MINISTRY OF AGRICULTURE AND WATER MANAGEMENT
OF TURKMENISTAN
TURKMEN AGRICULTURAL INSTITUTE
AGRICULTURAL RESEARCH INSTITUTE

WHEAT RUST DISEASES AND CONTROL MEASURES

Scientific production manual

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In the scientific-industrial manual it is given information about rust diseases of winter wheat as a dangerous disease. The manual describes the types of rust diseases and it is provided scientifically grounded advice of the microorganisms that cause them, causes of diseases, disease prevention and control measures.

Manual is intended for the Lessees, landowners, teachers, specialists and students.

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INTRODUCTION

"In the Program for Socio-Economic Development in 2018-2024 of the President of Turkmenistan" is paid a great attention to the amount of crop yields and to quality improvement. To increase the amount of high quality wheat is one of the main requirements of today. For successful solution this issue, all agro technics when wheat is grown in addition to its measures, it occurs in this crop and contributes to its productivity and on a scientific basis against diseases that damage the quality of the crop the need to carry out combat measures in developed ways occurs.

Highly esteemed President, on March 6, 2009 at a meeting of the Elders Council of Turkmenistan in Turkmenabat, said: "Once we have gained our independence, food security grain production in order to solve problems quickly had to make urgent decisions on the matter as soon as possible". Because the grain and the grain products are human food as it is one of the products they consume on a daily basis to cultivate, to reap a bountiful harvest from it is the need of the age is an important issue.

The National Program of Turkmenistan, as well as the "Key indicators of socio-economic development by 2030 of Turkmenistan" it will be produced in the country by 2030 the amount of grain to 1896.2 thousand tons. To the set points to achieve this, it has been developed on a scientific basis against diseases of this crop there is a need to conduct structured control measures. Because, the results of our research and scientific literature data grain to be taken from wheat under the influence of various diseases an average of 25.5-27.8 percent, if they occur in public, up to 70-95 per cent is lost and quality is reduced showing in the scientific literature and production practices confirms the available information.

1. RUST DISEASES

The data on wheat diseases collected from the scientific literature and the results of our own research are mainly due to the lack of about 25 fungal diseases, 3 bacterial, 1 virus, 3 nematode, 4 genetic and physiological and 8 nutrients in this crop indicates that it is more prevalent.

There are 3 types of rust-related fungal diseases in wheat, which greatly damage its yield and crop quality. When the spores of rust-forming mushrooms are created in favorable conditions, they can spread over long distances with the help of wind, damp air, water, small drops, humans, machinery, animals, and in a short time they can infect thousands of hectares of wheat and cause large grain losses.

Rust diseases are caused by regular sowing of wheat in the same place, the presence of field tests of diseased plants, the humidity of the air, the planting of unstable varieties, and the low level of agro-technical measures. Disease-causing fungi affects the leaves, stalks, buds, grains of wheat, leading to disruption of photosynthesis, metabolism in the cells, and premature drying. Corrosion, especially if it occurs during the early growth of wheat, has a high degree of damage to the plant.

The creators of the rust disease belong to the fungus belonging to the group *Urediniales*, and their species are distinguished by the fact that they can infect a particular plant. However, in one plant these fungi several species can multiply and grow at once. For example, single root wheat can also cause yellow, brown, and stem rust.

As soon as the fungus that causes the rust enters the wheat and enters its tissues, it begins to multiply in the cellular matter and, with the help of special ants (gaustoria), absorbs and nourishes the juice of the plant. Thousands of uredino-teliospores mushroom seeds form under the leaf epidermis. As they mature, the epidermis ruptures and the seeds under it spread through the air, falling on healthy plants and making them sick.

Depending on the air temperature and humidity, the symptoms of the disease in wheat appear after 5-15 days. As a result of the formation of spots and pustules on the leaves of diseased plants (small, soft, swollen hands fungus) cracks are formed, the metabolism is disturbed, water evaporation and loss are increased, and the leaves dry prematurely. As a result, the grains are less formed, the formed grains

become thicker and smaller, the quality of their composition changes and the germination decreases.

2. BROWN RUST DISEASE

Disease creator. *Puccinia tritici Eriks* (synonym *P.recondita Desm*.) fungus creates it. The spores of the pathogenic fungus are brown in color and round in shape. Teleito spores (winter form) are dark; uredospore (spring form) is brown in color, round in shape, arranged irregularly on the leaf and reminiscent of a wind-blown pillow. The diseased steam is formed mainly on the side of the leaf protruding from the stalk, and on the top of the leaf is a complete urediini pustule of single-celled urediini spores, consisting of small or rounded or ellipsoid-shaped shoots.

In our studies, brown rust often appeared along with septoriasis spots. This type of corrosion occurs in winter steam, in areas where early sowing is carried out, i.e. in well-groomed areas, when favorable weather conditions are formed was also recorded in the fall. As such, the wintering of diseased wheat roots has become difficult or they have often dried up.

Symptoms of the disease. In the area where the diseased wheat, especially the lower leaves of the stem, protrudes from the stem, full pustules are formed on the leaf, consisting of single-celled spores (seeds) consisting of small sprouts in the form of toga-varnish or elongation (Figs. 1-2).

