Comparative Studies on Cultivation Technology, Yield Accumulation and Its Quality for Winter Wheat Varieties Tolerant to Soil Salinity

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Abstract: Weather and climatic conditions of the Republic of Karakalpakstan are distinguished by unfavorable conditions in winter-spring period, soil salinity within the area, leading to reduction of wheat yield. The aim of the research was to develop and implement agro-technical activities to overcome the impact of unfavorable factors during winter wheat cultivation. There is evidence in the literature that diverse winter wheat cultivars have different resistance to stressful conditions and are able to tolerate drought and soil salinity. Various winter wheat cultivars with high productivity, good grain quality and ability to withstand adverse growing conditions were investigated. Field experiments were conducted in “Seyit” dehkan- farm” in Nukus district on the area of 3.5 ha, where leguminous crops were planted at 0.5 ha, and winter wheat was placed at the area of 2.0 ha. Soil type is meadow alluvial, medium-loamy in mechanical composition; humus content in soils varies from 0.7 to 0.9 mg/100 g. Generally accepted field and laboratory investigation techniques were used in the experiments. It was observed high correlation between the leaves area and crop yield - r = 0.88, and within the supply of solid and crop yield it formed r = 0.96. The highest productiveness formed the cultivar Krasnodarskaya 99 - 38.6 c/ha, which is above the standard rate for 6.7 c/ha. It represents the conformation to the high temperature, aridity and soil conditions of the region.

Key Words: Legume, Grain quality, Salinization, Soil fertility, Wheat.

1. Introduction

In the process of increasing productivity and improving the quality of grain important place belongs to the hereditary economic and biological properties of cultivars. In changing climate conditions, more stable are certain cultivars of winter wheat (Dorofeyev et al., 1987; Vislobokova et al., 2012).

Nowadays, the responsibility of farmers in the cultivation of winter wheat is the increase of crop productivity by combining it with tolerance to abiotic and biotic conditions of environment. Climatic conditions of the Republic of Karakalpakstan are characterized by arid type of climate, low rate of rainfall and limited amount of irrigation water. In such severe conditions cultivating of heat-resistant and salt resistant cultivars is the most acceptable choice.

2. Materials and Methods

2.1. Research area and object

Experiments were conducted in the research farm and laboratories of Tashkent State University / Nukus branch. Soil type is meadow-alluvial, medium-textured by mechanical content with 0.7-0.9 mg/100 g of soil humus content and low rate of soil nutrients availability.

Research object was represented by winter wheat cultivars with various sensibility levels to the unfavorable conditions of growth and grain quality - regionalized in the area short-stemmed intensive cultivars Skifyanka (standard), Polovchanka, Kupava, Moskwich, Tanya and Krasnodarskaya 99. Skifyanka cultivar distinguishes by its high tolerance to winter hardiness, which is important for severe winter conditions of the region.

2.2. Research methodology

In this research, common methods of field and laboratory experiments were used. Field experiments were conducted in 2011-2012; the average indicators for 2 years are given in the results. Data from various places of research plots are given separately.

The sowing area of research plot was 60 m², registered - 50 m², with four replications. The plots were selected by random repetitions. The indicators of seeds germination and plants conservation till harvest were counted on an area of 0.25 m² in duplicate repetition.

The determination of yield was performed by recalculation of the grain yield to 14% humidity and 100% grain pureness; the determination of grain structure was executed by the method of State Variety Testing of field crops, statistical processing of experiment results were conducted by the correlation and regression analysis. Cultivar Polovchanka, widely spread in the region, was adopted as a standard.

The nature of grain was determined on volume weight with 1 liter volume; the analysis of grain vitreescence was performed on diaphanoscope by calculation of completely vitreous and semi-vitreous grains with double replication. Grain protein

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content was determined by total nitrogen content. Gluten content was determined by double replication of 25 grams of crushed wheat hitch. Dough was prepared with 14 mL of water, followed by washing the water-soluble amino acids.

2.3. Experimental technology of winter wheat cultivation

Winter wheat cultivars were sowed after corn on silage crop on the 2nd of October, with 15 cm space and with sowing standard of 5.0 million seed shoots per ha. Plants were irrigated in autumn and twice in spring, in the early spring growth and after blooming. Phosphorus-potassium fertilizers were applied in the basic processing of soil, 15 kg of phosphorus were used with seeds sowing, while nitrogen fertilizers were used fractionally: during pre-sowing soil cultivation and during the period of grain formation by spraying urea solution.

3. Results

3.1. Results of experiments

Formation productivity by winter wheat plants depends on climatic conditions (Kononenko et al., 2010; Luhmenyov et al., 2012). Field germination and wintering of plants on saline soils have great importance as the factors which define the number of the plants on one unit of area. During the experiments the germination of seeds changed according to the characteristics of winter wheat cultivars. Krasnodarskaya 99 cultivar showed the highest germination - 76%, while the germination of Tanya and Polovchanka cultivars represented 72-74%, other cultivars showed lower results.

