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Baseline Maps of Autumn Wheat Yield using Geographic Information Systems for The Samtskhe-Javakheti Region

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ABSTRACT

In food production, not only the level of production but also its quality indicators are of great importance. The quality of wheat grains depends on the variety, climatic conditions and cultivation technology. Agro-climatic conditions affect not only wheat yield but also grain quality.

In studying the timing of sowing of the wheat crop, we tried to determine the effect of sowing timing and climatic conditions on wheat yield and quality. The vegetation period of wheat was characterized by different natural-climatic conditions, which were manifested by the drought of autumn and the sharp variability of high temperatures in spring.

The study used wheat varieties common in the region: Tbilisi 15, Red Doli bread of Akhaltsikhe and Sauli 9. On the content of chemicals in grains, we conducted an experimental study.

Phenological observations were made during the vegetation period: emergence, recording, pruning, plant resistance to dormancy, disease resistance.

As a result of the analysis of the research, we found:

- Based on the data obtained from the studies, we can say that the optimal sowing date of wheat in the Samtskhe-Javakheti region is 1-15 October.
- Previously, the optimal sowing dates were considered September 15-October 15. The data we obtained convinced us that wheat sown in September had significantly lower yields than wheat sown in early October (8%, 11%, and 20%). Delayed sowing after October 15 reduces crop yields by 65-75%.
- It is important for farmers to reduce the optimal sowing time, which means that sowing should be carried out in a short time, 10-15 days.
- Taking into account the optimal dates of wheat sowing in the Samtskhe-Javakheti region will allow us to dramatically increase the yield.

In addition, the results of the experiment showed that the quality and yield of grain depend on the dates of sowing, as well as the biological characteristics of the variety, soil-climatic and agrotechnical conditions.

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KEYWORDS: Wheat, Sow Dates, Wheat Quality, Crop, Grain Species Biology.

INTRODUCTION

Special attention is paid to cereal production because cereals are the basis of food security. Scientific research and available materials have established that Georgia is distinguished by the abundance of special, unique endemic species of wheat [1; 2; 5]. The currently changed climatic conditions have forced a review of such an important agronomic event as sowing dates. Equal crop emergence depends on the right sowing date, its normal development from the autumn, and successful overwintering. A significant deviation in either direction negatively affects the yield, for this it is necessary to strictly observe sowing dates of winter wheat.

According to the National Statistics Office of Georgia, local wheat production in Georgia has been very unstable in recent years, and the dynamics of sown areas are

characterized by a downward trend [3; 4]. The development of soil-climatic conditions and adaptive elements of technology in the region is one of the main factors in the stable production of wheat and high-quality grain in the Samtskhe-Javakhet region. Sowing dates are important since one of the main drawbacks of agriculture in the region is a short growing season, which limits the agro-climatic resource.

THE AIM OF THE STUDY

The study aimed to determine the effect of sowing dates on the yield, development, and quality of winter wheat in Samtskhe-Javakheti and to determine the optimal sowing dates for winter wheat in Samtskhe-Javakheti.

THE OBJECT OF THE STUDY

Our study examined crop yields as a function of sowing dates in the Samtskhe-Javakheti zone in 2017-2019. The experiment was conducted in Akhaltsikhe, on the experimental plot of the Samtskhe-Javakheti State University. We took three wheat varieties as research material: local variety - "Akhaltsikhe Red Doli" Triticum aestivum var. ferrugineum Alef, promising variety of winter wheat - "Tbilisi 15" and "Sauli 9", Triticum aestivum "Sauli 9".

Proper sowing date is one of the prerequisites for high wheat yields. Unfavorable meteorological conditions in autumn (little precipitation), winter, and early spring lead to thinning of autumn crops and often to their complete death [2; 6; 8].

METHODOLOGY OF THE STUDY

For our study, we chose four sowing dates: 20/09; 01/10; 10/10; 20/10, each of which was repeated four times. During the growing period, observations and records were made: sprouting, breeding, overwintering, flattening, spiking, flowering, ripening. Yield indicators were processed by the statistical analysis method. [7].

STUDY RESULTS AND ANALYSIS

It has been scientifically proven that when sown at the optimal time, wheat develops a strong root system, gives three to five seedlings, easily copes with winter cold and winters without losses, with a good and strong root system in the spring and moisture stored in the soil during the winter, wheat seedlings grow quickly and easily withstand spring drought and can produce a good crop even without rain or irrigation [2; 9; 10]. Delayed sowing significantly reduces yields, the plant does not keep up with growth and development, the root system remains underdeveloped and has no buds, such a seedling does not keep up with the second sprouting and the field remains sparse.

