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Spectral assessment of varieties and breeding lines of winter wheat during the restoration of spring vegetation

Abstract. The development of new and implementation of existing methods of field assessment of winter wheat genotypes is one of the key tasks of modern breeding. The use of modern screening methods in breeding allows the breeder to get a more objective assessment, as well as to increase the volume of the studied samples several times. The time of spring vegetation recovery (TSVR) is one of the key stages of the vegetation period of winter wheat. Biometric and spectral assessment of winter wheat with the onset of the TSVR allows establishing how plants of a certain genotype overwintered, as well as the state of their growth and development before the start of the second growing season. The purpose of this study was to determine the characteristics of plant growth and development of modern varieties and promising breeding lines of winter wheat of The V.M. Remeslo Myronivka Institute of Wheat (MIP) from sowing to the restoration of spring vegetation. The hydrothermal conditions of the seedling-TSVR period had diverse effects on the reproductive process of the genotypes of winter wheat under study. According to the study results, abnormally dry conditions of the period from sowing to the end of the autumn growing

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season in 2019 adversely affected the condition of winter wheat plants that were in BBCH Phase 10-13, autumn tillering did not take place. Regardless of the genotype, plants were more developed during the first sowing period. According to biometric and spectral parameters, at the time of spring vegetation recovery, the following varieties turned out better than the Podolyanka standard variety (NDVI = 0.52): MIP Dnipryanka (NDVI = 0.58), MIP Lada (NDVI = 0.56), Balada Myronivska (NDVI = 0.56) and lines Lutescens 37519 (NDVI = 0.55) and Erythrospermum 55023 (NDVI = 0.58). During the second sowing period, the variety MIP Dniprнanka (NDVI = 0.45) and the selection lines Lutescens 37519 (NDVI = 0.44) and Erythrospermum 55023 (NDVI = 0.43) were selected. The standard Podolyanka variety had an NDVI index value of 0.43. MIP Lada and Balada Myronivska varieties react more sensitively to the timing of sowing and need a longer period of autumn vegetation to accumulate more dry matter and better pass the winter rest period.

Keywords: soft winter wheat; varieties; breeding lines; spring vegetation recovery time; NDVI index; biometric analysis; morphophysiological analysis

RELEVANCE

Among the most important grain crops, winter wheat takes the first place in Ukraine in terms of cultivated area and is the main food crop. Over the past three years, the sown area of this crop reached approximately 6.8-7 million ha, which is a quarter of the entire arable land of Ukraine.

One of the factors of agricultural intensification in Ukraine is the collection and evaluation of remote sensing spectral data. Presently, the use of satellite monitoring during the growing season of agricultural crops is becoming the norm in the production activities of most agricultural enterprises.

The introduction of the latest scientific and technical achievements in breeding practice not only improves the quality of evaluation of the source material, but also increases the volume of samples studied. The spectral assessment of winter wheat plants in a complex, considering the data of morphological and biological analysis, allows identifying the reaction of the genotype to environmental conditions, the level of which depends on such properties as cold and frost resistance, drought resistance, resistance to pathogens, etc.

The development and implementation of a comprehensive method for field assessment of winter wheat genotypes based on spectral and morphobiological analysis will improve the quality of selection of initial forms and enable a more comprehensive investigation of the created varieties and breeding lines.

ANALYSIS OF RECENT STUDIES AND PUBLICATIONS

The time of spring vegetation recovery plays a noticeable role in the life of wintering plants, since the intensity and duration of solar radiation considerably affects their growth and development (V.D. Medynets, 2014.; V.D. Medynets, 1974.; O.Ye. Medynets, 2014; V.D. Medinets, 2001).

An increase in the average daily air temperature contributes to the gradual restoration of all physiological and biochemical processes in the plant. The ecological effect of the spring growing season recovery time allows predicting the ontogenesis of winter wheat in the second half of the growing season with high reliability. To a large extent, the final productivity of the crop is not influenced by the starting conditions of the TSVR (nature and quality of solar radiation), but by a more stable indicator – the duration of vegetation from its recovery to earing. The longer this period, the better plants use the energy of the Sun's rays during photosynthesis.

