ACCELERATED REPRODUCTION OF VETCH SOWING SEEDS FOR RISKY FARMING CONDITIONS

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Neustroev Alexey Nikolaevich,
Candidate of Agricultural Sciences, Researcher,
Yakut Research Institute of Agriculture. M.G. Safronov, Yakutsk
Alekseeva Valentina Ivanovna,
Candidate of Agricultural Sciences, Leading Researcher,
Yakut Research Institute of Agriculture. M.G. Safronov, Yakutsk
Bardeev Ivan Fedorovich,
master student, senior laboratory assistant, Yakut Research Institute of Agriculture. M.G. Safronov, Yakutsk
Savvinova Aleksandra Vladimirovna,
Senior Lecturer, Yakut State Agricultural Academy,Yakutsk

Summary

The article presents the results of studies conducted in the conditions of the indigenous bank of the middle course of the Lena River in Central Yakutia to study the accelerated reproduction of Vetch seeds when determining the seeding rates and the multiplication factor. It was established that, depending on the seeding rate during the vegetation period, the growth energy of the plants of the Vetch sowing plant is 0.70-0.82 cm / day, while the higher the rate, the lower the daily gain.

The maximum yield of seeds - 14.6 centners per hectare is ensured at the control (seeding rate - 2.0 million / hectare). The multiplication factor in the control variant was 16, with a decrease in the norm to 1.5 million / ha of viable seeds, the coefficient was 18, to 1.0 million - to 26. For accelerated reproduction of seeds, a decrease in the seeding rate to 1.0 million is recommended. seed germination per hectare with a multiplication factor of 26.

Keywords: vetch sowing, seeding rate, accelerated reproduction of seeds, multiplication factor, leguminous

In the Republic of Sakha (Yakutia) the main branch of agriculture is livestock. According to statistical data in2018 the number of cattle in the republic was 188.1 thousand heads, including cows - 74.2 thousand, horses - 184.2 thousand, pigs - 23.4 thousand goals. The volume of harvesting of succulent fodder was: silage - 27.9 thousand tons, haylage - 15.4 thousand tons. At the same time, the availability of food on average is 60-70% but the existing rations are not balanced in protein [1].

In this connection, the task is to achieve not only the provision of livestock feed, but also to improve their quality in composition and energy nutrition. Increasing the production of vegetable protein is one of the priorities of the northern feed industry. One of the ways to increase the production of highly nutritious fodder is to include a component from high-protein plants in sowing of fodder crops. The solution of this problem is possible, at first, due to the expansion of annual leguminous crops.

One of the most valuable in protein content of annual leguminous crops cultivated in Yakutia is vetch (*Vicia sativa* L.). In Yakutia it is used in a mixture with oats for the production of succulent fodder.

However, vetch crops are currently not widely spread in the republic. One of the reasons is the lack of stable seed production. In 2014 in the State Register of Breeding Achievements of the Russian Federation in zone 11, the first variety of

the vetch sowing Lenskaya 15, which was created in the conditions of Central Yakutia, was registered.

To intensify the production of the vetch seed, an important role is played by seed farming. The main task of which is the accelerated reproduction of seeds of a new variety of vetch Lenskaya 15, adapted to the conditions of Central Yakutia. Moreover, it is important to study the technology of propagation of seeds of the vetch seed, ensuring the maximum multiplication factor and output per unit area of the largest number of seeds with high sowing qualities.

For the formation of a high yield and full-fledged seeds of the vetch a special role should be played by providing the plants with an optimal nutrition area that will create the best conditions for growth and development.

The purpose of research is to study the effect of seeding rates on the seed productivity of a vetch seed and to determine the seed multiplication factor for their accelerated reproduction.

Location, conditions and research methods

Experiments were conducted in 2006-2007 and 2010 in Yakutsk Research Institute of Agriculture. The experimental plot is located on the indigenous bank of the middle reaches of the Lena River in Central Yakutia. The soil of the plot is frozen taiga pale yellow, solodized, typical of the agricultural zone of Central Yakutia. The granulometric composition is medium loamy, old arable.

