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An Effective Way to Increase the Yield of Wheat and the Effect of Its Feeding on the Reproductive Qualities of Cattle.

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ABSTRACT

With our studies, first time in the region, have been shown a significant increase of spring wheat yield and improvement of grain quality through the use of narrow-leaved lupine for green manure in the fallow used as a precursor of spring wheat. Our studies have shown filling in sod-podzol medium loamy soil 45-64 t / ha of green lupine mass, 32-44 t / ha of green mass of vetch mixture, inserting of 2.5 t / ha of straw with the adding of a compensating dose of nitrogen allows to significantly increase yields and improve the technological quality of grain of spring wheat. The effect of feeding the germinated grain to first-calf cows on reproductive capacity was studied. It has been established that calves from cows-first-calves, fed with sprouted grain, were born with a higher living weight and later were characterized by high energy of growth.

Keywords: germinated seeds, barley, wheat, reproduction, heifer, first calf cows, repair heifer, weight gain.

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INTRODUCTION

Gross production and grain quality of spring wheat depend on many factors. The most important one, that complexly activates vital functions of agricultural plants on the formation of high yields, is soil fertility, more efficient reproduction of which occurs when biological factors are activated [1].

Such biological factors include the application of organic fertilizers, rational crop rotation, sowing crops on green manure. Unfortunately, in recent years the application of organic fertilizers has been brought to a minimum because of the decline in the number of livestock. It is insufficient for the reproduction of soil fertility [2].

It is well-known that a sufficiently high content of nitrogen is necessary for the formation of high-quality spring wheat grain. Perhaps, that is the reason why traditionally used intermediate crops do not have an effective impact on the yield and quality of spring wheat in our conditions.

In our place independent sowing for green fertilizers is used, mainly, for winter crops. Green manure crops like rape and mustard plants, oil radish, vetch have time to accumulate a small green mass during intermediate sowings. In order to effect the fertility of poor sod-podzolic soils radically and to obtain a significant increase in the yield of spring wheat, much more high-protein green manure mass should be inserted into the soil than it can be obtained during intermediate sawing. We have chosen narrow-leaved lupine as the most common high-protein green manure culture for studying [3].

Another important factor in the biologization of agriculture is straw. In our conditions the most common precursor of spring wheat is winter rye, the straw of which may be put into the soil as a fertilizer [4].

Over the years of studying, we determined a close positive correlation link between the yield of spring wheat and the insertion of mineral fertilizers. The influence of nitrogen fertilizers on the improvement of grain quality indicators is also well known. At the same time the use of increased doses of nitrogen fertilizers causes lodging of spring wheat that, as the result, significantly reduces the yield of it and worsens the quality of grain. Along with this, two factors should also be mentioned: the increase in the cost of grain and the fact that the applied mineral fertilizers are also used by weeds efficiently [5].

Separate technologies, similar to our researched ones, are studied widely and at the same time they all are for the specific natural and climatic conditions of the country. The novelty of our research is the use of narrow-leaved lupine and vetch-oat mixture for green fertilizer as a precursor of spring wheat independent crops.

Studies of reproductive signs of dairy cattle, and their mutual influence, are devoted to the work of many Russian researchers [6]. The results they obtained are somewhat contradictory and allow us to state that for each individual livestock they can be different, which is influenced by many factors such as breed, productivity, feeding and maintenance conditions, and the organization of herd reproduction [7].

The high value is fed to the germinated grain to normalize the reproductive function of the cows. The use of sprouted grain will make it possible to replenish the ration of agricultural animals with vitamins, enzymes and minerals [8]. In addition, the composition of the germinated grain includes natural antioxidants, which contribute to the reduction of oxidative processes in the body, ensure high safety of young animals, increase of live weight, general resistance and productivity of farm animals [9].

The use of natural antioxidant drugs is an effective stimulator of the reproductive function of cows. Inclusion in the ration for cows in the period from calving to hunting in the preparation of VZKAPS, which includes wheat germ, contribute to increasing their fertility.