The essence of this natural phenomenon is related to the radiation regime, duration, intensity, and qualitative composition of sunlight, its exceptional role in the life of a plant organism. During the early recovery of the spring growing season, the intensity of blue-violet rays of the solar spectrum is quite low, and during the late recovery period, it increases and the intensity of red rays prevails. The later the vegetation of winter wheat resumes, the more total radiation enters the surface of crops. Therefore, in years with a late spring, plants grow and develop in conditions of higher air temperature and more solar energy. In the case of early spring, the vegetation of winter wheat occurs at lower temperatures and their slow growth, which is more favourable for the regeneration of damaged organs, plant growth, and the course of all growth processes (V.D. Medynets, 1974; V.D. Medynets, 2001; Yu.F. Tereshchenko, 2014).

Currently, methods of phenotyping winter wheat are the principal methods of breeding this crop in leading breeding institutions of developed countries of the world. All spectral studies are carried out using the basic NDVI index (Normalized Difference Vegetation Index, B.J. Rouse *et al.*, 1973). Recent studies indicate a close correlation between the NDVI index obtained during winter wheat flowering and yield results (T. Duan, S.C. Chapman, Y. Guo, B. Zheng, 2017).

Given that the UAV image acquisition operation is less time-consuming and with higher accuracy than previously used imageless proximal sensing, airborne UAV-based multispectral sensing is expected to increase the efficiency of high-throughput phenotyping (M. Maimaitijiang, A. Ghulam, P. Sidike, S. Hartling, M. Maimaitiyiming, K. Peterson, E. Shavers, J. Fishman, J. Peterson, S. Kadam *et al.*, 2017; M. Tattaris, M. P. Reynolds, S.C. Chapman, 2016).

The purpose of this study was to establish the features of plant growth and development of modern varieties and promising selection lines of winter wheat of MIP selection from sowing to the time of spring vegetation recovery using spectral and biometric evaluation.

MATERIALS AND METHODS

The study was conducted during the 2018/19-2020/21 growing seasons in the selective crop rotation of the winter wheat breeding laboratory at the V.M. Remeslo Myronivka Institute of Wheat (MIP) of the National Academy of Agrarian Sciences of Ukraine. Sowing was carried out after the soybean predecessor in two terms: 2018 – September 25 and October 5; 2019 and 2020 – October 5 and 15. Placement of land plots was systematic, four-fold repetition, accounting area – 10 m^2. Seeding rate – 5 million germinating seeds per 1 ha. The Podolyanka variety was used as a standard. Agricultural cultivation techniques were generally accepted for the Forest-Steppe zone. The study was conducted according to the “Methodology of the Field Experiment” (B. A. Dospekhov, 1979), phenological observations and records – according to the “Methodology of the State Variety Trial” (V.V. Volkodav, 2003). The main method of research is field-based, supplemented by analytical studies, measurements, calculations, and observations.

Spectral evaluation of winter wheat varieties and breeding lines was performed using a Mavic Zoom 2 UAV using a Parrot Sequoia multispectral camera. Pix4Dcapture and Pix4Dmapper software were used to form the orthophotoplan. Photo recording was performed with a multispectral camera at 30 m above the level of the object under study to improve the quality of the orthophotoplan, with an overlap of 80% of the images and with a time interval of two seconds. The NDVI index (Normalized Difference Vegetation Index) was calculated using the formula (“Measuring Vegetation”. NASA Earth Observatory. 2000-08-30.):

$$NDVI = \frac{NIR - RED}{NIR + RED}, \quad (1)$$

where NIR is a reflection in the near-infrared region of the spectrum; RED is the reflection in the red region of the spectrum.

The years of the study were contrasted with the hydrothermal regime, with an uneven distribution of precipitation over the months, which allowed for objective data. Meteorological conditions were analysed using data from a private stationary weather station connected to the Meteoblue global system (Basel, Switzerland), located within a radius of 6 km from the fields where the study was conducted.

