

## Influence of cultivation background intensification on spring wheat productivity in the subtaiga zone of the Krasnoyarsk Territory, Russia

Victoria Viktorovna Keler\*, Nadezhda Vasilievna Shram

Krasnoyarsk State Agrarian University, 90 Mira Avenue, Krasnoyarsk, Russia

\* Corresponding author's E-mail: vica\_kel@mail.ru

### ABSTRACT

This paper presents the results of studying the role of cultivation background intensification in the formation of productivity and yield structure of spring wheat varieties Novosibirskaya 29, Novosibirskaya 41, Novosibirskaya 15 and Altayskaya 75 in the subtaiga zone of the Krasnoyarsk Territory, Russia. The influence rate of crop rotation steam link using a full range of modern means of protection and fertilization on the elements of the yield structure of soft spring wheat and its variations were determined. The cultivation background providing the greatest positive response in crop productivity formation was also established. New varieties, in comparison with previously zoned ones, are able to use moisture, and also the elements of mineral nutrition and other factors of plant life are more productively. However, there are no universal varieties that are equally suitable for all backgrounds and conditions. Therefore, the identification of the productivity potential, the norms of new variety reaction to intensification factors in modern conditions of climate change, is the most important condition for the development of varietal technologies, improving the techniques and methods of grain crop productivity management. Under the conditions of the subtaiga zone of the Krasnoyarsk Territory, with the intensification of the crop rotation steam link, such productivity elements as the length of the main plant, the length of an ear and the number of spikelets in an ear of the studied varieties of spring wheat vary within weak and medium limits. Their variation coefficient ranges from 2-6% to 16-17%. It is best to intensify such indicators as productive tillering (Cv 14-38%) and the amount of grain in an ear (Cv 11-28%) within this zone. These elements respond well to the control of the phytosanitary state of crops using herbicides, insecticides and fungicides. The varieties of spring soft wheat Altayskaya 75 and Novosibirskaya 41, with the use of pesticides and ammonium nitrate, can increase the grain content of an ear by 2 times (by 17.7 pieces), and the number of spikelets in an ear by 1.5 times (by 5.7 pieces). The varieties Novosibirskaya 15 and Novosibirskaya 29, when applying nitrogen fertilizers and a full range of protective equipment, increase the productive bushiness from 1.1 to 2.2.

**Keywords:** Wheat, Pesticides, Variety, Fertilizers, Predecessors.

**Article type:** Research Article.

### INTRODUCTION

In modern agriculture, a variety is the basis of intensive and energy-saving technologies for crop production (Strizhova 2009; Ghosh *et al.* 2021). In recent years, the methods used to create varieties have been significantly enriched. This ensured the further development of breeding as a science and led to a significant increase and renewal of varietal resources (Koshelyaev 2012; Sharma *et al.* 2020). New varieties receive official recognition due to their advantages in comparison with the corresponding standards for the quantity or quality of products obtained, or for the agronomic indicators of plants, including resistance to diseases, pests, and other leading traits and properties that ensure the improvement of the variety manufacturability (Keler & Khizhnyak 2019; Zulfiqar

*et al.* 2021). In connection with the mentioned above, it can be argued that the analysis of the modern assortment of spring wheat response to the means of intensification is undoubtedly relevant in terms of productivity (Kryuchkov 2012; Mancipe-Munoz *et al.* 2021). The purpose of this study was to study the role of the predecessor intensification in the formation of productivity and yield structure of spring wheat varieties Novosibirskaya 29, Novosibirskaya 41, Novosibirskaya 15 and Altayskaya 75 in the subtaiga zone of the Krasnoyarsk Territory.

The tasks set during the study:

1. To determine the intensification influence of the crop rotation steam link on the elements of the yield structure of soft spring wheat and their variation;
2. Establish the cultivation background that provides the greatest positive response in crop productivity development.

## MATERIALS AND METHODS

The experimental part of the work was carried out on the basis of "Wet Elnik" LLC, Dzerzhinsky District, Krasnoyarsk Territory in 2018-2019. The aims of the study were to examine the varieties of soft spring wheat Novosibirskaya 15, Novosibirskaya 29, Novosibirskaya 41 and Altayskaya 75, included in the State Register of Breeding Achievements of the Russian Federation and admitted to cultivate in the Krasnoyarsk Territory.