The winter form of pustules is dark and the spring form is brown. They are round in shape, reminiscent of a wind-blown cushion, and are irregularly placed on the leaf (Figs. 1-2). When the surface of the leaf is rubbed by hand, the color of the pustules disappears. The weight of 1,000 grains of diseased wheat averages 7-7.5% and the quality is reduced.

At the end of the wheat growing season, the pustules turn glossy black, each of which forms numerous, needle-like, elongated two-celled teloi spores. If no timely action is taken, the spores of the disease will multiply in large numbers and spread around. The leaves of diseased wheat are dried 10-15 days before healthy plants before fruiting.

Figure 1 Leaves of wheat infected with brown rust

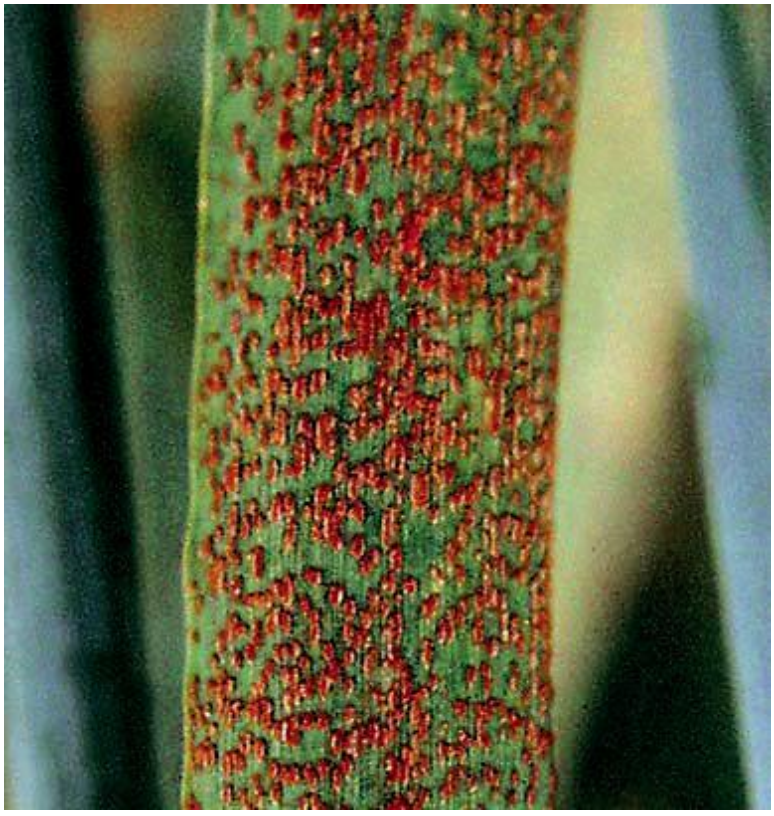

Figure 2. Brown rust pustules (spores retaining pouches) on wheat leaves

It causes the grains to be small, not fully ripe and the germination to decrease. This type of rust can also occur in the fall months when winter wheat is also planted early in the sowing season, when favorable weather conditions are present in well-sprouted fields. In this case, the wintering of the roots of the wheat becomes difficult or it dries up.

The source of the disease is mainly wild grasses (wild oats and barley), remnants of diseased wheat in the field, and wheatgrass sprouted from fallen grains. The pathogenic fungus grows well at a temperature of 6–35 ° C and a humidity of 63–77%, tolerates cold to -35 ° C in the winter and leads to the onset of the disease in early spring.

P.tritici Eriks. When infected with the urediniospores of the fungus, it infected the wild barley plants - wild barley (Horde-um spontaneum C. Koch) and oats (Avena fatua L.), barley (Eremo-pyrum orientale). When the average air temperature was 15–18 ° C and the humidity was 65–70%, the leaves of these plants formed fungus after 25 days. On the 8th day, when they were infected with aeciospores, they had symptoms of the disease.

Biological and ecological features of brown rust.

The pathogenic fungus grows well at 6°C and humidity of 63–77%, tolerates colds up to -35 ° C in winter, and early spring causes disease. In the conditions of Turkmenistan, the brown rust-forming fungus can reproduce in full and incomplete circulation. It is planted in the fall and wintering in the sprouts of sprouted wheat. The resulting spoils spread around the early spring months and keep the plants healthy gets sick. In the full cycle, mushrooms are an intermediate plant that grows, and wild barley and oats and barley, which are common in wheat fields, serve.

Brown rust has been reported in winter wheat sown in all provinces of the country. The prevalence of the disease may be low or high, depending on the air temperature in March and April and the amount of precipitation. The number of diseased plants is mainly in the range of 0.1-20%. The disease is caused by the constant rainfall during the rainy season and the retention of hot and humid air. Winter wheat and brown rust are also common, along with septoriasis. In this case, the incidence of septoriasis in wheat is higher than in brown rust.

