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Effect Of Dry Conditions on The Formation of Plastid Pigments of Annual Rye (*Secale Cereale* L.) Cultivars.

Makhramova M.Sh[1]., Urokov S.X[2].
PhD student faculty of biology, Samarkand State University[1], b.f.d, professor, Faculty of Biology, Samarkand State University[2].
maxramovamarhabo@gmail.com

Abstract. Rye (*Secale cereale* L.) is one of the most useful cereal plants. Rye products contain many biological substances necessary for human health. It contains carbohydrates, proteins, fats, phosphate salts, various macro and microelements, vitamins of group B, PP,E, A and other vitamins are found. There are many benefits of rye for the national economy . In agriculture, rye flour is used for bread, grain for animal feed, and green plant for pasture. Rye has several advantages over other plants . It is a much more cold - resistant plant than wheat . It has been found that many useful plants can grow in low sandy soils. In addition, the advantage of rye over other cereal plants is that it is considered as one of the plants that is more resistant to drought.

Drought tolerance is the ability of a plant to maintain is physiological characteristics without significant changes in drought conditions. The resistance of rye to drought is related to its physiological conditions. Because its root system has the ability to absorb water well. However, drought affects almost all physiological indicators of rye. It also causes a change in the amount of plastid pigments formed in its leaves. Under normal conditions the amount of chlorophyll a pigments in rye leaves is more than other pigments. But in arid environments, its possible to see a significant decrease in their production. Synthesis of chlorophyll b and carotenoids in leaves was found to be significantly reduced under drought conditions.

Therefore, this article provides information on drought resistance of annual rye (*Secale cereale* L.) cultivars and the effect of drought on its physiological characteristics and productivity.

Keywords: *rye, phenological stages, water deficit, pigments*

Introduction

Currently, the demand for rye (*Secale cereale* L.) and its products is increasing year by year, which in turn causes the development of their production at a faster pace. For this reason, in order to meet the demand of the world's population for rye products, measures are being taken by the world community to further develop the technology of growing rye .

Rye (*Secale cereale* L.) is one of the important cereal crops in Central and Eastern Europe. Rye is grown almost exclusively as a winter crop. Cultivated rye is an allogamous plant. Although the homeland of rye is Asia Minor, Central America, Iran, the Caucasus, and South Africa, it is mainly cultivated in Central and Eastern European countries (Poland-2.2 million, Russia-3.5 million, Ukraine-0 6 million ha). The most important rye growing countries are the Russian Federation, Poland, Germany, Belarus and Ukraine. These countries produce more than 75% of rye. In Germany, rye is mainly grown for livestock feed (50%), baking (22.5%) and ethanol production (17.5%). In recent years, the use of rye for biogas production (currently 7.5%) has been increasing [2;6].

Rye plants planted in the territory of our republic , measures are currently being sought to widely introduce the technology of growing rye becoming important economically .

Rye is distinguished from other cereals by its several useful properties. Rye grain contains a number of vitamins, amino acids, micro and macro elements. The lysine and threonine amino acids present in the grain ensure tissue growth and regeneration. Rye grain is very important for the medical field. Preparations made from rye grain are used to treat many oncological diseases. Rye is also a useful plant for agriculture. Its straw is a nutritious feed product for livestock. Taking into account such useful properties of rye, the demand for rye products is increasing every year. Widespread development of rye cultivation technology in our country, creation of high-yielding and high-quality grain varieties suitable for local conditions is one of the most urgent issues today [1, 3, 5].

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Drought- resistant plant compared to other cereals . Its root system absorbs water very efficiently . The dry weight of rye root is higher than that of ryegrass and triticale. In addition, rye steam consumes 20-30% less water per unit of dry matter than wheat. It was observed that the physiological properties of rye , even under drought conditions, did not change significantly compared to wheat. In general, the effect of drought on rye varies from molecular to morphological level. Effects of drought on rye are observed in phenological stages. For example, one of the first reactions to the effect of dry whiteness is the closing of the stomata. This leads to a decrease in the rate of photosynthesis and a relative decrease in carbon assimilation. Due to lower exposure to drought, it reduces cell division and negatively affects plant growth . If dry whiteness is observed during the phenological development period of the plant, it shortens its early flowering and grain filling period. As a result of drought, a decrease in rye productivity has been recorded. In experiments carried out by researchers in Serbia, a decrease in the yield of dry wheat rye from 8% to 38% was observed [2].