MATERIALS AND METHODS

Scientific researches on the topic "Ecologically balanced technology of grain production of spring wheat in the Republic of Mari El" have been made since 1996. For such a long period, numerous field experiments were conducted: on the study of seeding rates, methods of presowing and basic tillage, the influence of humic fertilizers, growth stimulators, precursors, and green manure crops on yield and grain

quality. In recent years, we have been studying anti-stress high-yield agriculture technology. Based on the results of our studies and observations, the most significant impact on the yield and quality of spring wheat was provided by green manure crops, therefore, the results of studies on the influence of predecessors on yield and grain quality conducted in 2002-2005 are considered in this paper.

Experimental studies were carried out on the experimental field of the Agrarian Technological Institute of Mari State University on soddy-weakly podzolic medium loamy soil in the arable layer of which humus was contained - 1.5-2.0%, P_2O_5 - 20.6-25.6, K_2O -10.3-15.6 mg per 100 g soil, pH_{sol}-5.9 – 6.2. Mineral fertilizers were placed under the presowing treatment. Field experiments were carried out according to the scheme: 1- winter rye, without fertilizers (control); 2- green manure lupine fallow (45-64 t / ha of green mass of narrow-leaved lupine in the phase of gray beans); 3 - green manure vetch-oat fallow (32-44 t / ha of green mass); 4- winter rye + insertion of N_{77-90} P_{29-34} K_{10-14}, calculated for obtaining the planned yield of 3 t / ha; 5- winter rye + insertion of fertilized chopped straw of winter rye (2.5 t / ha) with the adding of a compensating nitrogen dose at the rate of 10 kg on 1t of straw.

Every year, phenolic observations of spring wheat sowings were made, the leaf area was determined by the phases of the development of spring wheat, the weediness of crops during the shoots and before harvesting was studied. Harvesting of spring wheat grain was carried out in a continuous way by a combine harvester. The mass fraction of raw gluten, vitreousness, character were determined from the grain quality indicators by conventional standard methods. The research was carried out using the conventional and standard analysis methods. The scientists determined moisture content, sensory parameters, gluten quantity and quality, foreign impurities and foreign grain content in the original grain. It was cleared of mineral and organic impurities by washing in running water. Metallomagnetic impurities were removed with the help of the magnet. Main controlled factor of damp sprouted grain was the existence of embryo root of not more than 5mm for 90% of grain. A series of trials for getting dry sprouted wheat grain was carried out in the vacuum drying plant with infrared heating VDSU-2M. The suitable parameters of drying the sprouted wheat grain were selected within the heaters' temperature range of 40-100 ℃ and the pressure of 15kPa inside the drying plant. Infrared heaters' temperature and the layer of sprouted wheat were controlled using copper resistive temperature transducer with cable selection DTS 014-50M.V.3.20/3 established on heaters and inside the grain layer. As for specifications, temperature measuring range was from -50℃ to +150℃, error in measurement was ±0.25℃. The main reason of conservation method of sprouted grain involves the influence of different environmental factors, as well as pathogenic microorganisms' activity. One of the ways to remove the factors mentioned is sprouting and the subsequent drying inside the drying plant.

By the principle of pairs-analogues, 3 groups of 15 heads (control and 2 experienced) of black-motley breeds were formed on the 6-7 month of pregnancy.

The control group received the main diet, the animals of the first test group were given an equivalent in terms of energy nutrient replacement of a part of grain concentrates with wheat germinated in quantity of 25%, for animals of the second test group - 25% of the germinated barley grain. Feeding of the germinated grain was carried out during the entire period of research, beginning with a deep pregnancy and until the end of lactation.

The reproductive capacity of the first-calf cows was studied according to the criteria determining fertility: age at the first hotel, duration of the service and dry period, duration of the period between the periods and the insemination index. The growth and development of the young was obtained by weighing at birth until reaching the age of 6 months. According to the live mass data at different periods, the absolute, average daily and relative increments were calculated. The data obtained were processed biometrically on the basis of generally accepted statistical methods.

RESULTS OF RESEARCH

On average, during 3 years of research, the maximum yield was obtained for the lupine fallow (3.03 t / ha) and for applying calculated doses of mineral fertilizers by 3 t / ha (2.8 t / ha). Compared with the control point, the grain rise was 0.9 t / ha for lupine and 0.86 t / ha for mineral fertilizers.