3. YELLOW RUST DISEASE

Yellow rust is common in wheat, rye, and barley. *Puccinia striiformis West*. creates mushrooms in yellow wheat in winter wheat.(synonym: Puccinia glumarum Eriks. et Henn.).

Mushroom spores thrive at high humidity (65-85%) and at temperatures of 11–13 ° C. The disease first infects the lower leaves of wheat, the upper leaves during the period when the grains are in milk, and the crop is often dry (Figs. 3-4). Sick grains are also light in the form of diseased wheat. When the air temperature is above + 21 ° C, the mushrooms temporarily stop their growth. As a result, the disease is more prevalent, especially in the northern districts and foothills. Up to 10% of the crop is lost.

The main causes of jaundice in wheat include the planting of unstable varieties, disruption of crop rotation, the presence of plant disease tests in the field, over-supply of nitrogen, and the delay in sowing.

Figure 3. Wheat yellow rust

Symptoms of the disease. Yellow rust affects mainly the leaves, stalks, and grains of wheat. Its pustules are playful, light orange or lemon-colored, and are arranged in a long line on the leaf, as if to be made by the wind. This is why the disease is also called different, linear

rust. Mushroom spoils come in a colorless, crusty, round, elongated, shape.

Biological and ecological features of the disease. In the conditions of Turkmenistan, several generations of spores of the fungal fungus are formed in summer and they spread all around, causing great damage to the wheat. The growth of P. *striiformis* fungus requires 15–17 ° C and 60–85% humidity.

The damage caused by the disease. The loss of crop depends mainly on the period in which the disease occurs in wheat and the degree of disease of the plant. When 10% of the leaves of the disease are sick, the average yield is 4.2%, 25% when the disease is 15%, 50% when the disease is 30%, and the grain is sown. Yellow rust is found in wheat fields in all regions of the country. In particular, the disease is most prevalent in Ahal, Mary and Lebap regions due to the frequent occurrence of favorable weather conditions.

Figure 4. The stalks and leaves of the wheat are infected with yellow rust

P. striiformis grows in incomplete circulation. It hibernates in winter wheat, or in cereals, and in winter it infects winter and spring wheat.

Yellow rust is considered one of the most dangerous diseases of wheat, and occurs in countries that grow wheat after year, leading to

large grain losses. According to information of S.A. Abiyev, yellow rust is more common and severely damaged in Pavlodar, Akmola, Kostanay and Kyzylorda regions of Russia and Kazakhstan. According to M. Koyshibaev's stationary and route surveys from 1991 to 2001, yellow rust was not found in the southern regions of Kazakhstan, but in the mountainous regions - Almaty, East-Kazakhstan, Jambyl and South-Kazakhstan oblasts disease occur widely. This is due to the biological feature in the development of *P. striiformis*, i.e. 15–17 ° C is required for the growth of the fungus, and the growth of the fungus is temporarily inhibited when the air temperature is above 21 ° C. The author notes that in Almaty region, 10% of wheat leaves lost 5.3% of yield, 25% lost 16.1% of disease, and 31.7% of grain lost 52%. In 50% of the monkeys, the grain yield was reduced by 12.7% and in 75-100% by 23.5%.

Yellow rust is common in western Siberia in the Altai mountainous forests. Here a temperature of 8–15 ° C was required for the development of spores of *P. striiformis.*

V.E. Hohlachyeva and A.I. Morgunov note that the epidemic of yellow rust in wheat occurred in Tajikistan and Uzbekistan in 1999-2000, and that more than 50% of the crop was harvested. The authors point out that in Uzbekistan, wheat epidemics were recorded 3 times in winter wheat from 1940–1999, with a yield loss of 10.4–67.2%, depending on the severity of the disease. They also report that winter wheat in Uzbekistan is predominantly yellow and brown rust and often has epiphytotic, leading to a 30–50% loss of grain yield during the year.

4 STALK RUST DISEASE

Puccinia graminis Pers. mushrooms creates this disease. This mushroom has descendants (races) that are specialized according to plant species. For example, *P.graminis f.tritici Pers*. infects wheat and and chowder, P.graminis f.secalis rye, barley and chickpeas, *P.graminis f.avenea occur in* oats. Stalk rust is considered a particularly dangerous disease of wheat, which affects the stalks and sometimes leaves of this crop. *P.graminis f.tritici*, the creator of wheat stalk rust, often grows in full cycle. Mushrooms hibernate in the fields of wheat and vegetable waste in the form of teloi spore. In the early spring, they grow, forming basidio spores and basidio spores, and fall into the leaves and fruits of the zircon plant, preventing their growth continues. Later, spermogonies with spherical spheres form on its leaves. They combine to form

numerous spherical, colorless eosino spores, which are similar to bowl, and, with the help of the wind, spread around, passing to wild and cultured cereals, creating a rust-like rust. The uredini spores of *P.graminis f.tritic* already begin to grow at 3 ° C when the air humidity is 100%, they grow better at 20–25 ° C, and when they cross 40 ° C, they temporarily stop their growth. The races of the fungus found in the southern parts are resistant to high temperatures and drought.