LLC "Wet Elnik", where the experience was laid, is located in the subtaiga zone of the Krasnoyarsk Territory, Russia. The seeds were sown on May 20 by a rate of 6.0 million crops/ha after the obligatory pre-sowing dressing with the preparation "Oplot" at a working fluid consumption of 10 L ton<sup>-1</sup>. The soil of this station is gray forest one, the total area of the plot is 12 m<sup>2</sup>, the accounted one is 10 m<sup>2</sup>, the replication is four times. The results of soil analysis: the reaction of the pH medium of the salt extract is 6.0. Nitrate nitrogen content is low (7.2 mg kg<sup>-1</sup>), mobile phosphorus content is high (244.0 mg kg<sup>-1</sup>) and exchangeable potassium content is high (266 mg kg<sup>-1</sup>). Ammonium nitrate (34.4%, application rate - 70 kg per ha) was used as a fertilizer, based on the results of agrochemical analysis. Application term - pre-sowing cultivation. The introduction of phosphorus and potassium was not required according to the results of soil analysis. During the growing season, the crops were treated with modern means of protection: Puma Super 100, SC 0.6 L ha<sup>-1</sup>; Prozaro Quantum, EC 0.6 L ha<sup>-1</sup>; Decis Expert, EC 0.125 L ha<sup>-1</sup>; Ultramag Profi 2 L ha<sup>-1</sup>. Phenological observations, assessment and accounting were carried out in accordance with the "Methodology for state variety testing of agricultural crops." To solve the tasks set for the study, the materials of field experiments and laboratory analyzes were processed by the methods of mathematical statistics using a standard Excel package.

## Statistical analyses

The SPSS 20.0 program was used to analyze the results by ANOVA test, this test shows the presence or absence of significant differences in the studied variables. Experimental data were processed on the basis of the methods of mathematical statistics (Adedji 2020; Dospekhov 2011). Analysis of variance and regression was carried out in MS Excel.