The best resistance to unfavorable conditions of winter period had plants, which belongs to the “valuable” group of cultivars, like Krasnodarskaya 99 - the indicator of wintering was 77% among all plants, left for the winter period. Other cultivars showed almost equal results: 74-70%

The crops of standard cultivar Skifyanka showed the thinning of plants after early spring watering and loss of the plants till the full plant tillering, which contributed to the reduction of all parameters during the vegetation period.

Plants safety indicator for harvesting characterizes stability against unfavorable factors of vegetation (Fedotov et al., 2007). The highest conservation rate of plants showed Kupava and Krasnodarskaya 99 cultivars - 83 and 82% respectively; the lowest result showed Polovchanka cultivar with 77%, which is for 1% lower than the standard.

Leaf area plays an important role in the accumulation of dry organic mass. In the process of photosynthesis plastic substances are formed, which further converted by plants into proteins and carbohydrates.

According to our data, leaf area varies according to the phase of growth and by winter wheat cultivars, reaching a maximum value on the flowering phase. Observed cultivars had higher indicators of leaf area, compared to the standard (Fig. 1) and in the flowering phase reached 36.9-43.2 km²/ha (Fig. 2).

For the productivity of crops, long functioning of the leaf area has an important value, which can be judged by its size during the phase of milk-ripeness. High yield potential cultivar Tanya reached the result of 28.6 km²/ha, while low yield potential cultivar Polovchanka - 24.9 km²/ha. The lowest results showed Skifyanka cultivar - 18.7 km²/ha.

The correlation coefficient between the leaf area and grain yield was r = 0.88; between the accumulation of dry matter and grain yield was r = 0.96.

The high leaf area values of abovementioned cultivars has lead to greater accumulation of dry matter content by the plants (Fig. 2), Tanya cultivar showed 92.2 c/ha; Polovchanka cultivar - 88.4 c/ha and Skifyanka cultivar had 86.2 c/ha. Crops of standard cultivar Skifyanka formed less amount of dry matter compared to the other cultivars - 2.2-10.5 c/ha. There was no difference on the accumulation of dry matter depending on the sowing period.
3.2. Crop yield and yield structure of winter wheat cultivars

Study of the ability of cultivars to resist the influence of abiotic factors - unfavorable winter-spring and hot weather conditions during harvesting, and selection for sowing on the large areas more adapted to the local conditions cultivar, allows increasing grain production in a cheaper way. Current research helped us to identify the best cultivars and options, which forms the high productivity and good grain quality. The average data for 2011-2012 on crop yields and yield structure represented in Table 1.

During the formation of grain crop in Aral Sea region, high daily temperature with low humidity level are established, which differs from the optimal values for wheat crop and prevents the accumulation of high grain yields. Therefore, the yield of cultivars with high potential values in these conditions ensures the productivity by 2.5-3 times less.

For example, high-productivity cultivar Tanya with crop yield of 94.8 c/ha (4) under current conditions the crops accumulated an average of 2 years 35.3 c/ha and other cultivars showed the same results. Krasnodarskaya 99 cultivar showed the highest productivity in this experiment - 38.6 c/ha, which characterizes its high tolerance to high temperature, aridness and soil conditions of the region.

The main components which define the formation of winter wheat yield are the number of productive stems per unit area, the size and productivity of one spike. Grain yield accumulated by a large number of productive stems, higher grain mass and the weight of 1000 grains.

3.3. Technological parameters of grain quality of winter wheat cultivars

Crop yield and grain quality of wheat are formed during the period of growth and development, from sowing to maturity phase, and mainly related to soil and climatic conditions of a certain area (Fedotov et al., 2007).

Technological parameters of grain quality of studied cultivars are represented in Table 2. The determination of grain parameters, which characterize the size and quality of the grain, has shown that the highest parameters form Skifyanka cultivar - 792 g/L and Polovchanka cultivar - 788 g/L. Grain parameters of Kupava cultivar is lower compared to standard on 10 grams.

Plants of Kupava cultivar are similar to the plants of Skifyanka cultivar by its characteristics, phenotype, biological properties and agronomic requirements. The main difference is the consistent higher yields due to the less disease and larger grain size. By economic characteristics, Tanya cultivar is not inferior to the other cultivars by crop yield, however in marginal environmental conditions it has reduced gluten content. High rates of a productivity and high quality of grain in these conditions formed cultivar plants Krasnodarskaya 99.

4. Conclusions

Considering adverse soil climatic conditions of the region, a choice of the cultivar adapted for these conditions promote most quickly to increase a yield with high quality of grain.

Researchers established formation of higher rates at a
cultivar Krasnodarskaya 99. Sowing of this cultivar differed in resistance to adverse conditions of vegetation, formed the optimum area of leaves and supplying solid, productivity in comparison with other cultivar was 3.3-3.7 c/ha higher. Grain of this cultivar differed in fineness and good indicators of quality.

References