Stalk rust is a particularly dangerous disease of all types of grain crops, which causes their stalks to twitch and fall off and the grain crop to be completely lost. As a result of the disruption of the morphological structure of the diseased stem, the metabolism between the root and the stem is disrupted. In particular, when the disease occurs in the early stages of wheat growth, the yield is higher. The source of the disease is the remains of diseased plants, wild cereals, zircon (barberry, intermediate plant).

P.graminis f.tritici can also grow in a complete cycle. That is, V.P. Turapin has been proven that zircon does not play a significant role in the spread of the disease. In the author's experiments, wheat infected with spring teloi spores in winter wheat infected with spring teloi spores.

Wheat stalks in the northern regions of Kazakhstan occur in late July and produce several uredo generations. The incubation period was 23 days when the air temperature was 4 ° C and 7-9 days at 20-25 ° C. At the optimum temperature, i.e. 25 ° C, uredini spores grew for 2 hours. They, too, had fully maintained their activity in the cold at -33 ° C under the snow, only to die at -41oC.

The stalk rust first appeared in the United States in 1919, and was studied extensively in Uganda, Kenya in 1999, so the disease is also known as Ug-99. D. Hodson notes that *P. graminis f.triticus* is rapidly spreading around the air with the help of wind, and that the disease has already occurred in 2003 in Sudan and in 2007 in Iran.

V.P. Turapin and V.A. Mostovoy also note that in 1995 in the western, eastern regions of Kazakhstan, and in the Aktubin, Pavlodar, Kyzylorda, and Almaty regions, the rust appeared to be of little economic importance. However, as a result of M. Koyshibaev's 1990-2000 surveys, rust rusts are not found in the eastern, southern, and Jambyl and Almaty regions of Kazakhstan, including in the Shuysk and Issyk-Kul regions of Kyrgyzstan. The author noted that the smallest outbreak of the disease occurred in autumn in the Merensky district of Jambyl oblast in 2000, in autumn rye, twice in spring wheat sown in the

Komsomolsky district of the Kustanay region: in 1958 and 1962, the epiphytic disease was reported.

Z. Diyembaev and his colleagues note that rust rust was a common occurrence in spring wheat planted in the Kokshetau region of Kazakhstan in 1958 and in the northern regions in 1962. They show that in 1964, the disease occurred in the northern regions of Kazakhstan, in the Kostanay, Akmolinsky and Kokshetai oblasts, during which the epithelium of the grains was in the dark and 50-60% of the grain yield was lost.

The damage caused by rabies depends on the time of emergence of the disease, the degree of disease of the plants and the stability of the wheat sorghum. During the epithelium of the disease, the yield losses of Bezenchyk 98, Saratov 29 varieties that were resistant to this disease were reduced by 20-30%, and the yields of the resistant varieties Jana-Kyzyl and Kustanay 14 were reduced by 50-70%.

W.P. In Turapi's experiments, the grain loss was 11.9% and 70-80% at 40.2%, respectively, when the incidence of wheat germ infestation was 10-20%. The quality of grains obtained from diseased grains has decreased: the amount of starch, mono and disaharides in the grain, the total and protein nitrogen, has decreased, on the contrary, the amount of non-protein nitrogen has increased. During the wheat harvest, 77% of the disease was lost when the incidence was 100%, and 57.3% of the crop yield was 90%, respectively, during the germination period.

As a result of our 2004-2016 observations on Turkmenistan, only after the regular rains in June 2011, winter wheat sown in the fields of "Arkach" in Kaka district of Ahal region and "Ak alan" in Tejen district, after heavy rains in June 2011, was recorded at a time when there was no household significance, i.e., a small number of wheat roots. The diseased plants are mainly branched, (Figure 5).

If you rub the stems and leaves with your hands, they pass into your hands and form a yellow color. At the end of the wheat growing season, the urethane-pustules turn dark, glossy in appearance, and the oil stage of the fungus is formed. Uredini-spores consist of yellowish-brown, elongated, shell-like shoots and are 15–42x12–25 μm in size.

When the severity of the disease was assessed on the Peterson scale, it was 25–30%. The weight of 1,000 grains from healthy wheat in that field was 33.4 grams, and the weight of 1,000 grains harvested from wheat infected with rust was 24.2 grams. That is, the weight of diseased wheat grains was reduced by 27.5%. In our laboratory experiments, *P.*

graminis f.tritici began to grow at 3 ° C when the air humidity was 80–100%, it grew better at 10–24 ° C, when it exceeded 40 ° C and when the humidity was 80% less. They temporarily stopped their development. In the conditions close to production, with laboratory-grown teloi spores, artificially infested spring wheat did not become infected. The results show that high humidity is necessary for the growth and development of fungi.

Figure 5. Wheat stalk rust disease

In scientific sources, *P. graminis Pers*. a lot of information is given about the biological characteristics of the fungus, its races depending on the species of the plant, its conservation and source. According to G.S.Nevodovsky, the sporogonial stage of the fungus grows in barbaric species (*Berberis vulgaris* and others), the ure-religion in wheat and other wild grains. The author found it in 20 species of oatmeal, oats, and wild plants, including *Poa bulbosa, Bromis tectorum, Agropyrum re-*

pens, Roegneria Schreniana, Elymus multicaulus notes. The author speculates that the uredini-spores of fungi overwinter in the plants *Avena caespitosa and Festuca arundinaceae*, while the fungus results in zircon formation.