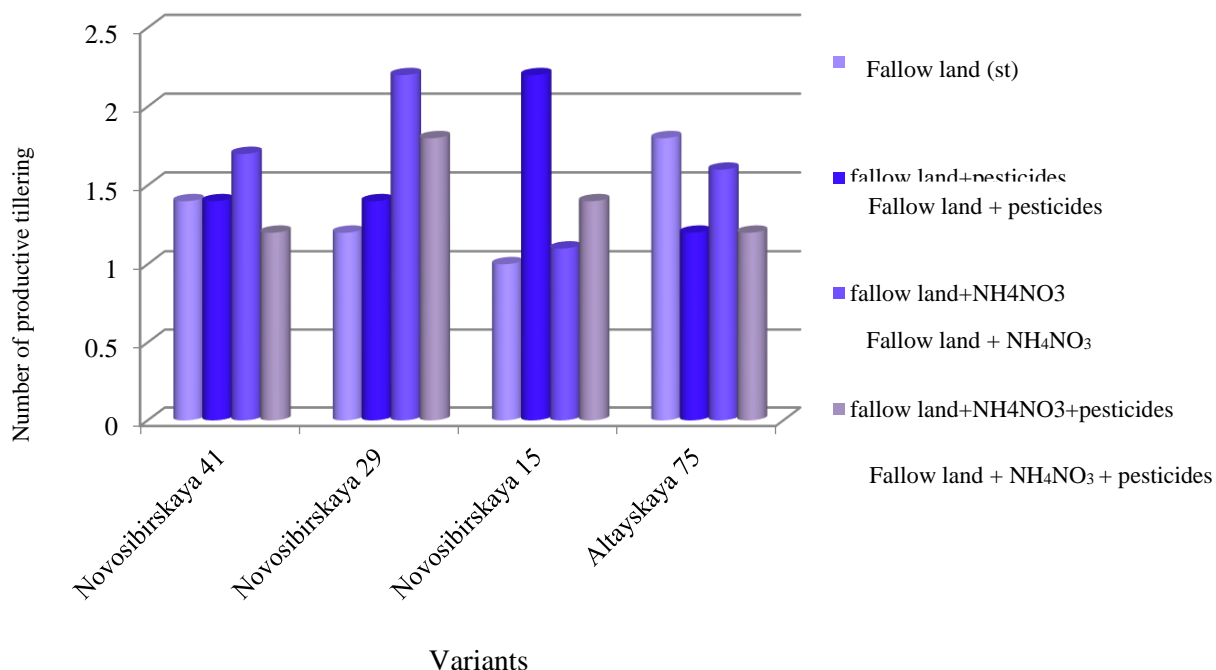
## RESULTS AND DISCUSSION

By assessing the elements of the yield structure, it was found that the productive tillering varied on the steam predecessor in the Novosibirskaya 15 variety from 1.0 to 2.2 when using the full range of pesticides (Fig. 1). The greatest response to the application of the studied elements of technology was obtained from the productive tillering indicator in the Novosibirskaya 29 and Novosibirskaya 15. Noteworthy, the use of nitrogen fertilizers alone did not increase the indicator significantly, only by 0.1-0.2 units. This is due to the crop weediness increase and the inhibition of cultivated plants (Motavalli *et al.* 2008; Zheng *et al.* 2016). As shown in Fig. 2, the length of the main plant varies insignificantly: from 86.7 to 104.5 cm reaching the highest value at the maximum healthiness of the Novosibirskaya 41 (104.5 cm). However, this is rather a negative effect, since long stems are more prone to lodging, which is inevitable under unfavorable autumn weather conditions in Siberia (Keler 2007). The length of the main spike varied between 5.8 and 9.4 cm (Fig. 3). It was found that this indicator changed the least in the Novosibirskaya 41 and Altayskaya 75 varieties. It can be assumed that it has genetic stability; the application of fertilizers and the use of plant protection products in these varieties do not increase it (Gilden *et al.* 2010; Hossard *et al.* 2014). The Novosibirskaya 29 variety, both with fertilization and with application of plant protection products, increased the length of the main spike by 1.3 cm (18.8%). The use of a set of measures showed