Biometric analysis was conducted according to the method of F.M. Kuperman (F.M. Kuperman, 1977), as well as according to the scientific publications of the MIP (V.T. Koliuchyi, V.A. Vlasenko, H.Yu. Borsuk, 2007).

RESULTS AND DISCUSSION

It is known that the rapid growth and development of winter wheat plants in autumn are incompatible with high winter hardiness (V.V. Volkodav, 2003). Plants are characterized by wide leaves, develop rapidly at all stages, especially during the tillering period, which adversely affects the course of hardening processes to the action of low temperatures. They are characterized by a rapid rate of development since the resumption of spring vegetation, have a large ear and large grain, and under conditions of favourable wintering can form a high yield. In natural conditions, plant growth and development depend on a complex of factors: soil, nutrients, light, moisture, heat, etc. A favourable combination of these factors enhances growth processes, and in case of their lack or excess, the weakening of plant development is noted (A.V. Cherenkov, A.D. Hyrka, O.O. Pedash, O.I. Dubovyi, 2009). Long-term observations and practice prove that in years when full-fledged sprouts are obtained in time, crops in the autumn develop well and have a strong root system and, as a rule, provide a high yield of grain even under adverse weather conditions in the summer months. Weakly developed and thinned autumn crops are almost always low-yielding (https://propozitsiya.com/sroki-poseva-ozimoy-pshenicy). The autumn period of 2018 was excessively wet (HTC = 1.76), the rest – dry (HTC = 0.005-0.27). The temperature regime of the growing season over the years of the study was slightly higher than the annual average (over the past 30 years).

Weather conditions in 2019 were unfavourable for seedlings: the amount of precipitation from August to the end of October was 28.7 mm (long-term average – 163.2 mm). The air temperature for August-October 2019 exceeded the long-term average values by 0.4-2.7°C. The increased temperature regime was observed in December 2019 and February 2020 – 8.1°C, with an average long-term value of 5.9°C over the past 30 years. Sharp changes in air temperature did not help winter crops to complete the hardening phase necessary for overwintering and to accumulate sufficient sugars in the nodes of the shoots. Their value was at 20% or lower, which is insufficient to counteract the adverse factors of wintering. This sugar content and the lack of snow cover during the winter led to the complete or partial death of winter crops, especially in the plots during the second sowing period. Such weather conditions created a natural background for selecting shapes with high adaptive capacity.

According to weather conditions, the 2018/2019 growing year was the most favourable for the growth and development of winter wheat plants. Thus, according to the amount of daily precipitation during the autumn-winter period until the time of vegetation recovery (March 4) in the spring, the year was quite wet, with repeated precipitation of more than 5 mm, which were productive (Fig. 1).