Based on many years of research, N.N. Lavrov *P.graminis Pers*. notes that the zircon family does not play a significant role in the development cycle of the fungus, which overwinters in perennial cereals (e.g., cliffs).E.E. Geshele notes that the *P.graminis Pers.* mushroom rye on the rocks infects the rye with a strong, low barley, but does not infect the wheat.

V.V. Plahotnik writes that in the northern regions of Kazakhstan, *P. graminis* gets sick rye, wheat and crustacean races, among which the race in the mushroom rye predominates. When 13 species of cereal plants were artificially infected with caterpillars, only wheat of them became infected. In the author's experiments, only 0.1-0.5% of fungal spores remained active when the stalks of plants infected with rust were kept under the umbrella until June, but their strength was also low.

V.V. Plahotnik and W.P. Turapin note that the natural source of the fungus *P.graminis f.tritici* can be found in cultured and wild cereals. That is to say, in experiments, when the grains were artificially contaminated with steam-derived mushrooms, barley, volosnes, rye, broad-branched wheatgrass, oysters, clay-free koster, cylindrical resin, and craps egilopsis were diseased. However, M. Koyshibaev notes that it is possible that these plants will not get sick under natural conditions. That is, the author points out that in 1978-1980, the epithelium of the rust rust in the Almaty region only occurred on Japanese coasts, but that wheat and barley were not infected. He noted that in the Kustanay and Turgay oblasts, barley was infected with rust, but that spring wheat was not infected, and concluded that Puccinia gram has specific races for each species of plant.

5. PREVENTION AND CONTROL MEASURES

As noted above, the results of the research prove that the pathogens that cause rust in wheat are capable of rapid reproduction. That is, most of them give a new generation every 3-4 hours, spreading long distances through wind, water, moisture, small drops in the air, animals, insects, machinery, people, and spreading thousands of hectares of wheat in a short time (epiphytic).), forming a large crop loss. According to

scientific sources and production experiments, an average 30-35 per cent of the grain to be harvested is lost, and 70-95 per cent in the year of their mass occurrence.

According to V.A.Zaharenko, an academician at the Russian Academy of Sciences of Russia, an average of 34 per cent of the annual wheat harvest is lost annually as a result of the effects of diseases around the world. The author notes, which due to the declining phytosanitary conditions in the wheat fields throughout the Russian Federation, 1.5 times the volume of wheat harvest was lost in 1986-1995, with a total grain loss of 106 million tons.

M. Koyshibaev in the northern parts of Kazakhstan in the 1990s noted that in 2001, wheat rust had 6 cases of epithelium of brown rust and septoriasis, leading to 20-30% grain loss and a reduction in quality. The author emphasizes that in recent years, the epithelium of yellow rust has been frequent in the eastern and southeastern regions of the country, and crop losses have been on the rise.

In Turkmenistan, more than 300 pests, more than 30 phytopathogens, and more than 100 types of weeds are affected by grain yields and crop quality. High results against these pests can only be achieved by conducting coordinated combative measures.

Based on the data collected from our field surveys in the fields of the regions in 2001-2017, comprehensive measures to combat wheat diseases have been developed and put into production. Given the soil and climatic conditions of our country and the peculiarities of agricultural management, the varieties cultivated and the types of chemicals used, the developed measures are now yielding high results in production. The final results of the wheat disease control program are mainly dependent on the source of the pathogen, the transition to healthy plants. For example, it is highly effective to treat only seeds with fungicides against fungal diseases that transmit to healthy plants through seeds, but agro technical measures, such as pre-planted varieties, fertilizers, sowing time, and seeding rules, do not yield much results. At the same time it changes in the types of crop rotation, including septo-riosis, helminthosporiosis, rhinophosporiosis, and pre-crop rotation (sowing) and soil-borne diseases and post-harvest vegetation residues. High results can be achieved by using the types and types of mineral fertilizers. Weather conditions, wheat varieties are of great importance in the mass emergence of corrosion, leachate diseases, which are spread through air and water droplets in the air, and agro technical measures are

less effective. However, despite these circumstances, the use of fungicides remains one of the most effective measures against all the above diseases of wheat.

The occurrence of post-disease diseases is mainly due to the presence of residues of diseased wheat in the wheat fields (straw, wheat germinated from fallen seeds), the presence of cereal weeds, the instability of disease-resistant varieties and grains from diseased plants, the prolonged release of free-flowing grains and factors such as prolonged retention of moist air (70% and above) during wheat growing.

Therefore, we recommend that the main focus be on integrated measures to combat the diseases that occur during the growing season of winter wheat and are spread through air and water droplets.