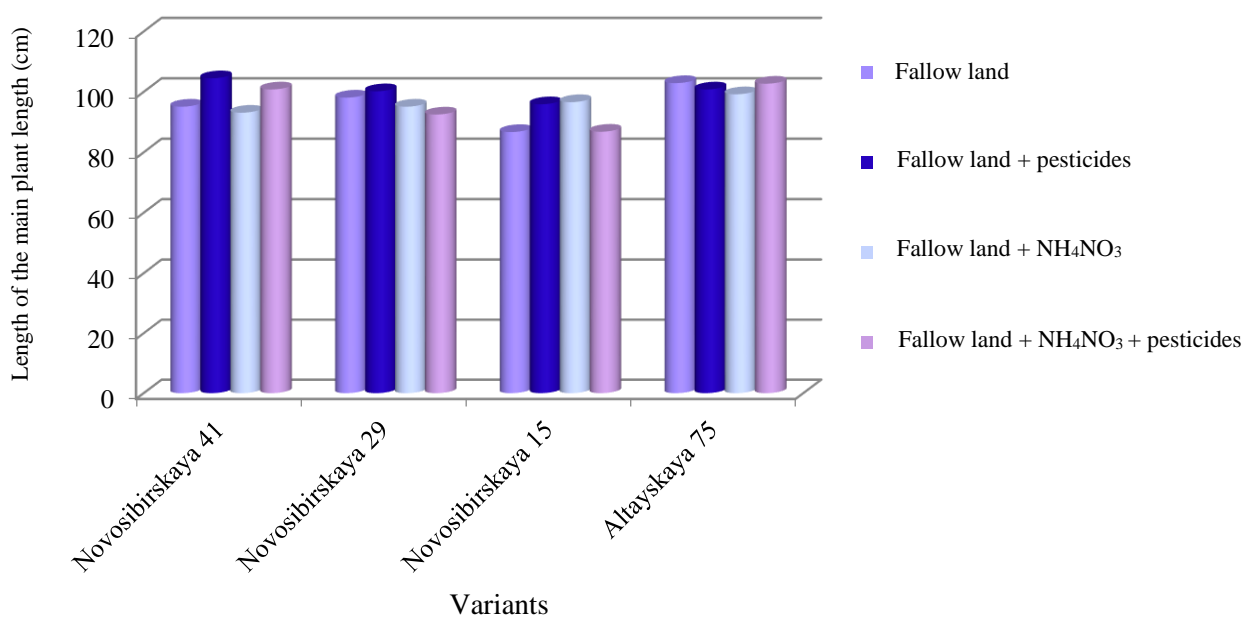


approximately the same results. Therefore, by financial tension in the economy, one can make a choice in favor of pesticides to control the number of pathogens and weeds (Nawaz *et al.* 2020; Russell *et al.* 2020).

Novosibirskaya 15 variety showed the increased ear by 2.3 cm (39.7%) using the full range of remedies. Fertilization did not have such an effect. The number of spikelets in an ear for all variants of the experiment was in the range of 10.1-16.2 pieces (Fig. 4). The largest number of spikelets in an ear was formed in Altayskaya 75 using chemical protection agents (16.2 pieces), while the least number in Novosibirskaya 15 without intensification (10.1 pieces). It was found that the number of spikelets is increased in an ear by 1.5 times in Altayskaya 75, compared to control.

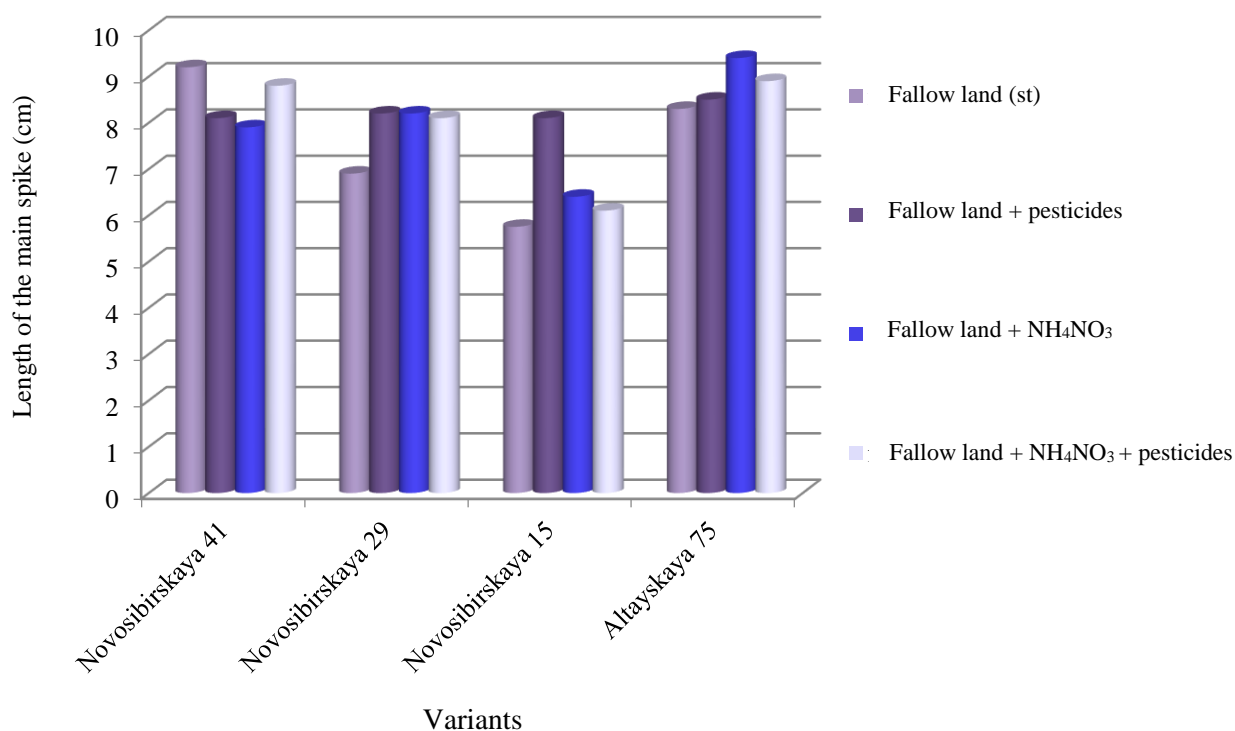


**Fig. 1.** Variations in the productive tillering of various varieties of spring bread wheat, depending on the use of intensification elements.