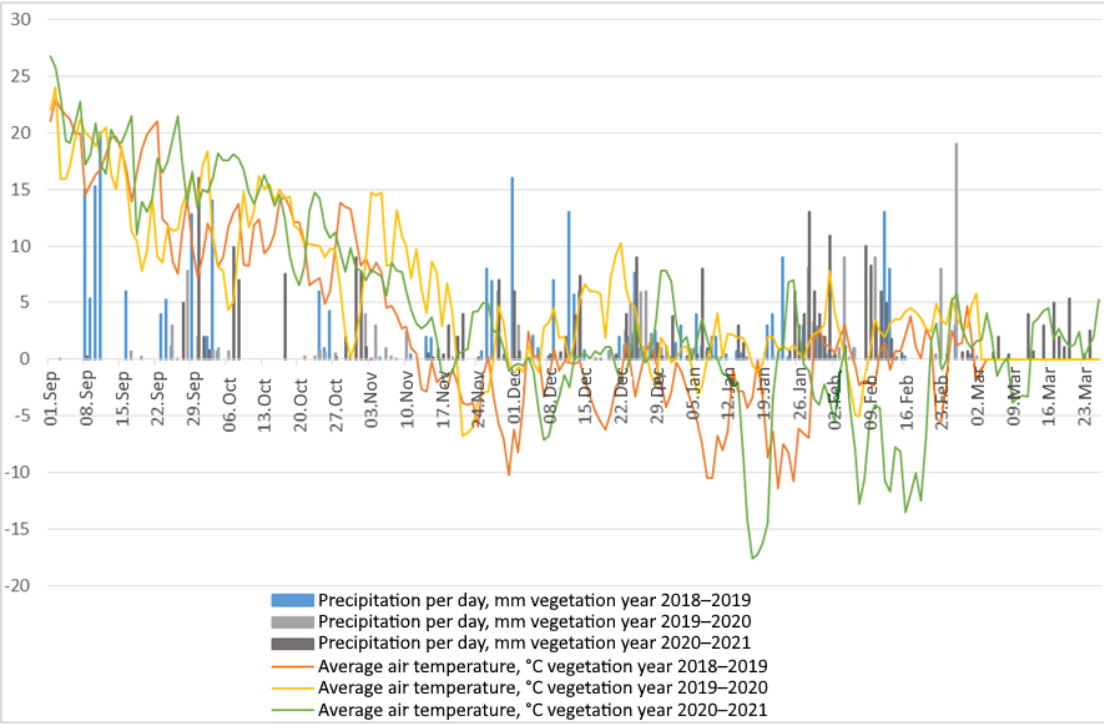

Figure 1. Climatogram of the autumn – TSVR period for 2018-2021, MIP

In the specified period of 2019/2020, the vast majority of precipitation did not exceed 5 mm, so it can be considered abnormally dry for the Forest-Steppe zone of Ukraine. During the resumption of the spring vegetation in 2020 (March 2), two rains of approximately 8 and 18 mm of rainfall were recorded, but this was insufficient to successfully establish the root system, the number of leaves and productive shoots.

In the autumn of 2020, four cases of productive precipitation (over 7 mm) were observed, as well as a substantial amount of precipitation during the period of winter dormancy. In general, moisture accumulation in the soil was more than sufficient for high-quality plant fertilization and successful restoration of spring vegetation (March 26).

The average air temperature during the autumn – TSVR period of the 2018/2019 growing year turned out to be more than optimal for the normal growth and development of winter wheat plants. A gradual decrease in the air temperature towards negative values positively affected the biochemical and physiological processes during the hardening of plants. This temperature regime positively affects the hardening of plants (Pirych, Bulavka, Kovalyshina, Derhachev, Humeniuk, 2018).

November 2019 was relatively warm and dry, but with sharp drops in air temperature to minus 5-7°C. The average value of the indicator in the winter period of the 2019/2020 growing year was mainly within 0-+3°C and only sometimes passed to a negative value, which indicates an almost complete absence of winter dormancy in winter wheat plants.

The autumn period of 2020 was satisfactory for the development and growth of winter wheat plants. In the pre-sowing period, two rainy days were noted with precipitation of 18 mm (out of a total of 24.1 mm for the entire period), which allowed for sowing in moist soil. The total amount of precipitation in autumn was 68.6 mm, which ensured good shoots and normal growth processes.

The heat requirement of plants is characterized by the sum of the average daily temperatures after their passage through the biological minimum for a certain growing season. It is known that during the autumn vegetation, winter wheat plants from sowing to stable transition at +5°C must undergo the second stage of organogenesis, form two to four stems and harden. For this, they need to collect the sum of effective temperatures of 450-550°C, provided that there is sufficient moisture (Tanchyk, Mokriienko, Motornyi, 2014). Under such conditions, plants accumulate a sufficient amount of plastic substances for the overwintering period, which allows them to better withstand the harsh conditions of both the winter and spring-summer growing seasons. In the fall of 2020, winter wheat plants of the second sowing period, during the period from sowing to a stable transition through +5°C, gained the minimum amount of active temperatures (Table 1).