Influence of crop on crop. The type of crop is not important in the development of rust, especially in its prevention. This is because as a result of the release and spread of pathogens (spores) from diseased wheat, healthy wheat is infected with these diseases at any stage of the growing season. However, the pathogens that cause these diseases are more common only in the wheat planted in the cultivated area, as free-growing (obligatory) plants. This is because, in our opinion, the duration of the growing period of wheat is prolonged in order to maintain good moisture and a high degree of nitrogen retention in the arable land. As a result, its resistance to disease is reduced. Scientific data have also been shown to play an important role in the occurrence of rust and leaf-infectious diseases in wheat. The main reason for this is explained by the fact that rusts spread mainly through plant residues.

Our phytosanitary surveys show that the disease of wheat with rust and sep-thoriosis depends to a certain extent on the type of crop sown and the variety's resistance to the disease. When regular wheat is planted in one place the incidence of rust and septoriosis in those areas in recent years and the incidence of plant diseases are high (Table 1).

As can be seen from the table, it is important that regular sowing of wheat crops in the winter wheat crop is important for the formation and spread of rust, and that the remains of diseased wheat (leaves, stems, grains) remain in the field. When two-sided crops (cotton, alfalfa, mash) were planted in the fields where these diseases occurred, and then wheat was planted, the disease was reducmashed or eliminated.

Table 1

The onset of rickets and septoriasis impact of the crop (Desert variety)

Types of plant crops	Yellow rust (spread level%)		Septoriosis spot, score	
	In sucking	grains in milk occuring	In sucking	grains in milk occuring
2006				
Corn	9,8	15,2	2	3
Cotton-plant	2,8	7,0	0	2
Lucerna	4,7	6,2	1	2
Winter wheat	15,9	19,5	3	4
2007				
Corn	11,3	16,0	1	2
Cotton-plant	2,1	3,9	1	1
mash	5,0	6,2	2	3
Winter wheat	17,0	33,2	3	4

The importance of crop rotation. Winter wheat is also a major source of plant residues and soil in the mass occurrence of rust. Pathogens overwinter mainly in soil, especially in plant residues, and next year they will reappear there and infect healthy plants. The results of our experiments show that if you carry out crop rotation, that is, sowing non-infectious crops (two-sided or perennial herbs) in the area where the disease has occurred leads to disease reduction and prevention.

Importance of mineral and organic fertilizers. DJ.T. Djiembayev notes that during the development of winter wheat: during the fall and spring and during the thawing period, when chlorophyte potassium fertilizer with 200 kg of superphosphate per hectare is applied, the incidence of rust is reduced by 15–20%.

In the northern regions of Kazakhstan, 90 kg of phosphorus fertilizer per hectare was applied to 4 sows of wheat, and rust was less common and 1.5–2 times higher than in control. In the case of

superphosphate supplementation, the incidence was 1.5-2.2 times higher and 1.1-1.2 times higher in nitrogen.

S.A. Abiyev notes that only nitrogen fertilizers increase the green mass of steam and reduce the resistance to diseases, and when given superphosphate, the growth of wheat accelerates and the growth period is shortened. The author shows that when nitrogen, phosphorus, and potassium fertilizers are administered in accordance with the norm, the incidence of rust with rust is reduced.

M. Koyshibaev notes that in the Kostanay region of Kazakhstan, the disease decreased 1.3-1.7 times in 1992-1993 when the epithelium of brown rust in the Irtyshanka 10 and Selinny-Jubilee varieties of wheat was given, and 20 kg / ha of superphosphate was applied per hectare.

The results of our 2009-2016 observations showed that to some extent, mineral and organic fertilizers have an effect on the occurrence of rust. That is, when 100 kg of phosphorus per hectare and 300 kg of nitrogen per hectare were applied to the top, the field-level prevalence of rust in the Sahara variety was 15.3 and 24.1%, respectively, in 2009 and 2010, respectively. In Turkmenbashi-1, the incidence of corrosion was 21.6 and 27.2%, respectively, compared to all other variants. The same result was obtained in the areas of 300 kg of nitrogen per hectare, 80 kg of potassium and 200 kg of phosphorus.

In our opinion, with the supply of nitrogen fertilizers only to wheat, the period of its growth and maturation is extended, and as a result, the resistance to diseases is reduced. On the other hand, when nitrogen and superphosphate are combined, on the contrary, the growing period of wheat is shortened and the disease resistance is increased. The results show that potassium and phosphorus fertilizers, trace elements such as zinc, copper, and silver, as well as organic fertilizers, are important in the normal development of wheat and its resistance to disease.

Importance of planting time and norm. M.Koyshibaev in 1991-1994 study in the Kustanai region concluded that wheat sowing dates were irrelevant in the occurrence of brown rust. This suggests that the disease is more likely to occur only in rainy years, depending on the weather. In 1991, in the first half of the wheat growing season, when the rainfall was 2.6 times normal (51 mm), brown and stalk rust appeared only in late-sown wheat. However, in 1992 and 1993, with 1.3-1.8 times more rainfall, these diseases occurred first in early sown wheat and later in late sowing.

