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THE TIME OF SPRING REVEGETATION OF WINTER WHEAT EFFECTING ON THE DEVELOPMENT OF BROWN LEAF RUST

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It is determined the dependence of winter wheat affection by brown rust to time of plants' spring revegetation (TSRV) and to periodicity of solar activity on 55-years observations Myrgorod selection field of Poltava region. Time of spring revegetation is a complex index for following light, thermal and partially water conditions of plants' spring development, that winter. Maximum sowing affection by brown rust was observed in years with average solar activity (61-120 W) under optimum and late time of spring revegetation. Minimum affection that doesn't demand protection agents application was observed in combining of two factors: 1 – in years with early time of spring revegetation (till 20th of March) and not depending on solar activity and 2 – in years with high solar activity (121-190W) and light dependence from time of spring revegetation. Such years were 28 between 55. Obtained results can be used in prediction of brown rust development on winter wheat.

Key words: *winter wheat, time of spring revegetation, brown rust, prediction, periodicity of solar activity.*

Statement of the problem. Brown leaf rust of wheat (pathogen Puccinia recondita f. Sp. Tritici Rob. Ex Desm) is one of the most common diseases [1]. Winter wheat yield loss from its destruction ranged from 3 to 10 and 15 kg / ha or more [9]. In the fight against disease is essential to have timely operational forecast of the pathogen to prevent unexpected epiphytoties or excessive pesticide load on the environment. Existing methods currently prognosis of the disease based on the anticipation phase in the long-cycle of the pathogen and unreliable weather forecasts, that is, in turn, predicted parameters, rather than the actual facts. To improve the forecast called to identify additional factors that affect plant damage by the disease. One such factor may be the time of spring revegetation of winter wheat (TSRV).

Analysis of major studies which discuss the problem. Time of spring revegetation is an integral indicator of these conditions spring overwintering plants: light (length of day, the spectral composition of light), heat (intensity of solar radiation) and water [5]. This figure is not predicted, and determines, programs, sets forward starting dose of these parameters, as varies widely (near Poltava - From 19 February to 17 April, for plants in both cases is the first day of spring life. These extremes TSRV disrupt ecological relationships in the system of plant-pathogen-environment prevailing at the best TSRV, and this action was called ecological effect TSRV. On the foundations of the theory of ecological effect TSRV created dozens of methods, algorithms, techniques, methods of plant breeding in Ukraine, Russia, Czech Republic, Germany [13], which operate in practice. They covered in the textbooks of the plant [2], genetics and breeding of certain plants [12], programming productivity [6]. There are some attempts to use them in entomology [3, 7]. However, the science of plant pathology, these new scientific knowledge until not included.

The purpose and objectives of the study. To improve the prognosis of this disease emergence and plant protection tasked to investigate the effect CHVVV to defeat winter wheat leaf rust brown.

Materials and methods research. The basic material for the study was compiled annual scientific reports Mirgorodska derzhsortodilnytsia for 55 years (1939 - 1940 1943 - 1945 1947 - 2000), preserved in the State Archives of the Poltava Oblast, as well as observations hidrometstantsiy and literature. Material Mirgorodska sortodilnytsia observed agronomic uniformity (occupied by a pair of black manured at the same farming over the years), methodological purity (assessment of the disease on a scale number 2 in two noncontiguous reps state testing) and the fact that it worked consistently experienced professionals: phytopathologists T.M. Koshevenko, V.L. Samoylovich, candidate of agricultural Science N.I .Nechyporenko. The date of spring revegetation recorded by the method of the State Commission for Testing and Protection of Plant Varieties. Of all the competitive set (extended) quality testing, we used data from the standard (ie better zoned) class that best meets grade-ecotypes. For the period called standard varieties succeeded each other in the following order: Ukrainian 246, Lisostepka 75, Bilotserkivska 198, 808 Myronivska, Odessa 51, Ohtyrchanka, Albatross Odessa - they all average persistent to defeat disease. The study was carried out by means of statistical grouping of data from the definition of the coefficient of variation and agronomic analysis [11].