Table 1. Characteristics of the weather conditions of the pre-sowing period, autumn vegetation and the TAVC-TSVR period, (2018/19-2020/2021, MIP)

Year	Interphase period	Date	Precipitation, mm		Sum of active temperatures, °C	
			sowing period		sowing period	
			I	II	I	II
2018/2019	Pre-sowing	01.09.18-24.09/04.10.18	71.0	101.7	439.1	537.9
	Sowing-TAVC*	25.09/05.10.18-05.11.18	37.7	7.0	427.3	328.5
	TAVC-TSVR**	06.11.18-04.03.19	160.4		-234.8	
2019/2020	Pre-sowing	01.09.19-04/14.10.19	14.8	16.5	533.2	639.5
	Sowing-TAVC	05/15.10.19-19.11.19	15.2	13.5	443.0	336.7
	TAVC-TSVR	20.11.19-02.03.20	115.9		175.1	
2020/2021	Pre-sowing	01.09.20-04/14.10.20	24.1	41.0	617.9	780.3
	Sowing-TAVC	05/15.10.20-10.11.20	44.5	27.6	418.5	256.1
	TAVC-TSVR	11.11.20-26.03.21	190.8		-142.0	

Note: * – time of autumn vegetation cessation, ** – time of spring vegetation recovery

A value of 418.5°C was recorded for the first and 256.1°C for the second sowing period. In percentage terms, the difference in the sum of the average daily temperature between the sowing periods was 38.8%, and in 2018 and 2019 – 23.1% and 25.0%, respectively.

The autumn period of 2018 was the wettest and warmest, which was a prerequisite for the good development of winter wheat plants during both sowing periods: over 107 mm of precipitation (a sixth of the long-term average for this zone); 18 days with an average air temperature of +10°C for plants of the first sowing period and 14 days – for the second period.

During the above period, 30 mm of precipitation fell in 2019, of which only two productive rains can be distinguished, which fell almost at the end (03.11.19 and 11.11.19, respectively) of the autumn growing season (4.0 and 2.4 mm). Under such conditions, at the time of termination of the growing season, winter wheat plants were in a development phase that varied between phases 10-13 according to the international BBCH classification, no autumn tillering occurred. Notably, the winter dormancy period until the resumption of spring vegetation was abnormally warm: the average daily air temperature ranged from 0°C to +1.6°C, and its repeated excess of +5°C was noted. The average value of the indicator for winter dormancy in the 2019/2020 growing year was +1.68°C, while in 2018/2019, 2020/2021 – -1.97°C and -1.04°C, respectively.

Consequently, the hydrothermal conditions of the germination period had different effects on the reproduction process of the winter wheat genotypes under study. Regardless of the genotype, plants were more developed during the first sowing period. Indicators of phytocenosis: the number of stems and leaves, the height of the plant and its weight are presented in Table 2.

Table 2. Biometric and spectral indicators of winter wheat plants of the first sowing period during the resumption of spring vegetation (average for 2018/2019-2020/2021 growing years, MIP)

Variety, breeding line	Quantity per 1 plant, pcs.		Plant height, cm	Weight of one plant, g	NDVI index
	stems	leaves			
MIP Assol	2.49	8.06	19.24	0.86	0.54
Balada MYR*	2.66	8.88	17.45	0.99	0.56
Hratsiia MYR	2.47	8.03	16.31	0.92	0.54
MIP Yuvileyna	2.37	8.21	17.31	1.00	0.53
MIP Lada	2.62	7.89	19.65	1.08	0.56
MUP Dnipryanka	3.10	9.12	18.69	1.04	0.58
Erythrospermum 55023	2.50	8.35	16.84	1.07	0.58
Lutescens 55198	2.43	8.28	17.13	0.93	0.52
Lutescens 37519	4.09	8.37	17.77	1.02	0.55
Lutescens 60049	2.24	7.79	16.23	0.81	0.53

Table 2. Continued

Variety, breeding line	Quantity per 1 plant, pcs.		Plant height, cm	Weight of one plant, g	NDVI index
	stems	leaves			
Lutescens 60107	2.87	8.12	17.99	0.95	0.52
Podolyanka St	2.62	8.14	16.98	0.77	0.52

