r = – 0.34), photosynthetic productivity (kg of grain per 1,000 units of photosynthetic potential) (r = – 0.34), and weak direct correlation with the length of the beans (r = 0.22) have been determined.

The length of the beans did not change significantly under the influence of the studied factors (Table 5).

The length of the beans varied over years: while in 2012, on the average over the experiment, it was 3.5 cm, in 2013 and 2014, it was 3.2 cm. It had weak inverse correlation with the seed yield (r = – 30), medium correlation with leafiness (r = – 0,32), overall leaf area (r = – 0,49), and the photosynthetic potential (r = – 49).

On the average over 2012-2014, plant protection means did not significantly affect density of generative shoots (Table 6).

It was maximum in case of introducing Albite in the phase of spring regrowing + budding. In the same variant against the nonpesticide and pesticide background, this value had advantages, compared to the reference, in individual differences. Interaction of factors had not been observed. Galega had the greatest number of generative shoots (85 shoots per m^2) in 2013, 62 shoots per m^2 in 2014, and 39 shoots per m^2 in 2012. Between this indicator and the seed yield, medium correlation (r = 0.59) was observed, which was expressed by the linear regression equation y = – 676 + 18.29 x, which was significant at x = 57 to 67. A similar relationship was observed for the number of beans per shoot (r = 0.37), and K_{ee} (coefficient of economic efficiency) (r = 0.34), reverse – with the number of seeds per bean (r = – 0.30); weak direct relationship – with PP (photosynthetic potential) (r = 0.11), weight of 1,000 seeds (r = 0.27) and NPP (r = 0.27).

The use of plant protection means did not affect the number of beans per shoot (Table 7).

Table 4 – Height of generative shoots, cm (on the average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A,
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	98.7	100.5	102.7	104.7	107.1	101.3	102.5
With pesticides	116.6	108.2	106.3	103.5	98.7	106.1	106.6
On the average by factor B, LSD_{05}=8.9	107.6	104.4	104.5	104.1	102.9	103.7	104.5
$LSD_{05; LSD05}$ for individual differences = 12.6							

Table 5 – Length of galega beans, cm (on the average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	3.1	3.2	3.2	3.1	3.4	3.6	3.3
With pesticides	3.4	3.3	3.3	3.2	3.4	3.3	3.3
On the average by factor B, LSD_{05}=0.4	3.3	3.2	3.2	3.2	3.4	3.5	3.3
LSD_{05}=0.2; LSD_{05} for individual differences = 0.5							

Table 6 – The number of generative shoots, pcs./m^2 (on the average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	59	64	67	57	61	62	62
With pesticides	58	62	66	62	61	61	62
On the average by factor B, LSD_{05}=4	58	63	67	59	61	61	62
LSD_{05}=2; LSD_{05} for individual differences = 6							

Table 7 – Number of beans per shoot (on the average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	32.2	56.1	43.3	39.9	38.7	43.5	42.3
With pesticides	40.5	47.4	39.5	44.2	47.5	33.1	42.0
On the average by factor B, LSD_{05}=6.4	36.4	51.7	41.4	42.1	43.1	38.2	42.2
LSD_{05}=3.7; LSD_{05} for individual differences = 9.1							

Table 8 – Number of seeds per bean. (on the average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	4.1	3.5	4.2	4.4	3.8	4.1	4.0
With pesticides	4.3	4.3	4.1	3.8	4.9	4.4	4.3
On the average by factor B, LSD_{05}=0.3	4.2	3.9	4.2	4.1	4.3	4.3	4.2
LSD_{05}=0.2; LSD_{05} for individual differences = 0.5							

Table 9 – Weight of seeds per generative shoot, g (on the average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	0.71	0.93	0.90	0.88	0.79	0.80	0.83
With pesticides	0.52	0.98	0.77	0.78	0.79	0.68	0.75
On the average by factor B, LSD_{05}=0.02	0.62	0.96	0.83	0.83	0.79	0.74	0.79
LSD_{05}=0.01; LSD_{05} for individual differences = 0.02							

Their maximum number was observed in case of introducing Albite in the phase of spring regrowing. In the same variant against the nonpesticide and pesticide background, and against the pesticide background with three repetitions of using the growth regulator, and in the budding phase, this indicator dominated, compared to the reference, when individual differences were considered. Positive interaction of factors was observed. Galega had the greatest number of beans per shoot (53.9 beans) in 2012, 40.4 beans in 2014, and 33.0 beans in 2013. Between this indicator and the seed yield, there was medium correlation (r = 0.51), and with seed weight per generative shoot (r = 0.59), with PP (r = 0.54) and K_{ee} (r = 0.56). Between the number of beans and the number of seeds per bean, weak inverse relationship (r = – 0.24) was observed.