Drought is one of the most limiting environmental stresses worldwide. As temperatures continue to rise and the evaporative demand of the atmosphere increases, droughts are expected to become more frequent in the future.

Drought: meteorological, agricultural, hydrological and socio-economic drought. Meteorological drought is a lack of precipitation over a period of time. Agricultural droughts lead to soil moisture deficits as a result of meteorological droughts. Hydrological drought is the insufficient supply of water to the plant. There are different mechanisms of adaptation of rye plants to these droughts [2, 4, 6].

Materials and Methods

Field experiments

Were carried out in the field belonging to the "Ulug Baraka yerlari" farm ,Jomboy district, Samarkand region.

Autumn rye seeds are sown in rows (15 cm between rows), narrow rows (7.5 cm between rows), two-sided rows in coordinated ways. Narrow row planting is an advanced method. In this case, the plants are evenly distributed on the field. The seeds were sown at an average depth of 4-5 cm. Plants were grown under drought and well-watered conditions. Fungicides and pepticides were used to prevent any plant diseases.

Soil and climatic conditions

The level of groundwater seepage in the experimental area is 8-10 meters. The mechanical composition of humus was 1.1% in the plowed (0-30 cm) layer, and 0.7% in the under-ploughed (30-50) layer. Total nitrogen is 0.12%, phosphorus is 0.12%, potassium is 2.2% in the plowed layer (0-30 cm), and their mobile form is N-NO_3-8.5, P_2O_5-22 ,0, K_2O-197 mg/kg was determined in the laboratory analysis.

The environment of soil water absorption is weakly alkaline, pH = 7.1-7.3.

of the experimental area is sharply continental, the average annual temperature is 13.4 ^{0} C, the average temperature in January is -1.2 ^{0} C, the average temperature in July is 27 ^{0} C, the highest temperature is 45 ^{0} C, the average annual precipitation is 312 mm mainly , it rains in winter and spring. The relative humidity of the air during the growing season is 44-54%, the hottest month of the year is July and the coldest month is January.

Plant material

In this experiment, total autumn rye (*S. cereale* L.)3 varieties, namely "Vakhsh-116", "Shalola" and "Savo" were used. These cultivars were grown in both drought and well-watered environments.

The variety of rye "Vakhsh-116" was created at the Vakhsh department of the Tajikistan Agricultural Scientific Research Institute by cross-pollination of wild rye 7323 with Bernub 9939 and first by multiple (mass) selection, and then by multiple single selection. .

In 1983, it was included in the State Register as a crop for green food in the irrigated lands of the Republic. It belongs to the genus vulgare.

The "Shalola " variety of rye was created by the method of analytical selection based on the Vakhsh-116 variety, i.e. by repeated natural selection. This variety is also regionalized in many countries.

Results and Discussion

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In this experiment, ryegrass seeds were sown at the end of August. It was determined that temperature is the main factor affecting the germination of seeds planted in this period and the duration of the next stages. In the conditions of Uzbekistan , the minimum temperature for the germination of seeds of winter wheat and barley crops is 6 ^{o}C, and in the experiment, the minimum temperature for winter rye is 1-2 ^{o}C. At a higher temperature, its germination was accelerated. At the time of germination of rye, when the air temperature was 6-8 ^{o}C , grass developed rapidly. Sown seeds germinated in 6-7 days in sufficiently moist soil. After germination, it began to flower in 13-15 days, the air temperature was 10-11 ^{o}C, it flowered quickly and well . In early spring, when the air temperature reached 4-5 ^{o}C, rye began to grow . Growth accelerated when the air temperature exceeded 10 ^{o}C , especially when the air temperature was higher than 20 ^{o}C, overnight growth was higher than other cereal crops.

Dry powdery mildew has a significant effect on all physiological parameters of the plant. Among them, it caused a change in the amount of pigments in the leaves of the plant . Chloroplast pigments also play an important role in the life of plants . Because leaf pigments are very important for the photosynthesis process . Chlorophyll is formed in the leaves of plants under special conditions .Plant pigments are formed only in lamellae and granules of plastids. The magnesium element is directly included in the chlorophyll molecule , and the iron supplement is included in the enzymes involved in the formation of chlorophyll. A group of yellow, orange, red pigments together with chlorophylls in green plants are called carotenoids. These pigments are present in the chloroplasts of all plants . Carotenoids are also invisible because they are found together with chlorophylls in chloroplasts. Because the amount of chlorophylls is on average three times more than caratinoids. But in autumn, as a result of the breakdown of chlorophylls, carotenoids begin to appear.In general, the formation of pigments in plants also depends on external environmental conditions.