Note: * MYR – Myronivka

Biometric analysis data, combined with the NDVI Index, allows for a more objective assessment of the condition of plants after overwintering and provides insight into how they develop, simulate the relative yield of a certain genotype. The implementation of NDVI index accounting in the selection process improves the efficiency of winter wheat plant state accounting during the growing season: the time for inspecting crops is reduced by 5-6 times and the dependence on weather conditions is reduced; the number of tested samples increases and the quality of the obtained results improves substantially. The breeder has time to interpret the data. Chlorophyll is known to absorb red waves: as a result, photosynthesis occurs, i.e., the plant grows and develops well, and the cell structure reflects near-infrared light. Therefore, there is a correlation between the value of the NDVI index and biometric indicators of aboveground biomass. The use of both methods of determining the state of winter wheat plants in a certain growing season allows establishing the reliability of the observed differences and obtaining the necessary information regarding valuable raw material for selection for high productivity and adaptability.

Varietal characteristics affected the level of development of winter wheat plants during the growing season. The best varieties and breeding lines of winter wheat in terms of the main biometric indicators included: MIP Dnipryanka, MIP Lada, Balada Myronivska, Lutescens 37519, and Erythrospermum 55023. They also had the highest NDVI index value.

During the second sowing period, the MIP Dnipryanka variety and the Lutescens 37519 and Erythrospermum 55023 breeding lines were selected. Varieties MIP Lada and Balada Myronivska were at the level or dominated in some morphological and spectral indicators the Podolyanka standard variety (Table 3).

Table 3. Biometric and spectral indicators of winter wheat plants of the second sowing period during the resumption of spring vegetation (average for 2018/2019-2020/2021, MIP)

Variety, breeding line	Quantity per 1 plant, pcs.		Plant height, cm	Weight of one plant, g	NDVI index
	stems	leaves			
MIP Assol	2.10	6.53	15.98	0.59	0.43
Balada MYR	2.18	6.20	15.58	0.54	0.44
Hratsiia MYR	2.01	5.87	12.99	0.55	0.43
MIP Yuvileyna	2.27	6.28	13.88	0.51	0.42

Table 3. Continued

Variety, breeding line	Quantity per 1 plant, pcs.		Plant height, cm	Weight of one plant, g	NDVI index
	stems	leaves			
MIP Lada	1.86	5.69	14.37	0.55	0.43
MUP Dnipryanka	2.53	6.94	16.74	0.67	0.45
Erythrospermum 55023	1.96	5.98	16.00	0.64	0.43
Lutescens 55198	1.96	5.87	14.89	0.54	0.42
Lutescens 37519	3.29	6.75	13.18	0.51	0.44
Lutescens 60049	2.22	6.27	13.99	0.58	0.43
Lutescens 60107	2.23	6.47	14.48	0.49	0.43
Podolyanka St	2.34	6.63	15.01	0.57	0.43

Note: * MYR – Myronivka

These varieties react more sensitively to the timing of sowing and need a longer period of autumn vegetation to accumulate more dry matter and better pass the winter rest period.

Thus, the conducted studies allowed establishing the features of plant growth and development of modern varieties, and promising selection lines of winter wheat of MIP selection from sowing to the time of spring vegetation recovery using spectral and biometric evaluation. The selected genotypes have a well-developed aboveground mass, are resistant to unfavourable conditions for growth and development, and can form high productivity.

CONCLUSIONS

The hydrothermal conditions of the seedling-TAVC-TSVR period had diverse effects on the reproductive process of the genotypes of winter wheat under study. According to the study results, abnormally dry conditions of the period from sowing to the end of the autumn growing season in 2019 negatively affected the condition of winter wheat plants that were in BBCH Phase 11-13, autumn tillering did not take place.