The increase in yield was also significant when the vetch-oat mixture or straw were added to the green fertilizer.

The size of the crop is formed with productivity elements, including the density of productive stems for harvesting, grain size, the mass of 1000 grains and the productivity of the ear. In our research a significant increase in yields to 3 t / ha on the variants with green manure fallows and when NPK was applied is provided by an increase in grain size and ear productivity.

Table 1: The Influence of predecessors on productivity and quality of spring wheat grain (average values for three years)

Predecessors	Productivity, t / ha	Protein, %	Natura, g/l	Mass Share of raw gluten,%	Size and aligned-grain,%
Winter rye (control)	2,13	14,1	686	23.8	79,0
Lupine syderat	3,03	17,7	743	30.9	90,0
Vetch-oat siveret	2,82	17,2	724	29.1	88,0
Winter rye + NPK for 3 t / ha	2,99	17,6	743	32.8	87,0
Winter rye + straw and N10 for 1 t of straw	2,54	15,6	707	27.3	85,0
HCP_{05}	0,039	0,57	6.11	1.08	2,12

The studied factors had a significant effect on the grain size of the ear. At the control point there were 20 pcs from one ear, with the investigated variants - 23-31 pieces. The productivity of the ear on average varied within 0.63 – 0.99 g during these three years. The mass of 1000 grains with the lupine green manure was 38.8 g, while with NPK on 3 t / ha - 38.0 g, which is 5.9-5.1 g more than in the control version. A significant increase (by 4.2 g) in the mass of 1000 grains occurred with the vetch-oat green manure.

While growing wheat grain, along with the yield value, its high technological quality, determined by a wide range of indicators, is also very important. These indicators are nature, the mass fraction of gluten and its quality, etc.

A similar pattern was found in the analysis of indicators of nature and gluten. With the lupine green manure fallow and the insertion of calculated doses of mineral fertilizers, the nature was 743 g / l, with the filling of the vetch-oat mixture - 724 g / l (for grades 3-4, must be at least 710 g / l, for higher and 1 -2 classes - not less than 730 g / l). At the control point (686 g / l) and when straw (707 g / l) was inserted the nature was lower than the requirements for the standard for grain of the 3rd and 4th grades.

The largest mass fraction of raw gluten (32.8%) was obtained by inserting calculated doses of mineral fertilizers, slightly less - by lupine (30.9%) and vetch-oat (29.1%). Gluten content is significantly lower in the wheat grain of the control variant (23.8%) and with the inserting of straw (27.3%).

An important indicator is the grain size and grain leveling. Large grains have higher specific gravity endosperm, hence higher and protein and gluten content. According to the largest total mass of grain on two adjacent sieves, in percentage to the initial sample weights are divided into three groups: high - more than 80%, medium - from 70 to 80%, low - less than 70%. In our studies, the factors studied had a significant increase in the level of grain grain equalization in comparison with the control by 6-11%. This fact is explained by the fact that with the introduction of mineral fertilizers and the sideral pairs, the grain evenly ripens on the main and lateral shoots of spring wheat.

It should be noted that the beneficial effect of green manure fallows on the formation of spring wheat yield is achieved through the implementation of the basic principle of the biologization of agriculture - the full provision of cultivated plants with nutrients through the activation of organisms that inhabit the soil. In our experiments, after plowing of narrow-leaved lupine into the soil, the intensity of cellulose decomposition

under spring wheat was 44.4%, after a vetch of a mixture of vetch-35.3%, straw -34%, mineral fertilizers - 25.9%, while at the control point 17-19%.

Using independent green manure for spring wheat, economic expediency is important. The results of our studies showed that the use of lupine and vetch oat green manure for spring wheat is economically profitable.

