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Parameters of *Miscanthus × giganteus* photosystem under the influence of weather conditions

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Purpose. To establish parameters of the photosynthetic system of *Miscanthus × giganteus* as affected by weather conditions during vegetation. **Methods.** Field studies were conducted at the Bila Tserkva Experimental Breeding Station of the Institute of Bioenergy Crops and Sugar Beet. The following chlorophyll fluorescence parameters were measured: Fo – minimum reliable fluorescence intensity at 40 μs, Fj – fluorescence intensity at the J-step (at 2 ms), Fi – fluorescence intensity at the I-step (at 30 ms), Fm – maximum fluorescence intensity at the P-step, Fv – maximum variable fluorescence, Fv/Fm – photochemical efficiency (quantum efficiency), Fv/Fo – efficiency of initial photosynthesis reactions, φPo – maximum quantum yield of primary photochemistry (at t = 0), VJ and VI – relative variable fluorescence at J-step and I-step, respectively, ψEo – efficiency/probability that an exciton, reducing QA to QA^-, moves electrons further along the intersystem transport chain, ψRo – efficiency/probability of electron transfer from PSII to PSI acceptors, and δRo – efficiency/probability that electrons from intersystem carriers reduce the terminal electron acceptors on the PSI acceptor side. **Results.** In all years of research, miscanthus plants experienced stress caused by adverse weather conditions. In 2022, a significant moisture deficit was observed in the first half of vegetation when miscanthus was actively developing vegetative mass. In 2023, there were heavy rains at the beginning of vegetation, with a significant rise in average daily air temperatures by August. In 2024, high mean daily air temperatures started in April, then in June, drought occurred, and such conditions continued until the end of vegetation. **Conclusions.** An analysis of the basic parameters of the chlorophyll fluorescence induction curve – Fo, Fj, Fi, Fm, Fv, Fv/Fm, Fv/Fo, and φPo – revealed strong and very strong correlations with weather elements, demonstrating their suitability for assessing stress in miscanthus plants caused by adverse weather conditions during vegetation. However, in our study these indicators were not selective for discrimination between drought stress or heat stress, i.e. state of plant photosystems can be identified as stressed without determining the type of stress, particularly in case of combined stress. Further studies should aim to identify correlations between certain parameters of photosystem and certain stress factors.

Keywords: *Chlorophyll fluorescence induction; Fo, Fj, Fi, Fm, Fv, Fv/Fm, Fv/Fo.*

Introduction

Giant miscanthus (*Miscanthus × giganteus*) is capable of producing a significant biomass yield even under challenging cultivation conditions [7, 10]. However, it is very sensitive to environmental factors, leading to uneven uptake of nutrients [11, 12]. Nutrient reserves stored in rhizomes of giant miscanthus provide better adaptation of the crop to cultivation conditions [14, 19]. However, annual crops have the advantage of restarting annually from seeds; i.e. environmental stress factors from previous years do not significantly affect their growth as happens with miscanthus.

Air temperature greatly influences growth processes; particularly, high temperatures can significantly shorten phenological stages of grasses. Studies have shown that excessively high air temperatures and lack of moisture result in suppressed growth and slowed development [30, 33]. Introduced crops such as giant miscanthus require adequate rainfall and sums of active temperatures to form sufficient biomass [55]. Compared to indigenous species, miscanthus is less adapted to weather conditions and requires careful selection of cultivation locations compared to C_3 photosynthesis crops in Ukraine's Forest-Steppe zone [37].

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Currently, plant stress assessment typically involves evaluating the extent to which plants reduce their biological productivity when environmental factors deviate from optimal conditions for the species [40]. However, this method works primarily for annual plants and not perennial bioenergy crops. Perennial plantations have distinct growth cycles involving productivity increases during the first years of cultivation and ageing. Ageing is an individual process influenced by many uncontrollable factors, potentially causing significant errors in stress assessments.