The results of the study of winter wheat yield indicators for the four main sowing dates are shown in Figure 1. Under the influence of the main indicators of productivity, crop yields also change depending on the sowing dates.

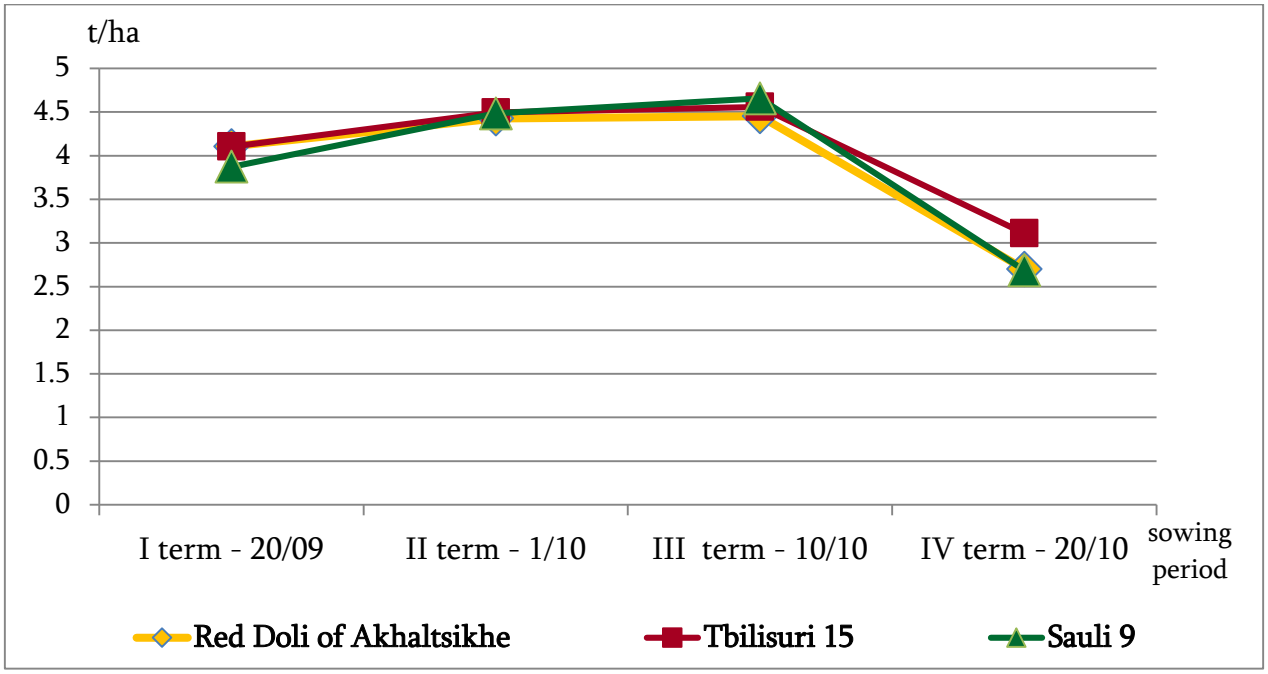

Figure 1. Effect of sowing dates on winter wheat yields (t/ha) in the Samtskhe-Javakheti region, 2017-2019.

Analysis of the data in the figure shows that the average yield of all three wheat varieties was the highest at the second and third sowing dates.

One of the tasks of the study was to create a series of basic geographic information maps by sowing dates for each variety. The GIS software product ArcGIS was used for this task. Based on these research results, geoinformation maps of the Samtskhe-Javakheti region were constructed for each of the winter wheat varieties (Akhaltsikhe Red Doli, Tbilisi 15, Sauli 9) at all four sowing dates (I date- 20/ 09; II

date - 01/10; III date - 10/10; IV date - 20/10). The maps are shown in Figures1-3.

Figure 2 shows four maps that allow us to characterize the productivity of the Akhaltsikhe Red Doli in all four sowing dates. As shown, the maps in the drawing are colored from light to dark, hence the yield increases from light to dark. The same is true for Figures 3 (Tbilisuri15) and 4 (Sauli 9). Each of them shows 4 maps characterizing the dynamics of yields of the corresponding varieties in all four dates of sowing.