The vegetation periods were favorable in terms of heat supply for all the years of research, but were contrasted in moisture supply. In 2006 the growing season was characterized by a dry spring. In May 11.3 mm of precipitation fell with an average monthly rate of 19.0 mm. June was warm with an average daily temperature of + 16.3 ° C, as opposed to + 14.9 ° C at the rate. Precipitations fell by half the normal (norm is 37 mm). July was warm; according to temperature conditions it was normal. Precipitations fell significantly less than a multiyear average (33.5 mm, versus 46). In August the usual temperature decrease was observed for this month, accompanied by abundant precipitation, which fell to

three times the norm (the norm was 44 mm). In 2007 the growing season was characterized by warm weather with sufficient rainfall throughout the summer. This had a positive effect on the development of the vetch and on the yield of green mass and seeds. The growing season of 2010, like previous years, was characterized by warm weather. May turned out to be not only warm, but also unusually wet - 54.5 mm. That is to say, it was favorable for the vegetation start of the vetch. The soil moisture reserves were enough for the normal maturity of plants in the period of further drought. In June and July there were little precipitation: 7.8 mm in the first decade, 4.3 in the second, 14.2 in the third, 0.7 in the first decade of July and 2.0 mm in the second decade. In the third decade of July the weather was rainy (78.2 mm) and warm.

The experiment was laid out according to the method of field experiment by B.A. Dospekhov [2], surveys and observations on the methodological guidelines for conducting field experiments with feed crops of the RAAS [3].

The term of sowing is spring, in the third decade of May - early June. The soil temperature in the layer of 0-20 cm at this time ranged from 6.2 to 8.9 ° C in the third decade of May and from 8.1 to 12.0 ° C in the first decade of June. The tilling is carried out in autumn, early spring and preplant generally accepted in the region [4]. The experiments were carried out in a three-field grain-crop rotation with a short rotation (fallow ground- vetch- vetch), typical of the arid conditions of Central Yakutia. Experiments on seeding rates were set in the second field (by a fallow), 5 versions were studied. Sowing in rows was done with a row spacing of 15 cm. Reiteration was on 4-fold, the area of plots was 25 m^2.

Experiment scheme:

Version 1. - 1.0 million viable seeds per hectare;

Version 2. - 1.5 million viable seeds per hectare;

Version 3. - 2.0 million viable seeds per hectare (control);

Version 4. - 2.5 million viable seeds per hectare;

Version 5. - 3.0 million viable seeds per hectare.

Laboratory germination of seeds on average over the years of research was high 93.3%, mass of 1000 seeds was 40.9 g, purity was 99%. In conjunction with careful preparation of the soil for sowing this has consistently ensured obtaining of vigorous young growth and full shoots and optimum stalk density in the future.

Phenological observations of the development of vetch plants are carried out in phases: shoots, branching, formation of inflorescences (budding), flowering, bean formation, ripening. Accounting for yield on green mass and seeds was held on all plots. Harvesting was done in a separate way, manually. After mowing the mass was collected into rolls for ripening, then was threshed on the "Sampo – 130" seed combine. The main seed cleaning was carried out on a "CM-0.15" seed cleaning machine.

Seed multiplication factor is calculated by dividing the number of collected seeds by the number of sown.

The processing of experimental data was carried out in accordance with the methodology of B. Dospekhov [2] and with the help of the software package "SNEDECOR" developed by O.D. Sorokin [5] and Microsoft Office Excel 2003.

Research results and discussion

The sowing spring vetch in Central Yakutia is recommended in terms as for spring grain crops at the end of the third decade of May [4; 6]. Depending on the onset of physical ripeness of the soil the first spring tilling is recommended by harrowing disc harrows or hoeing plow to a shallow depth with followed rolling. The main purpose of this treatment is the destruction and loosening of the soil surface to save and preserve soil moisture, in which the upper layer dries out but preserves the moisture of the lower soil layers. Another purpose is to provoke the growth of weeds which is destroyed by pre-sowing soil treatment [7; 8]. Sowing is done immediately after these methods of tilling. In our experience the vetch was sown in 2006, 2007 at the end of the third decade of May (May 25 and 31) depending on the readiness of the soil. In 2010 the sowing was on June 2.

In our experiments phenological observations were made throughout the growing season.