Many stress assessment methods rely on either indirect (evaluating plants' response to stress factors) or direct measures (observing morphological or physiological changes) [34]. Indirect methods include protein analysis under heat stress [9, 23, 28], thermal imaging of plants [41], proline tests [8, 44], and chlorophyll fluorescence induction (CFI) analysis to study the fluorescence induction curve [25, 26, 43]. Analysis of the fluorescence induction curve can reveal environmental influences on plants [46, 49, 53, 54]. Direct methods involve using controlled environments (climatic chambers or greenhouses) to simulate stress [5, 45] or germinating seeds/plants *in vitro* on osmotic solutions or varying media concentrations [36, 35].

The ***objective*** of the study was to determine the response of the photosystem of *Miscanthus* × *giganteus* to weather conditions.

Materials and Methods

Study Site

Field experiments were carried out at the Bila Tserkva Experimental Breeding Station of the Institute of Bioenergy Crops and Sugar Beet NAAS of Ukraine in 2022–2024. The region's conditions are highly favourable for the growth and development of miscanthus: the average long-term ground temperature is +10.8 °C, with an absolute maximum of +34.2 °C and a minimum of –27.6 °C. The average long-term relative air humidity is 74%, with an average of 33 days per year having relative humidity below 30% and 104 days above 80%.

The soil of the experimental site is deep leached chernozem of medium clay-loamy composition with low humus content in the 0–30 cm soil layer (3.5%); nitrogen 29–37 mg/kg; available phosphorus 200–220 mg/kg; and exchangeable potassium 100 mg/kg. Exchangeable cations are composed of calcium (78–90%) and magnesium (7–19%) of their total sum.

Experimental Design

A single plot area was 35 m^2. The experiment was conducted in three replications. *Miscanthus* × *giganteus* variety 'Osinnii Zoretzvit' was used in the study. The plantation was established in 2018, and from 2020 onward, no crop management except harvesting biomass was applied.

Weather Conditions

In May 2022, air temperatures and precipitation were close to the norm, except for early May, which was significantly drier. In June, excessively high average daily air temperatures were observed. A significant precipitation deficit was observed in early and mid-June, as well as an extreme deficit during the entire month. In July, only the first 10 days were extremely hot and had extreme precipitation deficit, while the rest of the month was within the norm. However, July had a significant precipitation deficit in the last 10 days and overall. Mid- and late August was significantly hotter, while the first 10 days experienced excessive precipitation followed by a moisture deficit in the last 10 days of the month. September 2022 had substantially higher precipitation compared to the long-term norm and a significantly cooler first 10 days. Late October was significantly warmer than the norm, with precipitation levels close to the long-term averages overall.

Early May of 2023 was cold and coupled with a moisture deficit. In June, air temperature was close to the norm, with precipitation deficits in the middle of the month and excess in the last 10 days. Early July was hot, with precipitation close to the long-term norm. August was extremely hot with a significant precipitation deficit. Mid-September of 2023 was hot, resulting in significantly above-average monthly temperatures. Meanwhile, there was a precipitation deficit in the late September. Late October was extremely warm with excessive precipitation. The whole month was significantly warmer than average.

Mid-May of 2024, was cooler, while the end of the month was warmer than the norm. Early May was dry. Mid- and late June experienced high air temperatures. A precipitation deficit was observed only in late May. July was extremely hot, with a significant precipitation deficit. Early and mid-August was hotter-than-normal and the end of the month was extremely hot, coupled with significant monthly deviations. Early August had above-normal precipitation, while the rest of the month had less precipitation than the norm.

The autumn months of 2024 were also warmer than the long-term norm. In early and mid-September, we observed precipitation deficit. Mid-October was close to the long-term temperature, while the beginning and end of the month was significantly warmer.

Table 1

Mean daily air temperature and precipitation, Bila Tserkva Experimental Breeding Station (2022–2024)