Sprouting was carried out inside the drying chamber at the temperature of +40 and atmosphere pressure favourable for the vital processes in grain. 2cm layers of grain were located on the pans inside the drying chamber which was conditioned by the peculiarities of the drying plant. Then the grain was dowsed with pure drinking water and left for 24 hours. A series of trials for sprouting included 9 experiments. The controlled parameter was the existence of 3-5mm embryo root for 95% of grain. 24-hour period for sprouting was selected by using this method, at the same time temperature inside the grain layer did not exceeded 25-26 ^{O}C. Then the grain was dried. When drying grain in the fixed layer the temperature of drying agent should not exceed the definite value. Basing on the data received by other scientists the researchers chose the parameters maintaining the temperature of grain mass of not more than +50 ^{O}C, the pressure inside the drying chamber was 15kPa [5]. The use of the drying method consisted of 3 periods: period of material heatup, period of constant drying rate, and period of falling drying rate. When moving from period to period, grain mass moisture factors were changing, thus, grain sensibility to heating was increasing from period to period. In this technology zero degree limits of protein denaturation were basic ones, as dried sprouted grain should continue its growth during the subsequent sprouting, hence, it should stay 'sleeping' after drying.

The drying plant presented in Figure was used for sprouting and drying.

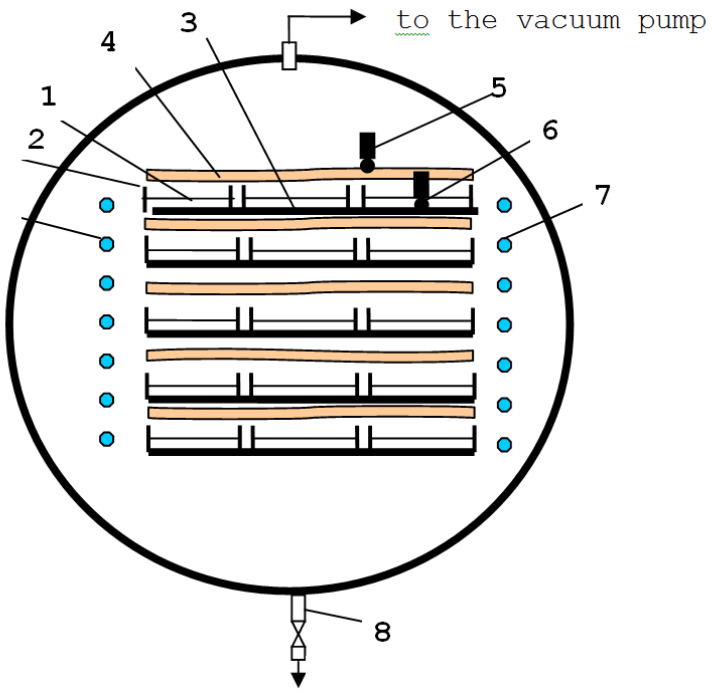

Figure: The diagram of vacuum drying plant with infrared transmitters VDSU-2M

Specifications of the drying plant VDSU -2M:

- number of shelves – 14 pcs
- number of pans loaded at the same time– 112 pcs
- overall dimensions of pans – 35x440x540 mm
- total loading of the drying chamber during grain drying – 150 kg
- temperature of infrared heaters – from 30 to 120 ºC
- pressure inside the drying chamber – from 15 to 20 kPa

– total capacity – 15 kW.

At the initial stage the temperature inside the grain layer did not exceed 34. By the final stage the temperature inside the grain layer had increased up to +40, 7 ^{O}C Thus, the following process modes were received:

1st 3-hour stage, heaters' temperature of 80 ^{O}C
2nd 5-hour stage, heaters' temperature of 70 ^{O}C
3rd 15- hour stage, heaters' temperature of 60 ^{O}C

Total drying time did not exceed 24 hours. The executed organoleptic estimate of dry sprouted wheat grain has shown high quality of the proposed products. The index of total antioxidant capacity (TAC) was 37.0mg/100g in comparison with 17mg/100g in wheat grain before sprouting.