The period from sowing to emergence of shoots lasts from 9 to 16 days (Table 1). It depends on weather conditions. In 2006, when the month was dry in May and June, shoots were noted 16 days after sowing and shoots appeared 9 days later in favorable moisture conditions in 2010. Vetch shoots appear on the 12th day from the date of sowing on average. Vetch begins intensively branching 8-9 days after germination. Bud formation occurs on days 13-21 from the onset of branching, and bud development lasts an average of 6 days. The vetch flowering phase begins on average on the 31st day after germination. This usually happens at the end of the first or second decade of July. The formation of beans begins from the bottom of the plant and gradually goes up. Ripening begins in the same order. According to our data the transformation of a flower into a green bean occurs on average in 10 days.

Table 1 - Duration of interphase periods of development of the spring vetch

Interphase period	Duration, days			
	2006	2007	2010	The average
sowing - shoots	16	11	9	12
shoots - branching	9	9	8	9
branching - budding	21	13	13	16
budding - flowering	5	7	5	6
flowering - bean formation	7	10	12	10
bean formation - ripening	27	31	23	27
sowing - ripening	85	81	70	79

During the years of research, from sowing of vetch to seed ripening 79 days passes an average (Table 1). The length of the growing season (shoots - ripening) at the spring vetch in Central Yakutia is 67 days.

The height of the vetch plants, its increase during the growing season vary depending on the seeding rate (Table 2). The plant height of the vetch is 10.0-10.9 cm with a daily growth of plants of 0.99-0.87 cm when sowing is in a pure form in this phase of branching.

Table 2 - The influence of the vetch seeding rates on height, interfacial growth and daily growth of plants

Seeding rate (million viable seeds / ha)	Plant height in the main phases of development, cm				
	shoots	branching	budding	flowering	ripening
1,0	3,0	10,0	23,4	35,0	58,0
1,5	3,0	10,0	23,3	34,2	57,3
2,0 (control)	3,0	10,5	22,4	33,4	58,3
2,5	3,0	10,1	24,9	33,5	50,1
3,0	3,0	10,9	23,5	32,7	51,2
Correlation coefficient r=		0,76±0,37	0,32±0,55	-0,96±0,16	-0,82±0,33
Seeding rate (million viable seeds / ha)	Plant growth in interfacial period, cm				
	shoots - branching	branching - budding	budding - flowering	flowering-ripening	shoots - ripening
1,0	7,0	13,4	11,6	23,0	55,0
1,5	7,0	13,3	10,9	23,1	54,3
2,0 (control)	7,5	11,9	11,0	24,8	55,2
2,5	7,1	14,8	8,6	16,6	47,1
3,0	7,9	12,6	9,2	18,5	48,2
Correlation coefficient r=	0,76±0,37	-0,01±0,58	-0,87±0,28	-0,70±0,41	-0,83±0,32
Seeding rate (million viable seeds / ha)	Daily growth, cm				
	shoots - branching	branching - budding	budding - flowering	flowering-ripening	shoots - ripening
1,0	0,87	0,79	2,32	0,62	0,82
1,5	0,87	0,78	2,18	0,62	0,81
2,0 (control)	0,94	0,70	2,20	0,67	0,82
2,5	0,89	0,87	1,72	0,45	0,70
3,0	0,99	0,74	1,84	0,50	0,72
Correlation coefficient r=	0,79±0,36	-0,02±0,58	-0,87±0,28	-0,70±0,41	-0,83±0,32

The greatest daily growth of plants is observed from the budding stage before the flowering of the vetch and is in the range of 1.72 - 2.32 cm. In total, during this interfacial period the plants add an average growth of 10.3 cm. The highest increase is observed at a reduced seeding rate (1, 0 million viable seeds / ha) - 11.6 cm ($r = -0.87 \pm 0.28$).

During the period from flowering to seed ripening the growth energy of a vetch is reduced. The daily growth of plants slows down and is only 0.67-0.45 cm.

During this period, which in Yakutia stretches to 37 days, the vetch grows more slowly than during the period from germination to flowering (30 days). Due

to its biological characteristics vetch can add to growth even after the seeds are fully ripe, especially if there is an excess of moisture during this period. On average, depending on the seeding rate of the vetch in its pure form the increase from germination to flowering is 30.8 cm, from flowering to ripening 21.2 cm.