Month	Mean daily air temperature (°C)				Precipitation (mm)			
	Days			Average	Days			Total
	1–10	11–20	21–31		1–10	11–20	21–31	
2022								
April	7.0	6.5	10.8	8.1	14.0	7.2	18.6	39.8
May	12.8	14.9	14.5	14.1	0.0	2.7	32.4	35.1
June	20.4	20.6	20.8	20.6	2.8	1.2	14.6	18.6
July	21.8	17.6	20.2	19.9	0.5	24.1	0.0	24.6
August	19.9	21.1	22.0	21.0	34.6	40.5	0.0	75.1
September	12.5	12.9	11.4	12.3	25.9	39.2	21.0	86.1
October	11.5	8.1	9.9	9.8	9.1	1.2	9.7	20.0
2023								
April	7.2	8.9	10.1	8.7	61.5	27.4	7.1	96.0
May	10.6	16.0	17.4	14.7	0.0	0.0	7.9	7.9
June	18.0	19.0	20.1	19.0	16.6	0.0	43.0	59.6
July	21.0	20.9	19.9	20.6	27.3	22.3	36.2	85.8
August	21.7	22.4	23.6	22.6	3.0	0.3	18.4	21.7
September	17.7	18.8	11.2	15.9	4.7	17.9	0.0	22.6
October	11.2	9.8	12.9	11.3	2.8	24.8	24.5	52.1
2024								
April	14.1	11.6	11.5	12.4	0.0	35.0	34.4	69.4
May	14.8	12.9	19.4	15.7	0.5	0.0	6.6	7.1
June	21.3	20.0	21.2	20.8	32.2	44.1	0.0	76.3
July	22.6	26.4	21.5	23.5	0.0	6.5	3.5	10.0
August	20.6	21.2	23.5	21.8	31.5	1.8	0.0	33.3
September	20.8	19.5	18.2	19.5	0.5	12.3	0.0	12.8
October	14.5	8.5	9.0	10.7	51.8	9.9	0.7	62.4
Mean annual								
April	7.0	7.8	10.4	8.4	14.0	17.0	16.0	47.0
May	13.3	15.3	15.8	14.8	16.0	12.0	18.0	46.0
June	17.3	17.3	18.7	17.8	23.0	27.0	23.0	73.0
July	18.5	19.4	19.1	19.0	35.0	24.0	26.0	85.0
August	19.7	18.6	17.0	18.4	16.0	25.0	19.0	60.0
September	16.0	13.7	11.8	13.8	13.0	11.0	11.0	35.0
October	10.1	8.1	5.4	7.9	11.0	10.0	12.0	33.0

Measurement of Chlorophyll Fluorescence

The study used a portable fluorometer "FLS 10s clip" (Fig. 1), which work is based on light absorption specters of chlorophyll (Fig. 2), determining chlorophyll fluorescence intensity and radiation time.

The following chlorophyll fluorescence parameters were measured: Fo – minimum reliable fluorescence intensity at 40 µs, Fj – fluorescence intensity at the J-step (at 2 ms), Fi – fluorescence intensity at the I-step (at 30 ms), Fm – maximum fluorescence intensity at the P-step, Fv – maximum variable fluorescence, Fv/Fm – photochemical efficiency (quantum efficiency), Fv/Fo – efficiency of initial photosynthesis reactions, φPo – maximum quantum yield of primary photochemistry (at t = 0), VJ and VI – relative variable fluorescence at J-step and I-step, respectively, ψEo – efficiency/probability that an exciton, reducing QA to QA^-, moves electrons further along the intersystem transport chain, ψRo – efficiency/probability of electron transfer from PSII to PSI acceptors, and δRo – efficiency/probability that electrons from intersystem carriers reduce the terminal electron acceptors on the PSI acceptor side. Measurements of the chlorophyll fluorescence induction curve (CFI) parameters were conducted during the last decade of each month from May to October, when giant miscanthus plants accumulated the most biomass.

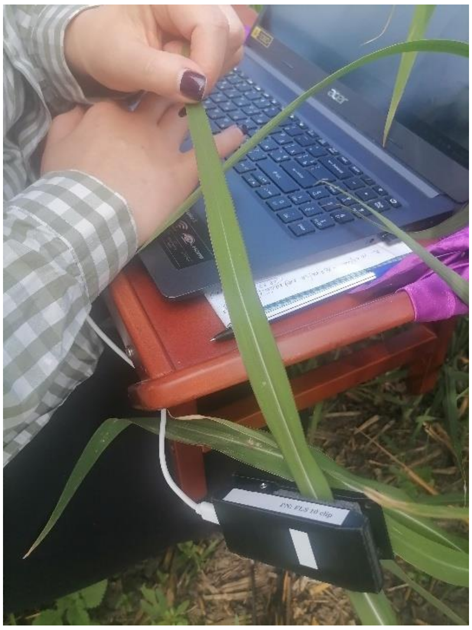

Fig. 1. Taking measurements with fluorometer “FLS 10s clip”