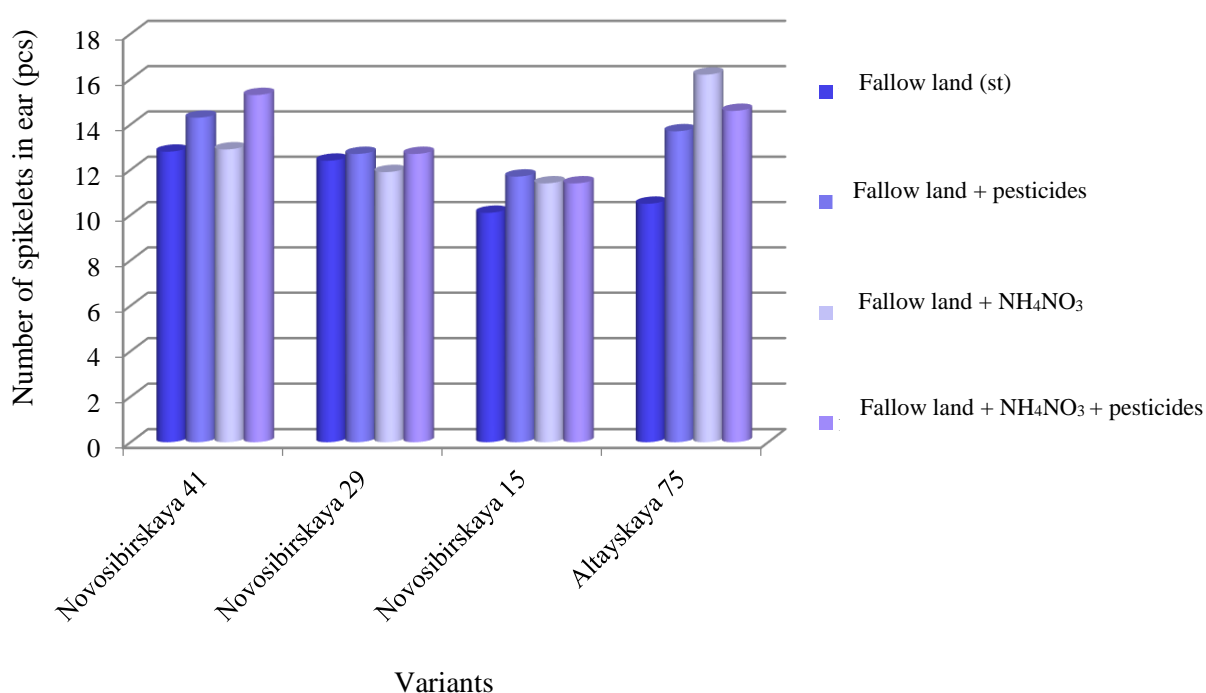


**Fig. 2.** Variations of the main plant length (cm) of various varieties of spring soft wheat, depending on the use of intensification elements.