As a result of our research, yellow and brown rust has been found to be more prevalent, especially in the rainy years, first in early sowing (September, October), and then in mid and late (November, December) sowing. These areas were even more prevalent in areas where wheat was overgrown and sown with an increase of 4.0-5.0 million hectares per hectare. When sowing wheat, the formation of dense stems and leaves in areas with higher planting norms disrupts the air exchange and creates favorable conditions for the emergence of diseases. In particular, the constant rainfall, the drop in moisture, leads to the mass emergence of diseases. During the dry or rainy years, the incidence of diseases was low in areas with sparse germination (0.5-1.0 million ha / ha), only in some areas, in single plants, and their incidence was low. In general, the rusts are low in the rainy, arid years, in the first half of the growing season of late wheat, and in the high rainy years, first in the early sows, then in the middle and late sows, especially in the increased sowing norms. They were encountered masse in the places where they were taken.

Chemical control measures. NI Vavilov points out that the only way to protect plants from diseases is to be environmentally friendly and economically inexpensive, to plant disease-resistant varieties. However, due to the presence of brown rust and leaf spot epithelium in wheat in the Kustanai variety section of Kazakhstan in 1993-1994, no resistance to these diseases was observed in any of the tested varieties, and all varieties, i.e. 34 varieties, were strong and only three varieties. In the Akmolla region, too, when the epithelium of brown rust and leaf yellow spot disease occurred in 2000-2001, 70 districts of wheat were infected with these diseases to varying degrees.

As it turns out, as a result of the evolution that has been going on for years, all kinds of free-living creatures are developing at a high rate, forming new genes that overcame the barrier to stability in plant varieties. Therefore, academician R.A. Urazaliyev argues that "despite the rapid pace of plant selection, only chemicals can be used to combat them due to the emergence of new species of fungi, bacteria, viruses and mycoplasmas."

The results of analyzes of literary sources show that agro technical methods and biological means alone are not enough in the fight against wheat diseases and in reducing the damage they cause. For example, the results of special calculations by American experts showed that if chemicals were not used, pesticides would be lost by 30%, and grain

prices in the markets would increase by 50-70%. Therefore, in the integrated management of plant protection against diseases, of course, first of all, natural factors should be used, and it is recommended to use chemicals if the incidence of the disease is high and the damage will be economically significant.

Chemical control of fungal diseases of grain crops began in Kazakhstan in the 60s of the last century. For the first time in Almaty oblast, A. Tursumbaev uses colloidal and broken sulfur, carotene and mores tan fungicides against wheat germs and these remedies have an 80-90% biological effect against the disease, with 5.3-8.3 centners per hectare of their sown area determines whether the grain crop is protected.

The results of our study in 2004-2017 showed that good results could not be obtained without the use of hi-chemical agents when rust-borne rust epidemics occurred in the form of epiphytotic. Therefore, we recommend that chemical contaminants be used as soon as possible to prevent the spread of pesticides in the affected areas.

In the experiments, only chemicals against rust were effective when applied in a timely manner. For example, in 2010, in the Sahara variety of winter wheat, yellow rust and leakage occurred during the blizzard. The prevalence of yellow fever was on average 1-2% and that of leprosy was 21%. Alto-Super, 3% KE, broader 30 KE, title DUO, colossal Pro, merit and rex, 12.5% fungicides showed 81.2-93.3% efficiency against yellow rust and spread the disease to the surrounding area prevented and led to the disappearance of symptoms of the disease, the development of diseased wheat, the normalization of growth.

The efficiency was in the range of 47-86.4% due to the high incidence of leprosy and the high incidence of plant diseases (3 points) during the spraying of fungicides. However, leprosy was also prevented from spreading. In the areas where the fungicides were used, healthy yields were measured, and the average weight of 1,000 grains was 5.5-9.5 grams per hectare and 3.7-9.5 centners per hectare compared to control. 13-33.3%) led to excessive grain retention (storage).

Experiments were carried out on 15 hectares of wheat during the grain-growing period of the Sahara variety of wheat (Table 2) in order to identify new types of highly effective fungicides against yellow rust (Table 2).

Table 2

Influence of fungicides on rust (Sahrai variety)

Fungicides	Sprinkled rules l/ha, kg/ha	Sprinkled number	The plant is diseased level, %		Biological efficiency %
			Before spraying	15 days after spraying	
Control	-	-	33,1	34,2	-3,3
Colossal Pro	0,3	1	33,6	1,4	95,8
Title DUO	0,25	1	36,2	1,9	94,7
Merit	0,8	1	35,0	2,0	94,3
Alto super, 3% k.e.	0,5	1	28,1	1,8	93,6
Broader 30 KE	0,4	1	24,3	2,1	91,4
Sineb SP	3,2	2	29,5	4,9	83,4

As can be seen from the table, the diseased levels of wheat in the experimental fields were in the range of 24.3-36.2% before the fungicide was sown. In experiments, systemic fungicides - colossal Pro, titanium DUO, merit, alto super and broader - were sprayed 15 days after spraying, and the rate of infection in plants was reduced to 1.4-2.1%. The growth of diseased plants has begun to normalize, the pustules on the leaves have dried up, and they are noticeable. The experiment was comparative, i.e., the effect of the touch-affected mercury SP was also low (83.4%), despite the fact that this fungicide was repeatedly sprayed 14 days after the first time.