During our experiments, plant varieties were grown in arid and well-supplied environments, and the amount of pigments in their leaves was compared, and it was observed that the amount of pigments in the leaves of plants grown in arid environment was significantly reduced. The results obtained are explained on the basis of the following tables.

Table 1

Phases of development	Vakhsh-116					
	Pigments mg /g (aqueous environment)			Pigments mg /g (arid environment)		
	Chlorophyll a	chlorophyll b	carotenoids	Chlorophyll a	Chlorophyll b	carotenoids
Congestion	3.31	2.52	0.38	2.81	1.65	0.28
Tubing	3.42	2.65	0.42	2.39	1.46	0.31
Spike	2.94	2.31	0.49	1.97	1.25	0.34
Flowering	2.88	2.23	0.51	1.79	1.12	0.37
Milk ripening	2.75	2.11	0.55	1.61	1.05	0.41
Wax ripening	2.49	1.88	0.62	1.52	0.99	0.43

The above information , the amount of pigments in the leaves of "Vakhsh-116" rye variety was studied according to the development phases, in which the amount of chlorophyll "a" was found relatively more than other pigments. The amount of chlorophyll "a" and chlorophyll "b" pigments in the leaves of plants grown in water environment was higher in the tuber phase than in other phases . The amount of carotenoids was higher in the wax ripening phase . The amount of pigments decreased significantly in the dry environment compared to the watery environment according to the developmental phases. So, dry whiteness caused a decrease in the amount of pigments in plant leaves. Dryness has shown its effect on the low synthesis of pigments in plant leaves.

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Table 2

Phases of development	Shalola					
	Pigments mg /g (aqueous environment)			Pigments mg /g (arid environment)		
	chlorophyll a	chlorophyll b	carotenoids	chlorophyll a	chlorophyll b	carotenoids
Congestion	3.23	2.31	0.39	2.98	1.85	0.29
Tubing	3.32	2.45	0.43	2.69	1.96	0.33
Spike	2.91	2.25	0.48	2.47	1.75	0.38
Flowering	2.89	2.21	0.51	2.19	1.62	0.41
Milk ripening	2.82	2.15	0.56	2.11	1.45	0.44
Wax ripening	2.57	1.89	0.61	2.05	1.29	0.49

The data in the table , the amount of pigments in the leaves of the "Shalola" rye variety was studied according to the development phases, in which the amount of chlorophyll "a" was found the most. The amount of chlorophyll pigments decreased according to phases . We can see that the amount of carotenoids increased according to the phases .In the experiment, we can see that the difference between the amount of pigments in the leaves of plants grown in a well-watered environment and in an arid environment is not so great.

Table 3

Phases of development	Savo					
	Pigments mg /g (aqueous environment)			Pigments mg /g (arid environment)		
	chlorophyll a	chlorophyll b	carotenoids	chlorophyll a	chlorophyll b	carotenoids
Congestion	3.09	2.15	0.33	2.12	1.55	0.21
Tubing	3.21	2.19	0.41	2.29	1.66	0.29
Spike	2.81	2.15	0.43	2.17	1.35	0.31
Flowering	2.79	2.12	0.47	2.12	1.22	0.35
Milk ripening	2.62	2.09	0.51	2.05	1.15	0.37
Wax ripening	2.47	2.01	0.55	2.01	1.11	0.41

During the experiments, it was found that the amount of pigments in the leaves of the Savo rye variety is less than that of the Vakhsh -116 and Shalola varieties. In this variety, it was found that the amount of pigments in the leaves decreased significantly in the dry growing environment. The dry arid environment caused a low production of pigments in plant leaves.

As a result of the research, when the amount of pigments in the leaves of all three varieties was determined in wet and dry conditions, it was found that the amount of pigments in the leaves of Shalola rye variety is well synthesized in dry conditions.

Conclusion

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The results of this study show that drought significantly affects all physiological processes of the plant. In this place, it also affects the synthesis of pigments in the leaves of the plant. That is, in a dry environment, less pigments are produced in plant leaves. In the results of this experiment , it can be seen that the synthesis of plastid pigments in the leaves of Shalola rye variety is not significantly reduced even in a dry environment.

So, it was determined during the experiment that Shalola rye variety is drought- resistant among all three rye varieties. Our research revealed that Savo is a drought-resistant variety .

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