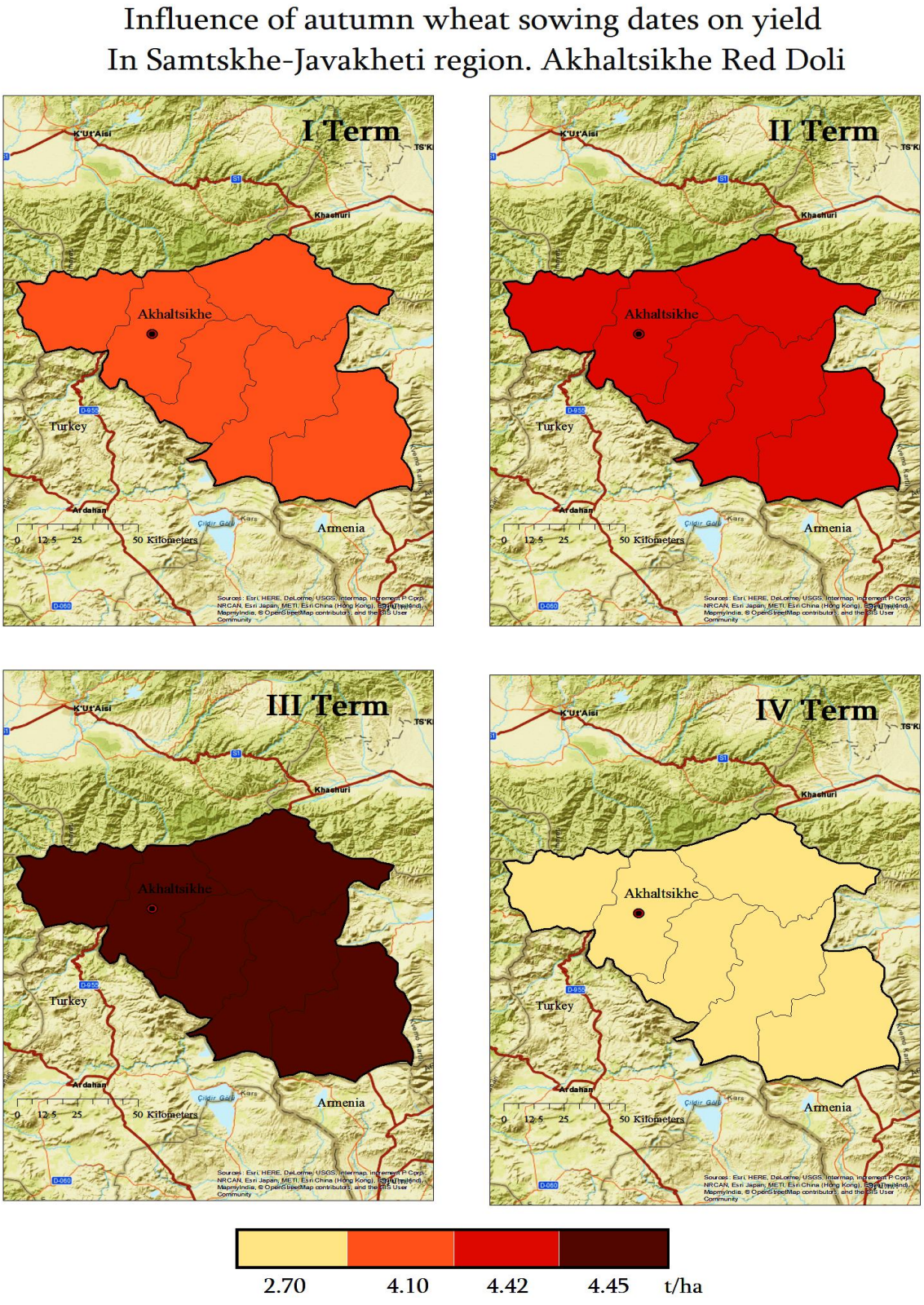

Fig.2. Influence of autumn wheat sowing dates on yield In Samtskhe-Javakheti region. Akhaltsikhe Red Doli, 2017-2019.