Regardless of the genotype, plants were more developed during the first sowing period. According to biometric and spectral parameters, at the time of spring vegetation recovery, the following varieties turned out better than the Podolyanka standard variety (NDVI = 0.52): MIP Dnipryanka (NDVI = 0.58), MIP Lada (NDVI = 0.56), Balada Myronivska (NDVI = 0.56), Lutescens 37519 (NDVI = 0.55), and Erythrospermum 55023 (NDVI = 0.58). During the second sowing period, the variety MIP Dniprнanka (NDVI = 0.45) and the selection lines Lutescens 37519 (NDVI = 0.44) and Erythrospermum 55023 (NDVI = 0.43) were selected. MIP Lada and Balada Myronivska varieties react more sensitively to the timing of sowing and need a longer period of autumn vegetation to accumulate more dry matter and better pass the winter rest period.

The use of biometric analysis methods with the NDVI index to determine the condition of winter wheat plants in a certain growing season allows establishing the reliability of the observed differences and obtaining the necessary information regarding valuable raw material for selection for high productivity and adaptability.

REFERENCES

[1] "Measuring Vegetation". NASA Earth Observatory. 2000-08-30.

[2] Cherenkov, A.V., Hyrka, A.D., Pedash, O.O., Dubovyy, O.I. (2009). Vplyv strokiv sivby ta azotnykh pidzhyvlen' na rist i rozvytok roslyn ozymoyi pshenytsi vprodovzh vesnyano-litn'oho periodu vehetatsiyi. Byuleten' Instytutu zernovoho hospodarstva, 37, 86-93.

[3] Dospekhov, B.A. (1979). Textbooks and textbooks for higher agricultural educational institutions. Yzd. 4-oe, pererab. y dop. Moskva : Kolos, 1979. 416 s., yl. (Uchebnyky y ucheb. posobyya dlya vyssh s.-kh. ucheb. zavedenyy).

[4] Duan, T., Chapman, S.C., Guo, Y., Zheng, B. (2017). Dynamic monitoring of NDVI in wheat agronomy and breeding trials using an unmanned aerial vehicle. Field Crops Research, 210, 71-80.

[5] Kolyuchuy, V.T., Vlasenko, V.A., Borsuk, H.YU. (2007). Influence of sowing dates and nitrogen fertilization on the growth and development of winter wheat plants during the spring-summer growing season. Kyiv: Ahrarna nauka, 800.

[6] Kuperman, F.M. (1977). Breeding, seed production and technologies for growing grain crops in the forest-steppe of Ukraine. 3-e yzd. Moskva: Vysshaya shkola, 287.

[7] Maimaitijiang, M., *et al.* (2017). Unmanned Aerial System (UAS)-based phenotyping of soybean using multi-sensor data fusion and extreme learning machine. ISPRS J. Photogramm. Remote. Sens, 134, 43-58.

[8] Medynets, O.YE. (2014). Energy factors for the development of winter wheat diseases. Abstracts of scientific practice. conference dedicated to the 90th anniversary of Dr. s.-g. Sciences Medinets Vasily Dmitrovich. Poltava, 2014, 9-72.

[9] Medynets, V.D. (1974). Influence of ecological conditions and time of resumption of spring vegetation of plants on a ratio of bodies and productivity of winter wheat, their value for varietal agrotechnics and selection: votref. dis. ... Doctor of agricultural sciences Sciences. Kharkov, 1974, 48.

[10] Medynets, V.D. (2001). Management of plant ontogenesis (agroecological direction)]. Poltava: Verstka, 2001. 86.

[11] Medynets, V.D. (2014). The role of time of restoration of spring vegetation in ontogenesis, phylogeny and selection of wintering plants. Abstracts of scientific practice. conference dedicated to the 90th anniversary of Dr. s.-g. Sciences Medinets Vasily Dmitrovich. Poltava, 2014, 4-6.

[12] Pirych, A.V., Bulavka, N.V., Kovalyshyna, H.M., Derhachov, O.L., Humenyuk, O.V. (2018). Peculiarities of plant growth and development in the early stages in a number of Myronov varieties of soft winter wheat and their connection with frost resistance and yield. Naukovi dopovidi NUBiP Ukrayiny, 5(75). Rezhym dostupu: http://dx doi.org/10.31548/dopovidi 2018.05.013/.