On the studied options the conditional net income is by 459-1278 rubles / ha more than at the control option. The maximum net income 2859.49 rubles per unit area was obtained using lupine for green fertilizer. It should be noted that the green manure fallow is considered more profitable economically compared to the NPK addition of 3 t / ha. Analysis of production costs shows that the high cost of mineral fertilizers increases the amount of costs significantly. The conditional net income for the use of lupine and vetch oat mixture for green fertilizer increased by 264.2 - 683.8 rubles / ha compared to the NPK addition of 3 tons / ha. In connection with the high costs associated with the use of mineral fertilizers, this option shows the lowest profitability - 32.0%, in options with green manure it was 40.5 - 45.9%. It should be noted that the use of straw with the inserting of a compensating dose of nitrogen 10 kg ai. per 1 ton of straw is effective both for increasing the productivity of the plant and for the profitability of wheat production. Thus, the use of lupine and vetch oat green manure is as effective for the productivity of spring wheat as the adding of mineral fertilizers with the calculation of grain production of 3 tons / ha.

Reproductive capacity is one of the main factors ensuring the profitability of dairy cattle (table 2).

Table 2: Reproductive qualities of first-ancestral cows

Indicator	Group		
	Control	I experienced	II experienced
Age at the hotel, m.	25,9±0,7	25,7±0,6	25,9±0,9
Inter-period, days	388,9±5,9	376,0±4,5	372,0±5,5
Service period, days	124,6±3,6	109,3±4,5**	113,7±3,8*
Dry period, days	61,3±1,3	60,3±0,5	59,8±1,1
Insemination index	1,5±0,04	1,2±0,03***	1,4±0,03*

An analysis of the reproductive qualities of the first class cows in the study groups showed that the use of sprouted grain was a factor in the positive effect on the duration of the service period and the insemination index. According to Table 2 it can be seen that the shortest service period was found in the animals of the 1st test group (109.3 days), which is lower by 15.3 days or 12.3% ($P \leq 0.01$) than in the control group; II trial - for 4.4 days or 3.9%. From the service period, in turn, depends on milk production. The duration of the inter-hospital period was 388.9 days to 372.0, while the difference in these indicators for groups is not reliable. The use of germinated grains had a positive effect on fertilization. The best insemination index in animals of the 1st experimental group was 1.2, which is significantly lower than the control group analogs by 0.3 ($P \leq 0.001$).

The reproductive qualities of cows include the live calf mass at birth, which characterizes the passage of the period of pregnancy and viability of the offspring.

The use of sprouted grain in the dead-aged period affected the live weight of calves, both at birth and in other age periods (Table 3).

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Table 3:- Dynamics of live weight of experimental calves

Indicator	Группа Group		
	Control	I experienced	II experienced
Average daily gain, g	33,9±0,22	35,5±0,19	34,9±0,20
Live weight in 6 months, kg	172,9±1,42	178,1±1,10	176,6±1,13
Live weight at birth, kg	772±7,14	792,3±5,9	787,1±6,45
Absolute increase, kg	138,9±1,58	142,6±1,06	141,7±1,16
Relative increase,%	134,4±0,55	133,5±0,39	133,9±0,50

According to the data obtained, calves from the cows of the experimental groups had a large live weight in all age periods in comparison with the control group. The difference was, respectively, in the groups at birth 1.6 kg or 4.7% ($P \leq 0.001$), 1.0 kg or 2.9% ($P \leq 0.001$). It has been established that calves from cows-first-calves, fed with sprouted grain, were born with a higher living weight and later were characterized by high energy of growth.

According to the live mass data, the absolute, average daily and relative increments for the period from birth to 6 months of age were calculated, which showed that for 6 months after birth, the absolute increase in the calves of the 1st test group was 2.7% higher than in the control group, and 2.7% II experienced - by 2.0%. The high energy and the growth rate of the repair telescopes of the experimental groups are also confirmed by the average daily growth, in the first group, 792.3, and in the second group 787.1 g, which is 20.3 g and 15.1 g more than the control group respectively.

CONCLUSION

Thus, green manure fallows and straw are effective and environmentally friendly agricultural practices for the cultivation of spring wheat. Filling in sod-podzol medium loamy soil 45-64 t / ha of green lupine mass, 32-44 t / ha of green mass of vetch mixture, inserting of 2.5 t / ha of straw with the adding of a compensating dose of nitrogen allows to significantly increase yields and improve the technological quality of grain of spring wheat. The data obtained by us testify to the positive effect of the use of sprouted grain in the feeding of cattle on the reproductive capacity and growth of young animals.

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