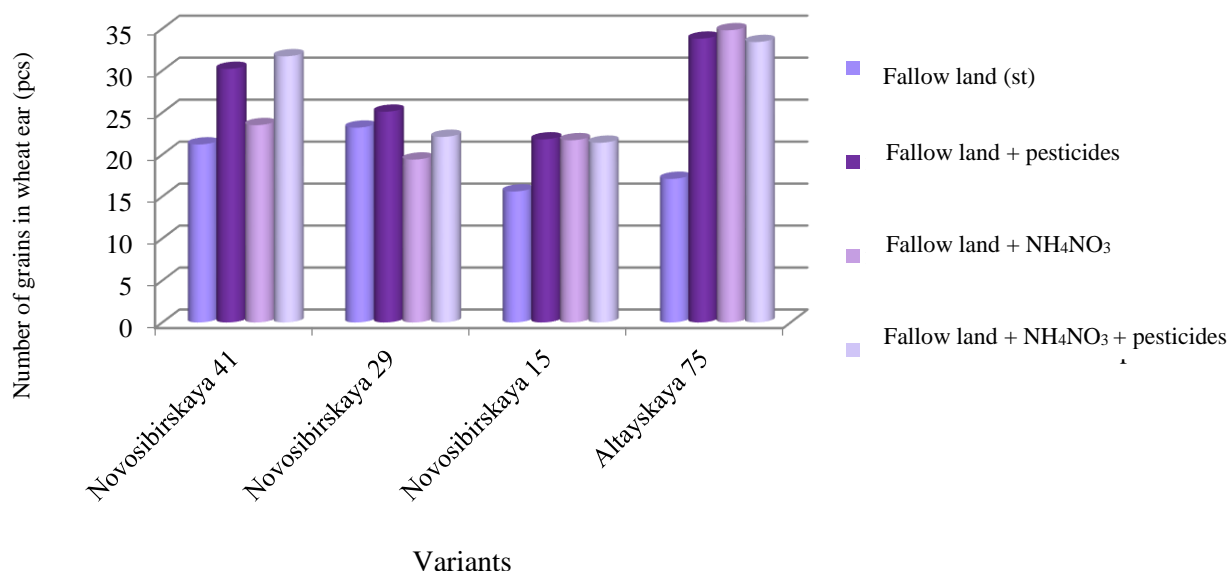
**Fig. 3.** Variations in the main spike length (cm) of spring soft wheat different varieties, depending on the use of intensification elements.



**Fig. 4.** Variations in spikelet numbers (pieces) in an ear of different varieties of spring soft wheat, depending on the use of intensification elements.

The amount of grain in an ear is a trait that varies widely from 15.6 to 34.8 pieces (Fig. 5). A significant increase of wheat grains in the Novosibirskaya 15 was recorded with all intensification options. The grain content increased by more than 6 grains both by the introduction of pesticides and fertilizers, both separately and in combination.

When using remedies, the Novosibirskaya 41 increases the amount of grain by almost one and a half times (by 9 pieces), which also entails yield increase. The maximum number of grains in this variety is achieved using a set of measures. It was found that the amount of grain in an ear doubled by fertilization (by 18 pieces), using pesticides and via the complex of these measures (by 95.3%) in Altayskaya 75. Consequently, the grain yield of the studied variety using intensification elements can also be doubled.



**Fig. 5.** Variations of grain number (pcs) in an ear of spring soft wheat depending on the use of intensification elements.

Two-sample t-test showed that statistically significant ( $p < 0.01$  and  $p < 0.001$ ) differences were found between the options "pure fallow" and "intensification" among Novosibirskaya 15, Novosibirskaya 29, Novosibirskaya 41 and Altayskaya 75 between all intensification elements with productive bushiness and the number of grains per ear. The Altayskaya 75 variety also reliably increases the number of spikelets in a spike when using a complex of modern protection means.

## CONCLUSION

1. Under the conditions of the subtaiga zone of the Krasnoyarsk Territory, by the intensification of the crop rotation steam link, such productivity elements as the length of the main plant, the length of an ear and the number of spikelets in an ear within the studied varieties of spring wheat vary within weak and medium limits. Their variation coefficient ranged from 2-6% to 16-17%. It is best to intensify such indicators as productive tillering (V 14-38%) and the amount of grain in an ear (V 11-28%) within this zone. These elements responded well to the control of the phytosanitary state of crops using herbicides, insecticides and fungicides.

2. The varieties of spring soft wheat including Altayskaya 75 and Novosibirskaya 41, using pesticides and ammonium nitrate, can increase the grain content of an ear by 2 times (by 17.7 pieces), and the number of spikelets in an ear by 1.5 times (by 5.7 pieces). The Novosibirskaya 15 and Novosibirskaya 29 varieties, once applying nitrogen fertilizers and a full range of protective equipment, increase the productive bushiness from 1.1 to 2.2.

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