Studies. Found that spring revegetation of winter wheat in Mirgorod occurred on average in 55 years on March 26, with the largest deviations from February 19 (1995, 2002) to 17 April (1963, 2003). During this period, was 37 years with damage plant leaf brown rust, including the degree of damage over 50% 12 years, 70% of leaf surface - 3 years. The biggest development of the disease occurred in years when the spring vegetation restored in optimal time 21-31.03 (Table 1), suggesting that the pathogen is well adapted to optimal living conditions of the host plant. Table 1 noteworthy absence or slight damage plants in the early years of the growing season (from 19.02 to 20.03), which does not require chemical protection. Over the 19 years only once (in the 1977th, very wet year) lesions reached 53% of the leaf surface, but it is evident later - the first generation failed to develop, so little effect on yield (53.3 t / ha). Slight variation coefficient indicates the stability of such dependence. On the contrary, a significant variation (dispersion) data optimally years and later TSRV indicates strong influence on the development of the pathogen have some factors. One of these factors are forecasting deal may be periodicity of solar activity, as measured by the number of spots on the solar disk (Wolf number W).

1. Number of years of defeat and the average percentage of leaf rust brown lesions standard variety of winter wheat in the state testing in 55 years

TSRV	Number of years				The average percentage of diseased leaf area		Coefficient of variation, V%
	together	including			during the years of damage	during all years	
		without damage	infestation with> 50%	infestation with> 70%			
19-28.02	6	3	-	-	19,7	9,8	7,7
1-10.03	3	3	-	-	0	0	0
11-20.03	10	3	1	-	24,1	16,9	6,8
21-31.03	21	6	6	1	45,4	31,3	29,0
1-10.04	11	3	4	2	37,2	31,0	11,7
11-20.04	4	-	1	-	28,7	28,7	15,6
All years	55	18	12	3			

Indeed, such a relationship exists (Table 2). It is most often and most crops of winter wheat on Mirgorodska sortodilnytsia was affected by brown rust in years with moderate solar activity (61-120 W) than optimal, and (especially) for late TSRV. For low solar activity (1-60 W) damage was smaller, and for high - quite small. At first glance, it seems strange that the greatest development of brown rust pathogen does not coincide with the maximum and average solar activity. However, it became clear that this is consistent with the laws of astrophysics. That is the main indicator behaves emissivity of the Sun - solar constant Eo, depending on the frequency of its activity: it increases rapidly with increasing the number of sunspots from 1 to 60, reaches a maximum W = 61-120, and then decreases, reaching the lowest values W, equal 250 [8].

2. The influence of solar activity W to damage of winter wheat by leaf rust brown in years with optimal and late TSRV

Index	W		
	1-60	61-120	121-190
Optimal TSRV (21-31.03), 21 years			
Average% damage	32	57	14
Number of years	12	5	4
including with damage of more than 50%	3	3	0
Late TSRV (1-20.04), 15 years			
Average% damage	27	81	26
Number of years	7	3	5
including with damage of more than 50%	2	3	0

From the analysis of the data in tables 1-2 we see that the low development of a brown leaf rust pathogen of wheat in Mirgorod that does not require the use of protective measures (unless required by other diseases), there during the years with spring revegetation before March 20 - regardless of periodicity of solar activity - and in the years of maximum solar activity (W = 120-190) regardless of TSRV. There was 28 years of study 55, that is half. Of course, theoretically possible exceptions to this rule - the large stocks of infection in nature and subject to the express terms of constant rain, dew, high humidity in the spring and summer. Such conditions are only partially observed once in half a century in 1980. In practice, this conclusion is important because reasonable rejection of cultivation of crops saves money, increases the purity of products, reduces pesticide load on the environment. However, it is equally important to take into account trends in the time of the arousal of winter plants. From the same data in 55 years we conclude: in the 30's and 40's of last century vegetation of winter wheat recovered on average April 3-4, in the 50's and 60's March 30-31, in the 90s and in the years 2001-2010 - already 15-19 March, including 6 years was a constant TSRV in February. It is no accident recently significantly diminished rust in field crops production. So TSRV ever younger, also increased the scope of its deviation from the norm in both sides that need to be considered in strategic forecasting the development of disease.