Plant protection means contributed to increasing the number of seeds per bean by 7.5% (Table 8).

The use of Albite did not increase it. In considering individual differences, this indicator prevailed against the pesticide background with the introduction of the growth regulator in the budding phase. Positive interaction of factors was observed. Galega had the maximum number of seeds per bean (4.6) in 2012, 3.9 - in 2013 and 2014. Weak inverse correlation was found between the number of seeds per bean and the seed yield (r = – 0.22), medium direct correlation – with NPP (net productivity of photosynthesis) (r = 0.32) and K_{ee} (r = 0.40).

The use of plant protection means contributed to reducing weight of seed per generative shoot by 9.4% (Table 9).

It was the highest with introduction of Albite in the phase of spring regrowing. In the same variant against the pesticide background, it was advantageous by individual differences. Positive interaction of factors was observed.

On the average for 2012 through 2014, the use of plant protection means decreased the seed yield by 11.3%, this was apparently due to plants' inhibition with herbicides; and decreased number of pollinators in old-growth plantings of galega due to the use of insecticides (Table 10).

Their number was the greatest when plants were sprayed with Albite in the phase of spring regrowing. By individual differences, this indicator dominated against the nonpesticide background with the double use of growth regulator, and at the beginning of spring regrowing against the pesticide background, the excess over the reference amounted to 55.3 and 50.1%. Positive interaction of factors was observed. The maximum seed yield (714 kg/ha) of galega was reached in 2013, 462 kg/ha - in 2012, and 182 kg/ha - in 2014.

On the average over the years of the research, the use of pesticides reduced the K_{ee} by 10.4% (Table 11).

Table 10 – Galega seed yield, kg/ha (on the average for 2012 through 2014)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	385	540	598	469	441	441	479
With pesticides	264	578	424	473	412	396	425
On the average by factor B, LSD_{05}=30	324	559	511	471	426	419	452
LSD_{05}=17; LSD_{05} for individual differences = 42							

Table 11 – Coefficient of economic efficiency (on the average for 2012 through 2014 at natural humidity)

The background of plant protection (A)	Variants of using Albite (B)						On the average by factor A
	1st	2d	3d	4th	5th	6th	
Without pesticides (reference)	0.049	0.048	0.050	0.051	0.046	0.047	0.048
With pesticides	0.029	0.050	0.044	0.046	0.043	0.044	0.043
On the average by factor B,LSD_{05}=0.003	0.039	0.049	0.047	0.049	0.044	0.045	0.045
LSD_{05}=0.002; LSD_{05} for individual differences = 0.005							

It was the highest in case of two and three repetitions of Albite introduction, as well as in the phase of spring regrowing. In considering individual differences, this indicator had the minimum value against pesticide background without the introduction of growth regulator. Negative interaction of factors had been determined.

CONCLUSIONS

Thus, plant protection means and Albite did not affect the time of phenological phases' onset, duration of the interphase and vegetation periods. The studied factors did not increase the number of all and vegetative shoots, nor did they affect the height of shoots and the length of beans. The use of plant protection means decreased the seed yield by 11.3% (425 kg/ha). It was the greatest when plants were sprayed with Albite in the phase of spring regrowing (559 kg/ha). By individual differences, this indicator dominated against the nonpesticide background in case of double use of growth regulator (598 kg/ha), and at the beginning of the spring regrowing against the pesticide background (578 kg/ha); density of shoots, number of beans per shoot, and the weight of seeds per shoot contributed to this. The average correlation had been found between the density of generative shoots ($r = 0.55$), number of beans per shoot ($r = 0.51$), and the seed yield. The maximum Albite pay-back by seeds was reached when it was used against the pesticide background in the phase of spring regrowing (4,825 g/ha). The studied factors did not improve the coefficient of economic efficiency.