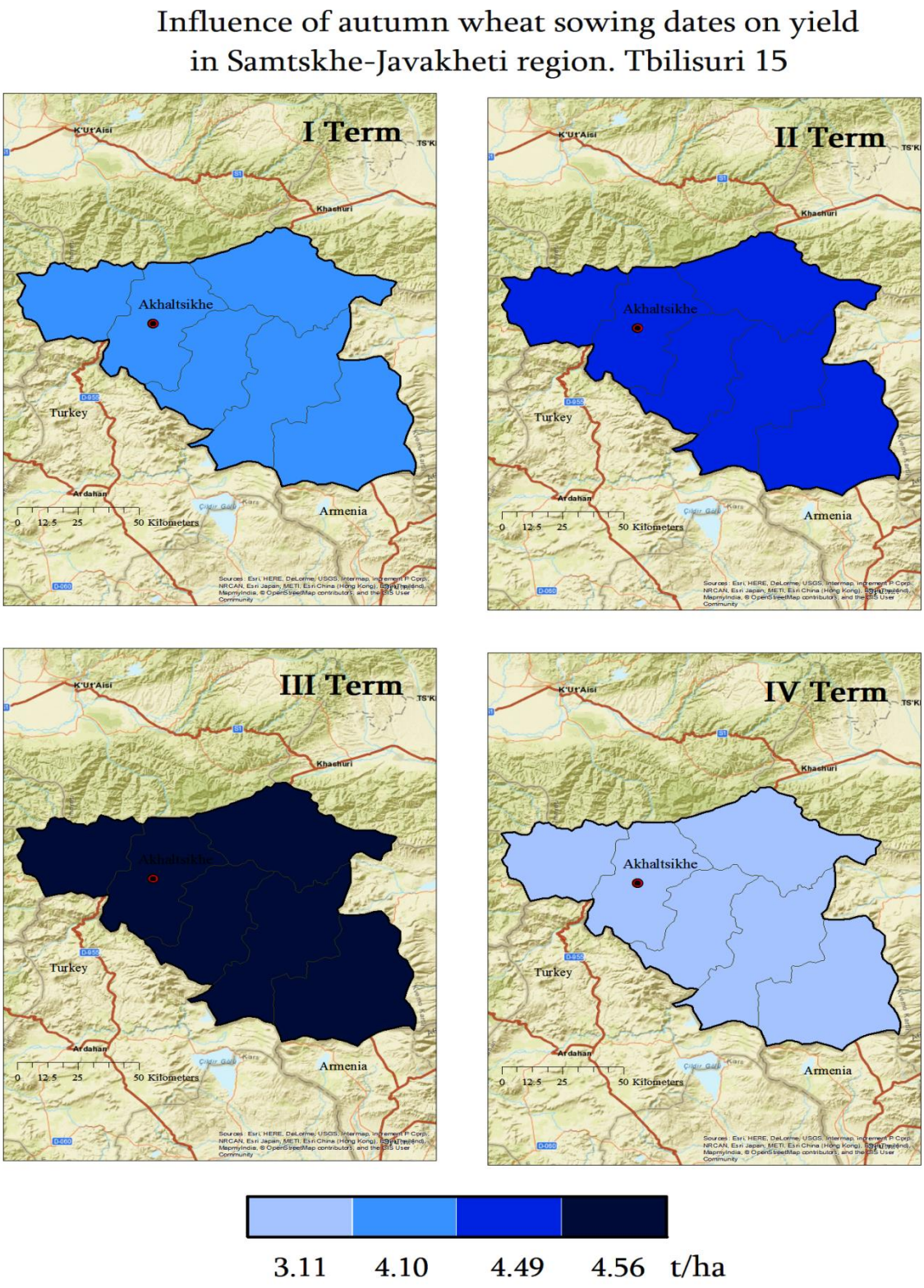

Fig.3. Influence of autumn wheat sowing dates on yield In Samtskhe-Javakheti region. Tbilisuri 15, 2017-2019.