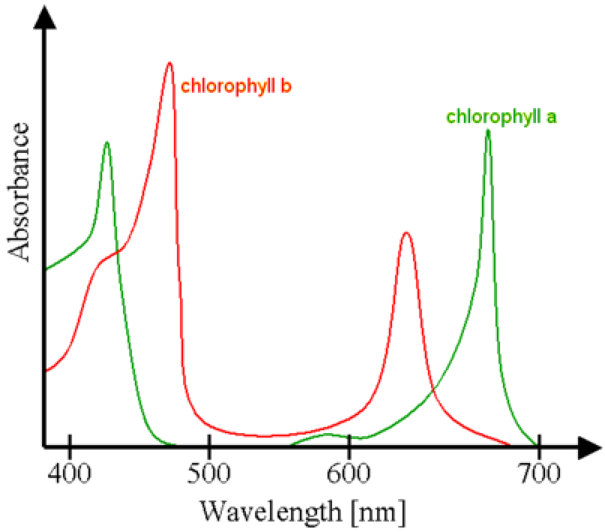

Fig. 2. Main light absorption specters of chlorophyll, which are the used in the “FLS 10s clip” operation

Experimental studies were conducted according to general field research and special methodologies [59, 56, 58, 57]. Statistical analysis was performed using the TIBCO Statistica software and descriptive and correlation statistical methods [59].

Results and Discussion

Weather conditions varied significantly during the study years and influenced the growth and development of giant miscanthus plants, as they have specific requirements not only for precipitation but also for a sufficient number of warm months. To assess this impact, we analysed the significance coefficients of weather element deviations (Table 2).

Table 2

Coefficients of significance of the weather elements’ deviations

Month	Mean daily temperature	Precipitation
	2022	
April	−0.19	−0.25
May	−0.68	−0.27
June	2.18	−2.41
July	0.48	−1.83
August	1.72	0.78
September	−0.50	1.57
October	1.32	−0.68
	2023	
April	0.21	1.72
May	−0.12	−0.95
June	0.97	−0.59
July	0.89	0.02
August	2.78	−1.99
September	0.66	−0.38
October	2.30	1.01
	2024	
April	2.53	0.79
May	0.83	−0.97
June	2.36	0.15
July	2.49	−2.27
August	2.24	−1.38
September	1.81	−0.68
October	1.88	1.55

Thus, in 2022, June was extremely hot, coupled with an extreme shortage of precipitation. In contrast, August and October showed significant deviations from the long-term average daily air temperatures toward warming, although precipitation levels were close to typical deviations from the long-term norm. However, only September recorded significantly higher precipitation.

In 2023, the months of the second half of the miscanthus growing season, August and September, were notably hotter than the norm. Temperature deviations in other months remained within acceptable normal ranges. Regarding precipitation, April experienced significantly high levels, while August faced a near-extreme precipitation deficit.

2024 presented more atypical growing conditions than previous years. Extremely high air temperatures were observed in April, June, July, and August, with significant deviations from the long-term norm in September and October. July experienced an extreme precipitation deficit, while August showed substantial deviations toward lower precipitation levels. The large amounts of precipitation that fell in October during 2023 and 2024 could no longer significantly impact the biomass accumulation of miscanthus plants.

In 2022, a significant moisture deficit was observed during the first half of the vegetation period, when miscanthus plants were actively forming vegetative mass. In this period cold and hot periods alternated. In 2023, heavy rains occurred at the start of the vegetation renewal stage, with near-normal precipitation levels in July. A significant increase in average daily air temperatures occurred in August. On the other hand, 2024 presented quite different weather conditions compared to the previous years of study. Starting as early as April, plants were exposed to high average daily air temperatures. Dry vegetation conditions developed by June, with elevated temperatures persisting until the end of the miscanthus vegetative period. Drought began in July, but alternating periods of moisture deficit and excess during the spring months, along with winter replenishment of moisture reserves, allowed plants access to water throughout the vegetation period.