REFERENCES

1. Mihaylikova, V. V., Strebkova, I. S., Govorov, D. N., Zhivykh, A. V., Ispolzovanie sredstv zaschiti rastenii v Rossiiskoi Federatsii [The use of plant protection means in the Russian Federation], *Protection and Quarantine of Plants* 2013, *9*, 8-10.
2. Sanin, S. S., Fitosanitarnie problemi intensivnogo rastenievodstva [Phytosanitary problems of intensive crop production], *Protection and Quarantine of Plants* 2013, *12*, 3-9.
3. Vavilov, P. P., Filatov, F. I., Yartieva, Z. A., Kozlyatnik vostochnii [Eastern galega], *Recommendations on the technology of growing new silage crops for fodder and seeds*, Kolos, Moscow 1982.
4. Raig, H. A., Nymsalo, H. K., Kozlyatnik vostochnii – tsennaya bobovaya kultura: Osobennosti agrotehniki [Eastern galega – a valuable legume: Peculiarities of agricultural practices], *Fodder Crops* 1988, *5*, 35-39.
5. Kshnishatkina, A. N., Viraschivanie kozlyatnika na semena [Growing galega for the seed], *Fodder Production* 1983, *4*, 23-25.
6. Razdorskaya, L. A., K voprosu o siryevoi baze rastitelnih insektitsidov v SSSR [To the question of the raw materials base of plant insecticides in the USSR], *The state and prospects of studying plant resources of the USSR*, Moscow 1938, pp. 82-93.
7. Medvedev, P. F., *Novie kormovie kultury SSSR [New fodder crops in the USSR]*, Selkhozizdat, Moscow, Leningrad 1948.
8. Bazylev, E. Y., Deorduyev, I. T., Osnovnie vidi fitofagov na kozlyatnike vostochnom [Main types of phytophagans for Eastern galega], *Fodder plant resources as the factor of scientific and industrial progress in fodder production: Abstract of Report of the Rll-Union Rcientific-Rroduction Conference*, Kiev 1989, pp. 37-40.
9. Khokhryakova, T. M., Bazylev, F. A., Zaschita kozlyatnika vostochnogo ot boleznei [Protection of Eastern galega from diseases], *Fodder plant resources as the factor of scientific and industrial progress in fodder production: Abstract of Report of the Rll-Union Rcientific-Rroduction Conference*, Kiev 1989, pp. 21-25.
10. Deordiyev, I. T., Ekologicheski bezopasnie meropriyatiya po zaschite posevov kozlyatnika vostochnogo ot vrednih nasekomih [Environmentally friendly measures of protecting Eastern galega crops from harmful insects], *Eastern galega – problems of cultivation and use: Abstract of Report at the 3rd International Scientific-Production Seminar*, Penza 1993, pp. 23-25.
11. Eryashev, A. P., *Development of the basic methods of cultivating Eastern galega on leached black soil of the forest-steppe zone of the non-black earth belt*, Kinel, 2003.
12. Sergeeva, N. A., *Formirovanie produktivnosti kozlyatnika vostochnogo v zavisimosti ot rezhima ispolzovaniya na vischelochennih chernozemah yuga lesostepi Nechernozemya [Forming efficiency of Eastern galega, depending on the model of use on leached black soils of the South forest-steppe zone of the non-black-soil belt]*, Penza State Agricultural Academy, Penza 2011.
13. Simonov, S. N., *Galega – novaya kormovaya kultura [Galega – a new fodder crop]*, Moscow 1938.
14. Vakhrusheva, T. E., *Naibolee vredonosnie bolezni nekotorih kormovih kultur [The most harmful disease of some fodder crops]*, Part 2, Saratov Agricultural Institute, Saratov 1978, pp. 149-151.
15. Fedorova, R. N., Monitoring fitosanitarnogo sostoyaniya nekotorih novih, perspektivnih i netraditsionnih selskohozyaistvennih kultur [Monitoring of the phytosanitary state of some new, promising and unconventional agricultural crops], *New and unconventional plants and perspectives of their practical use: Proceedings of the 2nd International Symposium*, Vol. 5, Pushchino 1997.
16. Melkumova, E. A., *Biopreparat Albite dlya povisheniya urozhaya i zaschiti selskohozyaistvennih kultur [Biopreparation Albite for increasing the yield and crop protection]*, The All-Russia Research Institute of Plant Protection of the Ministry of Agriculture of the Russian Federation, 2006.
17. Dospekhov, B. A., *Metodika polevogo opita (s osnovami statisticheskoi obrabotki rezultatov issledovanii) [Methods of field experiment (with the bases of statistical processing research results)]*, Agropromizdat, Moscow 1985.
18. *Metodika gosudarstvennogo sortoispitaniya selskohozyaistvennih kultur [Methods of state grade testing of agricultural crops]*, Kolos, Moscow 1985.