It remains to investigate the mechanism of action TSRV and answer the question of why such a seemingly unobtrusive phenomenon as the spring arousal of plants has a strong effect on the system agrobiocenoses? Early vegetation - a short winter and long spring, late vegetation - long winter and short spring. TSRV, in essence, is the same as the height of the sun above the horizon. The above major deviations from the norm TSRV 19 February and 17 April for plants and pathogens - is not different dates, and in both cases, the first day of spring arousal life. In the first case (February 19) the sun is only 28 height at apogee, sunbeam, overcoming a thick layer of Earth's atmosphere, lose shortwave part of the spectrum, a short day the earth reaches a orange-red rays of low energy (total radiation 310 calories · cm^2 · day) . In the second case, the first day of arousal plants April 17 the sun is at an altitude of 50,3 at apogee, for a long day on the ground, it sends energy 615 calories · cm^2 per day. This affects the starting temperature of plants and pathogens (Table 3), regardless of weather changes.

3. Average temperature of the first decade after the spring arousal of winter wheat plants during the earliest and latest TSRV

Index	Optimal TSRV (norm)	Early vegetation		Late vegetation	
		1998 year	2001 year	1963 year	2000 year
Date of TSRV	26.03	22.02	11.03	17.04	5.04
The average temperature after the spring arousal of plants, C:					
the first 10 days	5,9	1,8	5,4	11,5	10,6
the second 10 days	8,2	3,6	1,6	15,6	15,6
the third 10 days	10,5	7,7	8,0	19,1	14,3
the fourth 10 days	12,6	9,5	10,3	19,9	13,2
for 40 days	9,9	5,7	6,3	16,6	13,4

Infection of plant rust teliospores occurs at temperatures between 2.5 and 31 C (optimum 15 - 25 C) subject to the drops of dew or rain on the leaves [9]. Other authors [10] as the minimum average daily temperature of infection, call +5 C. Listed in the table. 3 temperature favorable for the pathogen up for optimal TSRV and adversely - by early TSRV in the first two decades after regrowth. For plants, however, these early TSRV temperature is extremely favorable for the growth of biomass, because they quickly become immune to the pathogen, although infections that stock will be in nature. This explains the slight development of rust or it's lack in years with early TSRV. As pointed out by the theory of ecological effect TSRV by V. Medynets [5], in such years crop of winter wheat eventually forming density of productive stems 600-800 pc. on 1 square meter dry biomass yield of 150-200 kg / ha, and for the late vegetation crops mainly liquefied (250-350 productive stems on fallow land), undersized, easily blown by the wind through, sometimes hinder the development of brown rust in comparison with the optimal TSRV.

Conclusions:

1. In '55 state testing on Mirgorodska sortodilnytsia winter wheat restore the spring vegetation average on March 26 with deviations in some years from 19 February to 17 April.
2. The greatest development of brown leaf rust on winter wheat crops occurred in optimal TSRV (21-31 March), because the pathogen is well adapted to optimal, particular heat, living conditions of the host plant.
3. The smallest growth of the pathogen brown leaf rust on winter wheat (which does not require the use of protective measures) was observed during the years of the early vegetation (from 19 February to 21 March) almost regardless of weather and solar activity and during high solar activity (120-190 W) no TSRV. There was 28 years of study 55.
4. The spring vegetation begins before applying protection measures, so the conclusions set out in Section 3, provide an opportunity to prevent epiphytoties or refrain from spraying fungicides, which reduces costs, provides clean production and reduce pesticide load on the environment.
5. Proposed for use in strategic, operational forecasting of brown leaf rust pathogen new indicator - the time of spring revegetation of winter wheat.

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