Regarding precipitation data, 229.3 mm fell from April to October 2022, compared to 345.7 mm in 2023 and 271.3 mm in 2024. While the numbers might suggest that 2024 was the most challenging year for vegetation, it's crucial to consider not just the amount of precipitation but also air temperatures at the time. Most importantly, whether plants were sufficiently prepared to counteract extreme weather events during critical stages of growth and development played a vital role. In other words, coincidence of precipitation deficits or extreme high air temperatures during critical growth periods had a more negative impact on miscanthus plants than a severe shortage of precipitation during phases where the plants were less sensitive.

For traditional agricultural crops, the dryness coefficient (Cd) can be calculated, showing the percentage yield of a specific variety in the driest year compared to its yield in the year with maximum moisture [6]. However, perennial bioenergy crops exhibit year-to-year productivity differences depending on plantation age. As shown in Table 3, despite suboptimal conditions and the stress experienced by giant miscanthus due to limiting factors, biomass yield increased year by year. This growth was attributed to the development and rooting of plants within the plantation, optimisation of spatial arrangement, and the accumulation of larger amounts of reserve nutrients in the rhizomes, supporting better biomass development annually.

Table 3

Biomass yield of giant miscanthus

Year	Biomass yield (t/ha)	Standard deviation	Standard mean error
2022	22.1	1.13	0.43
2023	30.3	1.52	0.57
2024	39.3	2.41	0.91

Plants have specific stress adaptation mechanisms related to their photosynthetic apparatus, which plays a key role in plant functioning as shown by other researchers [2, 3, 48]. Thus, we will analyse the monthly values of the CFI curve indicators determined during the study years (Tables 4–6).

Table 4

Monthly values of the CFI indicators of 'Osinnii Zoretzvit' variety of giant miscanthus (2022)

Month	Fo	Fj	Fi	Fm	Fv	Fv/Fm	Fv/Fo	φ_{Po}	V_J	V_I	ψ_{Eo}	ψRo	δRo
May	368.9	782.9	997.9	1391.9	1023.0	0.74	2.77	0.74	0.40	0.61	0.60	0.39	0.39
June	385.4	777.4	704.4	951.4	566.0	0.59	1.47	0.59	0.69	0.56	0.31	0.44	0.44
July	327.4	607.4	577.4	776.4	449.0	0.58	1.37	0.58	0.62	0.56	0.38	0.44	0.44
August	400.8	851.8	1144.8	1760.8	1360.0	0.77	3.39	0.77	0.33	0.55	0.67	0.45	0.45
September	426.6	897.6	1485.6	2076.6	1650.0	0.79	3.87	0.79	0.29	0.64	0.71	0.36	0.36
October	372.3	664.3	1016.3	1260.3	888.0	0.70	2.39	0.70	0.33	0.73	0.67	0.27	0.27

Table 5

Monthly values of the CFI indicators of 'Osinnii Zoretzvit' variety of giant miscanthus (2023)

Month	Fo	Fj	Fi	Fm	Fv	Fv/Fm	Fv/Fo	φ_{Po}	V_J	V_I	ψ_{Eo}	ψRo	δRo
May	359.4	725.4	1143.4	1396.4	1037.0	0.74	2.89	0.74	0.35	0.76	0.65	0.24	0.24
June	441.8	877.8	1566.8	1783.8	1342.0	0.75	3.04	0.75	0.32	0.84	0.68	0.16	0.16
July	396.8	726.8	1316.8	1610.8	1214.0	0.75	3.06	0.75	0.27	0.76	0.73	0.24	0.24
August	436.1	878.1	1529.1	1847.1	1411.0	0.76	3.24	0.76	0.31	0.77	0.69	0.23	0.23
September	538.3	1254.3	1817.3	2011.3	1473.0	0.73	2.74	0.73	0.49	0.87	0.51	0.31	0.32
October	506.5	1150.5	1828.5	2036.5	1530.0	0.75	3.02	0.75	0.42	0.86	0.58	0.14	0.14

Table 6

Monthly values of the CFI indicators of 'Osinnii Zoretzvit' variety of giant miscanthus (2024)