Depending on the seeding rate the growth energy of a vetch is 0.70-0.82 cm / day. At the same time the higher the rate is, the lower the daily increase ($r = -0.83 \pm 0.32$). As a result the height of the vetch plant in its pure form is 50.1-58.2 cm (Table 2).

On average, over the three years of research on grain yield all options for seeding rates not only did not have an advantage over the control (14.6 centners / ha), but even significantly inferior to it. With a decrease in the seeding rate to 1.0 and 1.5 million viable seeds per hectare, the grain yield was 2.9 and 2.1 c / ha, respectively. An increase in the seeding rate to 2.5 and 3.0 million viable seeds, as compared with the control variant, also has a negative effect on the grain yield (table 3).

Table 3 - Influence of vetch seeding rates in single-species seeding on its seed yield (c/ha)

Seeding rate (million viable seeds/ha)	seed yield (c/ha)				Deviation from control	% by control
	2006	2007	2010	average		
1,0	12,3	20,2	2,7	11,7	-2,9	80,0
1,5	15,1	20,0	2,4	12,5	-2,1	86,0
2,0 (control)	16,7	24,0	3,1	14,6	-	100,0
2,5	16,2	20,8	2,1	13,0	-1,6	89,0
3,0	14,2	18,9	3,3	12,1	-2,5	83,0
LSD_{05}	1,6	4,7	1,5	1,5		

From an agronomical point of view the norm is considered optimal if it provides the maximum yield per hectare of the main products of a given crop with its high quality and lowest labor and material costs [9]. Our data showed that the optimal rate for Central Yakutia is sowing 2.0 million viable seeds per hectare. However, in order to accelerate the spread of spring vetch in the agricultural regions of Yakutia an increase in the multiplication factor is required [10; 11; 12].

VC. Khramoy [12] believes that for the rapid introduction of new varieties (crops) into production even the reproduction factor within 5-15 is insufficient.

According to our data the multiplication factor of the vetch in the control variant (2.0 million viable seeds / ha) is 16. While decreasing the norm to 1.5 million viable seeds per hectare the multiplication factor rises to 18, while decreasing to 1.0 million - up to 26 (table 4).

Table 4. Seed multiplication factor of vetch

Seeding rate (million viable seeds / ha)	years			average
	2006	2007	2010	
1,0	27	45	7	26
1,5	22	29	4	18
2,0 (control)	18	26	4	16
2,5	14	18	2	11
3,0	10	14	2	9

Thus, for the accelerated seed reproduction of the sawing vetch in the conditions of Central Yakutia we recommend reducing the seeding rate to 1.0 million viable seeds per hectare, which is two times lower than the optimum (2.0 million viable seeds / ha) and sown twice more area with the same amount of seed. Although the yield will be lower, the total collection of seeds from the area will be higher.

Conclusion

On the basis of the research the seeding rates of vetch cultivated for seeds were studied, the dates for the onset of the main development phases were established, the interfacial and daily growth of plants was observed, the seed multiplication factor was calculated for the accelerated reproduction of the vetch sowing in the area of risky farming.

The average duration of the interphase periods of the spring vetch in the weather conditions of Central Yakutia is determined. After sowing seedlings

appear after 12 days; from germination to flowering takes 31 days. The duration of the interfacial period from flowering to the formation of beans is 10 days; from the formation of beans to seed ripening takes 27 days; the growing season from germination to seed maturation lasts 67 days. The period from the date of sowing to ripening is 79 days.

Depending on the seeding rate during the growing season, the growth energy of the vetch is 0.70-0.82 cm / day. It should be noted that the higher the rate, the lower the daily increase.

The optimal seeding rate for spring vetch is 2.0 million viable seeds per hectare. This ensures the maximum yield of seeds - 14.6 c / ha.

The research results proved the fact that for the accelerated reproduction of seeds it is recommended to reduce the seeding rate to 1.0 million viable seeds per hectare in order to increase the multiplication factor. The multiplication factor of the vetch in the control variant (2.0 million / ha of viable seeds) is equal to 16. With a decrease in the norm to 1.5 million viable seeds per hectare the multiplication factor rises to 18. With a decrease to 1.0 million it rises to 26.

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