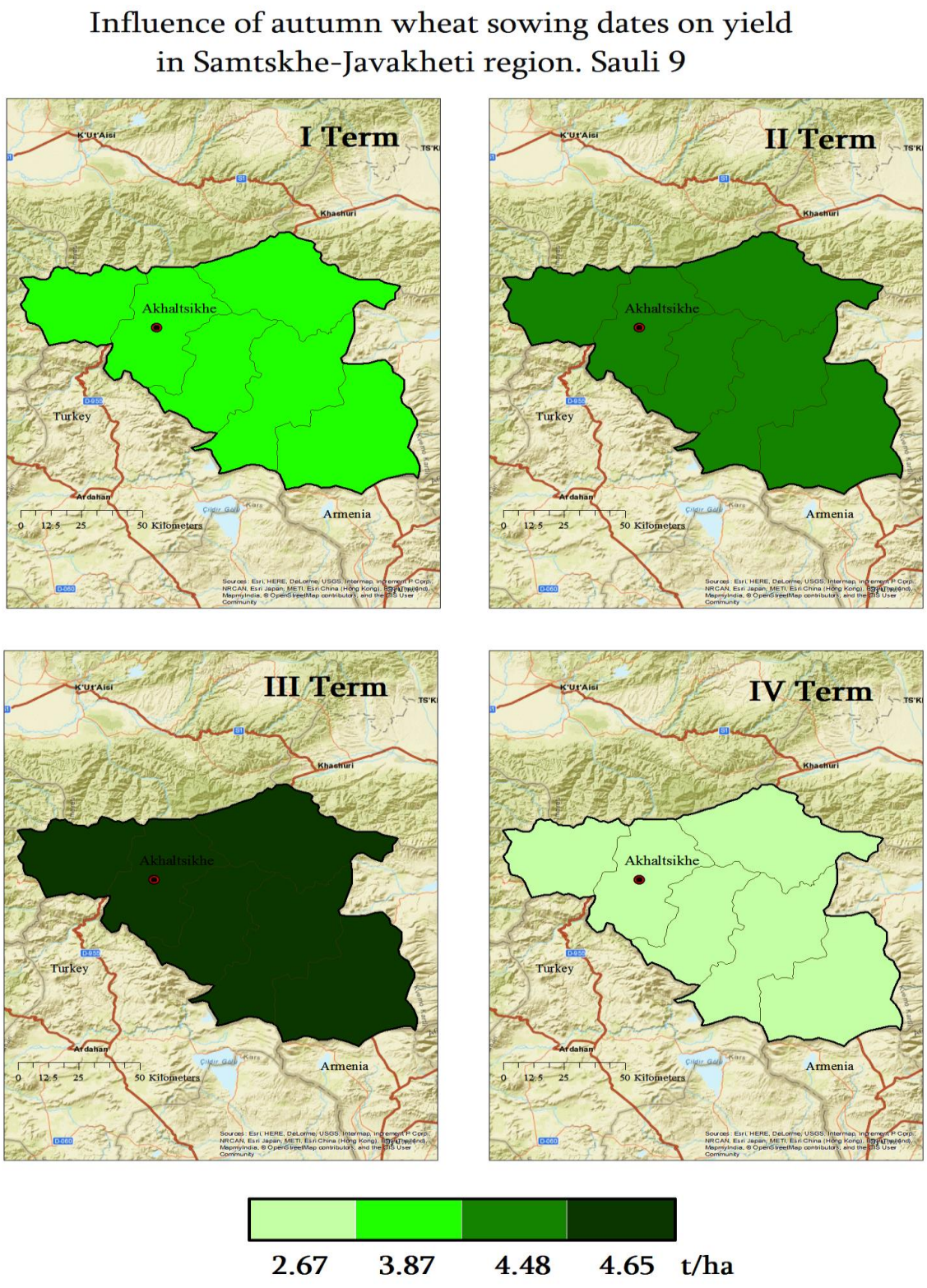

Fig.4. Influence of autumn wheat sowing dates on yield In Samtskhe-Javakheti region. Sauli 9, 2017-2019.

The oldest local variety, Akhaltsikhe Red Doli, is less responsive to sowing dates, although a yield increase of 7-8% is a really good result. Delayed sowing, as expected, significantly reduces yields (65%). The quality of the local variety is high, but delayed sowing dates dramatically reduce the weight of 1000 grains.

Sowing the variety Tbilisuri 15 in the second and third dates is characterized by even higher yields (9-11%) and at the same time, the weight of 1000 grains increases sharply, indicating an increase in its quality and high yield potential. Delayed sowing reduces the yield of this variety by 75%.

Sauli 9 is more resistant. The second and third sowing dates give a significant yield increase (15-20%) but delayed

sowing increases the losses by 69%, and, as in the case of Akhaltsikhe Doli, sharply worsens grain quality.

CONCLUSION

- Based on the data obtained from the studies, we can say that the optimal sowing date of wheat in the Samtskhe-Javakheti region is 1-15 October.
- Previously, the optimal sowing dates were considered September 15-October 15. The data we obtained convinced us that wheat sown in September had significantly lower yields than wheat sown in early October (8%, 11%, and 20%). Delayed sowing after October 15 reduces crop yields by 65-75%.
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- Taking into account the optimal dates of wheat sowing in the Samtskhe-Javakheti region will allow us to dramatically increase the yield.
- In addition, the results of the experiment showed that the quality and yield of grain depend on the dates of sowing, as well as the biological characteristics of the variety, soil-climatic and agrotechnical conditions.

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