Month	Fo	Fj	Fi	Fm	Fv	Fv/Fm	Fv/Fo	φ_{Po}	V_J	V_I	ψ_{Eo}	ψRo	δRo
May	293	544	812	1272	979	0.77	3.31	0.77	0.25	0.52	0.75	0.48	0.48
June	384	811	1476	1849	1465	0.79	3.83	0.79	0.29	0.74	0.71	0.26	0.26
July	389	800	1431	1768	1379	0.78	3.54	0.78	0.30	0.75	0.70	0.25	0.25
August	388	803	1323	1698	1310	0.77	3.37	0.77	0.32	0.71	0.68	0.29	0.29
September	383	716	1037	1330	948	0.68	2.48	0.68	0.37	0.67	0.63	0.33	0.33
October	264	354	421	522	258	0.46	0.92	0.46	0.34	0.59	0.66	0.41	0.41

The possibility of applying such evaluation approaches has been confirmed in the study of the CFI parameters for drought resistance, salt tolerance, and general plant stress resistance [4, 24, 27], also for mustard [22] and radish [18]. It is believed that a high initial fluorescence index (Fo), approaching 500 relative units, indicates plant sensitivity to increased planting density [17]. This means that even at the initial stage of chlorophyll fluorescence, we can determine the degree of planting density.

In our studies, the highest Fo values were observed at different stages of plant development. In 2022, it was in August–September, in 2023, in August, while in 2024, a plateau was reached starting from June. The most significant impact on this indicator was linked to average daily air temperature, which was notably high when Fo values peaked. However, in all years of the study, the Fo index decreased in the final month of vegetation. This reduction could result from partial leaf senescence and improved sunlight availability to active leaves, or the natural conclusion of physiological processes as the plants aged and autumn-specific weather conditions established.

Several researchers indicate the relationship of the CFI curve segment between Fm–Fv as means to assess plant responses to high or low temperatures, drought, or nutrient deficiency [1, 15, 16, 21, 29, 38, 52]. They also note that during intense stress or natural leaf senescence, Fv can exceed Fo [51, 50]. Our studies observed such changes in October 2024, which we attribute to natural leaf senescence. Similar observations in June and July 2022 may be linked to drought and extreme air temperatures during this period. The correlation dependencies obtained between average daily temperatures, monthly precipitation, and the CFI curve indicators (Table 7) highlight the significance of basic chlorophyll fluorescence induction criteria as a method for evaluating the stress levels or adaptive traits of giant miscanthus.

Table 7

Correlation dependencies between mean daily temperature, monthly precipitation and parameters of the CFI curve

Parameter	2022		2023		2024	
	Air temperature	Precipitation	Air temperature	Precipitation	Air temperature	Precipitation
Fo	−0.303	0.674	−0.407	−0.245	0.954	−0.139
Fj	−0.157	0.785	−0.485	−0.355	0.980	−0.139
Fi	−0.492	0.798	−0.125	0.005	0.963	−0.040
Fm	−0.349	0.895	0.008	0.153	0.947	−0.138
Fv	−0.348	0.900	0.152	0.285	0.930	−0.135
Fv/Fm	−0.494	0.782	0.966	0.913	0.829	−0.326
Fv/Fo	−0.368	0.885	0.970	0.925	0.823	−0.219
φ_{Po}	−0.494	0.782	0.966	0.913	0.829	−0.326
V_J	0.593	−0.634	−0.822	−0.749	−0.130	0.112
V_I	−0.785	−0.130	−0.410	−0.336	0.820	0.198
ψ_{Eo}	−0.593	0.634	0.822	0.749	0.130	−0.112
ψRo	0.785	0.130	−0.154	−0.143	−0.820	−0.198
δRo	0.785	0.130	−0.164	−0.151	−0.820	−0.198

* Reliable deviations are highlighted in red.

In 2022, precipitation had the most significant impact on the CFI parameters, suggesting it as the most critical factor for plant growth. On the contrary, in 2023, both precipitation and air temperatures influenced the state of the photosystems, while in 2024, extreme high air temperature was the main stress factor. Physiological responses of other plant species to stress under similar conditions have been reported in the works of many researchers [13, 20, 31, 32, 39, 42, 47].