In the controlled form of the experiment, the incidence and spread of yellow rust continued. To determine the effect of the fungicides used on winter wheat yields, 5 sample bundles of 1 m2 each were obtained from the types of experiments. The biological yield was calculated on 1 hectare by determining the number and weight of the stalks, stalks, and grains in each stalk in the experimental bundles (Table 3).

Table 3

Effect of fungicides on yield (Sahara variety)

Versions	Number of suck	1 account in the dice pf grains weight	Gram of in one suck grain	Biological fertility S/ha	In additional (protected) s/ha (%)
control	456	364,8	0,8	36,5	+0
Kolosal Pro – 0,3 l/ga	460	427,8	0,93	42,8	+6,3 (17,3)
Titul DUO – 0,25 l/ga	463	421,3	0,91	42,1	+5,6 (15,3)
Merit – 0,8 l/ga	460	414,0	0,9	41,4	+4,9 (13,4)
Alto super – 0,5 l/ga	459	417,7	0,91	41,8	+5,3 (14,5)
Broader 30 – 0,4 l/ga	457	420,4	0,92	42,0	+5,5 (15,1)
Sineb SP – 3,2 kg/ga	458	393,9	0,86	39,4	+2,9 (7,9)

As can be seen from the table, the use of fungicides against yellow rust has reduced the symptoms of the disease in wheat. With the restoration of metabolism in the leaves, healthy harvest tests and grains were formed. Compared to the experimental type of experiment, 2.9-6.3 centners (7.9-17.3%) of grain yield per hectare was higher. Biochemical analyzes of grains obtained from wheat treated with fungicides have shown that these fungicides do not degrade the quality of the grain. As a result of laboratory tests, the amount of gluten in grains obtained from sown varieties of systemically effective fungicides during experiments during the grain formation was on average 25.6-28.3% and protein 10.2-13.3%. In the case of experimental exposure (sineb SP), these indicators were 23.6–26.8% and 10.2–11.8%, 21.2–22.8% and 9.5–12.1% in control, respectively was equal to%.

When sowing to determine the effect of the fungicides used on the germination of grains, there was no difference in the germination and germination of the seeds sown from the experimental and control experiments. Efforts have been made to check the effectiveness of new remedies against diseases that occur during the growing season, and to determine the rules and timing of their sowing. As can be seen from Table 4.3.7, the average length of the yellow uredospores in the leaf

varied from 400 KE to 0.3 l / ha in the experimental experiment, with a mean variation of 400 KE to 0.35 l / ha in 16.8 cm. which is 11.2% and 16.8% respectively, respectively. Title DUO - 0.35 l / ha of yellow rust with wheat rust: uredo spores had an average leaf length of 14.2 cm and in control, the average was 16.4 cm. Fifteen days after the spraying of the fungicides, the leaf-length uredo-spores of the yellow rust were reduced to an average of 2.4 cm in the basal 400 KE-0.3 l / ha variant, with the efficiency of the fungicide equal to 78.6%.

The collected data show that high results cannot be obtained without the use of chemicals in the fight against corrosion. Initially, the fight against pests of wheat leads to a decrease in the spread of diseases

Given that the pathogens that cause these diseases can be transmitted to the new generation within 3-5 hours, the chemical control measure should be carried out as soon as possible. We recommend spraying fungicides 2-3 times (alternately) in order to completely eliminate pathogens when the need arises, i.e. if the disease continues or re-emerges. It is necessary to take into account the wheat fields where the diseases have occurred, and in recent years the fungicides have been sprayed on those fields before the disease has appeared, or as soon as the first signs of the disease appear.

Thus, against yellow rust, leakage, septoriasis, and yellow spot disease, 0.4 liters per hectare: alto-super, 3% ke (250 g / l propiconazole + 80 g / l ciproconazole) and broader 30 KE (150 g / l propiconazole +150 g / l diphenoconazole), from 0.35 liters: colossal Pro (200 g / l propiconazole + 200 g / l tebuconazole), title DUO (200 g / l propiconazole + 200 g / l tebuconazole), basil 400 KE (200 g / l propiconazole + 200 g / l tebuconazole) or 0.8 liters: rex, 12.5% ks Spraying of one of the fungicides (125 g / l epoxyconazole), merit (125 g / l epoxyconazole + 125 g / l carbendazim) led to the eradication of these diseases.

Today, these fungicides are widely used in all provinces against diseases that occur during the development of wheat and spread rapidly through air and water droplets, and prevent the growth and reproduction of pathogenic fungi in diseased wheat, preventing their growth and reproduction gives high results in the acquisition, as well as in the treatment of diseases where they occur. As a result, wheat crops grow and grow normally and healthy yields are formed, with an average of 25-30% grain per hectare being protected.

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CONTENT

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TURKMEN AGRICULTURAL INSTITUTE

AGRICULTURAL RESEARCH INSTITUTE

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WHEAT RUST DISEASES AND CONTROL MEASURES