[13] Riznyk, O.I., Sayko, V.F., Lobas, M.H. (1994). Cereals, legumes, cereals and corn in agroecosystems K.: Urozhay, 1994, 41-54.

[14] Tanchyk, S.P., Mokriyenko, V.A., Motornyy, V.A. (2014). Produktyvnist' pshenytsi ozymoyi zalezhno vid strokiv sivby. [Productivity of winter wheat depending on sowing dates]. Naukovi dopovidi Natsional'noho universytetu bioresursiv i pryrodokorystuvannya Ukrayiny, 2. Rezhym dostupu: http://nbuv.gov.ua/UJRN/Nd_2014_2_9.

[15] Tattaris, M., Reynolds, M.P., Chapman, S.C. (2016). A Direct Comparison of Remote Sensing Approaches for High-Throughput Phenotyping in Plant Breeding. Front. Plant Sci, 7, 61.

[16] Tereshchenko, YU.F. (2014). Elucidation of the ecological effect of CHVVV in textbooks for agricultural universities. Abstracts of scientific practice. conference dedicated to the 90th anniversary of Dr. s.-g. Sciences Medinets Vasily Dmitrovich. Poltava, 2014, 35-37.
[17] Volkodav, V.V. (2003). Methodology for the examination of the sovereign varieties and the testing of varieties of cereal roslin, cereals and leguminous crops. Kyyiv: Alefa, 2(3), 241.

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Спектральна оцінка сортів та селекційних ліній пшениці озимої у період відновлення весняної вегетації

Анотація. Розробка нових та впровадження наявних методів польової оцінки генотипів пшениці озимої є одним із ключових завдань сучасної селекції. Застосування сучасних методів скринінгу в селекції дає можливість селекціонеру дістати більш об'єктивну оцінку, а також у рази збільшити обсяги досліджуваних зразків. Час відновлення весняної вегетації (ЧВВВ) є одним із найважливіших етапів вегетаційного періоду пшениці озимої. Біометрична та спектральна оцінка пшениці озимої із настанням ЧВВВ дає змогу встановити, як перезимували рослини певного генотипу, а також стан їх росту та розвитку перед початком другого періоду вегетації. Метою дослідження було встановлення особливостей росту та розвитку рослин сучасних сортів і перспективних селекційних ліній пшениці озимої селекції Миронівського інституту пшениці імені В.М. Ремесла (МІП) від сівби до відновлення весняної вегетації. Гідротермічні умови періоду сходи-ЧВВВ по різному впливали на репродукційний процес досліджуваних генотипів пшениці озимої. За результатами досліджень аномально посушливі умови періоду від сівби до часу припинення осінньої вегетації у 2019 р. негативно вплинули на стан рослин пшениці озимої, які знаходились у фазі 10-13 за міжнародною класифікацією ВВСН, осіннього кущіння не відбулось. Незалежно від генотипу більш розвинутими були рослини за першого строку сівби. На час відновлення весняної вегетації за біометричними та спектральними показниками кращими за сорт стандарт Подолянку (NDVI = 0,52) виявилися:

сорти МІП Дніпрянка (NDVI = 0,58), МІП Лада (NDVI = 0,56), Балада миронівська (NDVI = 0,56) та лінії Лютесценс 37519 (NDVI = 0,55) й Еритроспермум 55023 (NDVI = 0,58). За другого строку сівби виділили сорт МІП Дніпрянка (NDVI = 0,45) та селекційні лінії Лютесценс 37519 (NDVI = 0,44) й Еритроспермум 55023 (NDVI = 0,43). Сорт стандарт Подолянка мав значення індексу NDVI на рівні 0,43. Сорти МІП Лада та Балада миронівська більш чутливо реагують на строки сівби та потребують тривалішого періоду осінньої вегетації для накопичення більшої кількості сухих речовин і кращого проходження періоду зимового спокою

Ключові слова: пшениця м'яка озима; сорти; селекційні лінії; час відновлення весняної вегетації; індекс NDVI; біометричний аналіз; морфофізіологічний аналіз