Conclusions

An analysis of the basic CFI indicators (Fo, Fj, Fi, Fm, Fv, Fv/Fm, Fv/Fo, and φPo) demonstrated strong and very strong correlations with weather elements. This confirms their effectiveness in identifying stress in *Miscanthus × giganteus* caused by adverse weather conditions during vegetation. However, in our study, these indicators were not selective to drought or heat stress. Therefore, further studies should aim to identify correlations between specific photosystem parameters of *Miscanthus × giganteus* and stress factors and develop an algorithm to determine the type of stress affecting the crop.

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Присяжнюк О. І.[1*], Маляренко О. А.[1], Пенькова С. В.[2], Вороненко О. В.[3] Вплив погодних умов на стан фотосистеми міскантусу гігантського. *Новітні агротехнології*. 2025. Т. 13, № 1. https://doi.org/10.47414/na.13.1.2025.326533

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Мета. Установити особливості стану фотосистеми міскантусу гігантського під впливом погодних умов. **Методи.** Польові дослідження проводили на Білоцерківській дослідно-селекційній станції Інституту біоенергетичних культур і цукрових буряків НААН упродовж 2022–2024 рр. У процесі дослідження вимірювали такі параметри флуоресценції хлорофілу: Fo – мінімальна достовірна інтенсивність флуоресценції при 40 мкс; Fj – інтенсивність флуоресценції на J-кроці (при 2 мс); Fi – інтенсивність флуоресценції на I-кроці (за 30 мс); Fm – максимальна інтенсивність флуоресценції на P-кроці; Fv – максимальна змінна флуоресценція; Fv/Fm – фотохімічна ефективність або квантова ефективність; Fv/Fo – ефективність початкових реакцій фотосинтезу; φPo – максимальний квантовий вихід первинної фотохімії (при t = 0); VJ – відносна змінна флуоресценція на J-кроці; VI – відносна змінна флуоресценція на I-кроці; ψEo – ефективність / ймовірність, завдяки якій захоплений екситон, викликавши відновлення QA до QA^-, може перемістити електрон далі, ніж QA^-, у міжсистемний ланцюг транспортування електронів; ψRo – ефективність / ймовірність, з якою захоплений електрон PSII переноситься до акцепторів PSI; δRo – ефективність / ймовірність, з якою електрон із міжсистемних носіїв електронів рухається до зменшення кінцевих акцепторів електронів на стороні акцептора PSI (RE). **Результати.** Досліджено, що в усі роки досліджень рослини міскантусу зазнавали дії стресу, спричиненого нестачею вологи в ґрунті та високою температурою повітря. Зокрема, у 2022 році спостерігали значний дефіцит вологи у першій половині вегетації, коли рослини міскантусу активно формували вегетативну масу. У 2023 році пройшли сильні дощі на початку відновлення вегетації міскантусу, а значне підвищення середньодобових температур повітря відбувалось в серпні. Погодні умови 2024 року не були подібні до попередніх років дослідження, оскільки вже починаючи з квітня рослини зазнавали впливу високих середньодобових температур повітря, а посушливі умови вегетації сформувались вже у червні. На додачу, висока температура повітря протрималася до кінця вегетаційного періоду міскантусу. **Висновки.** Аналіз базових показників кривої індукції флуоресценції хлорофілу (Fo, Fj, Fi, Fm, Fv, Fv/Fm, Fv/Fo та φ_{Po}) показує наявність сильних та дуже сильних кореляційних зав’язків між елементами погоди та цими змінними, що може засвідчувати їх придатність для визначення стресу рослин міскантусу від впливу погодних умов під час вегетації. Проте, у цьому досліджені, ці показники не виявили селективності щодо визначення стресу через водний дефіцит або високі температури повітря. Тобто стан фотосистеми рослин можна визначити як такий, що піддається стресу без точного встановлення виду стресу, особливо у разі комбінованого стресу. Тому в подальших дослідженнях слід шукати взаємозв’язки між окремими параметрами фотосистеми міскантусу й факторами стресу.

Ключові слова: *індукція флуоресценції хлорофілу; Fo, Fj, Fi, Fm, Fv, Fv/Fm, Fv/Fo.*

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