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THE INFLUENCE OF DRAUGHT ON THE SUNFLOWER'S PHOTOSYNTHETIC ACTIVITY AND PRODUCTIVITY

Sunflower formed in conditions of the North American arid prairies (ed. V.S. Pustovoit, 1975) and according to P.A. Genkel (1967) belongs to hemixerophytes.

In vegetation experiments (soil crops) Peredovik variety plants were grown under the optimal water supply (soil moisture at 70% of its total moisture capacity). Then separate groups of plants were affected by draught at the beginning of the formation of heads (Variant I); at the beginning of flowering (Variant II); and twice, at the beginning of the formation of heads and the beginning of flowering (Variant III). Draught was produced by discontinuing irrigation until the water deficit of lower story leaves reached 25%. Afterwards, irrigation was resumed.

Investigations have shown that draught substantially reduces sunflower productivity, especially that of the achenes (Table 1).

The plants that experienced water deficit at the early stage of the ontogenesis (Variant I) slowly built up their total assimilation surface which was 61% of the control figure at the end of the experiment (Table 1). The same area was formed by the plants that experienced draught at a later stage of their ontogenesis (Variant II), but they began to fall behind in the growth of photosynthetic surface and hence in the dry substance accumulation at a later date than was the case in the first variant.

Draught also negatively affected the photosynthesis intensity. In Variant I this figure was lower roughly 50% in the first storey leaves and in 27 days after the draught was discontinued it was 60% to 80% lower than the check.

Table 1

Influence of Draught on the Plants' Productivity and Assimilation Surface

Variant	Arid weight, g			Total leaf area per plant, sq cm
	overground mass	leaves	achenes	
Control	110.2	42.6	9.06	3.498
I	77.2	27.1	4.57	2.135
II	85.6	29.2	7.13	2.110
III	57.1	23.3	2.94	1.910

The leaves of the seventh to 12th storeys that were affected by draught in embryo or at the initial phase of the post-embryonal growth, had a 7-10% more intensive photosynthesis than the respective leaves of control plants.

Draught tends to reduce the chlorophyll content in the physiologically old leaves of the lower storey that experienced water deficit in the greatest degree, while in the middle and upper storey leaves chlorophyll remains unchanged or even increases. After the draught the quantity of chlorophyll in the middle and upper storey leaves is upgrading and can even exceed the check. This chlorophyll, however, is little active (Table 2).

Draught exerts a profoundly deleterious effect on the primary photosynthetic reactions bearing on the absorption and conversion of light energy. Judjing by the activity of the Hill reaction, it causes substantial changes in the photosynthesis electric transportation chain (Table 3).

When water deficit grows slowly (Variant I) the Hill reaction was less active in the experiment with ferricyanide than in the experiment

Table 2

Changes in the Assimilation Number Under the Influence of Draught (% of the check)

Storeys	During draught			10 days after draught		
	I	II	III	I	II	III
Upper	74	108	80	45	1.100	76
Middle	45	92	58	56	98	50
Lower	44	65	15	75	86	20

with 2.6-dichlorphenol-indophenol (DCPIP). 10 days after the draught the rate of ferricyanide photoreduction was lowered (72-96% of the control figure), whereas the activity of the Hill reaction in the experiment with DCIPIP was completely restored (97-106% of the check). This demonstrates that draught exerts a more profound and often irreversible impact on the section of the photosynthetic chain transmitting electrons, which is linked with the long-wave pigment system.

Rapid increases in water deficit do not substantially after the Hill reaction rate (Variant II). The leaves that were affected by water deficit at the embryonal phase of formation had a more intensive photosynthesis and a still more active Hill reaction with DCPIP as the electrone acceptor (up to 168% of the check). Similar violations in the photosynthesis electrical transportation chain were also recorded when the methods of electronic paramagnetic resonance and after-radiation were used (N.I. Volodarsky, Ye.Ye. Bystrykh, 1975).

In our experiments draught caused the upgrading of the after-radiation level, which testifies to less effective use of primary produce in direct photosynthetic reactions.

Table 3

Changes in the Activity of the Hill Reaction in Isolated Chlorelayers Under Violations of the Water Regime (% of the check)

Storey	Variant I (draught at the beginning of head formation)		Variant II (draught at the beginning of flowering)		Variant III (draught at the beginning of head formation and the beginning of flowering)	
	1	2	1	2	1	2
Upper	83.5	97.2	88.6	102.0	126.8	168.7
Middle	76.0	81.8	102.0	101.3	96.7	139.4
Lower	49.3	77.8	106.3	96.8	5.0	103.8

1--ferricyanide; 2--DCPIP

Apparently, disturbances in the photosynthetic primary reactions caused by water deficit can noticeably affect the activity of the subsequent links of the photosynthesis and the efficacy of the photosynthetic apparatus as a whole.

Thus, the sunflower's photosynthetic apparatus proved very sensitive to water shortage. High oil yields are therefore largely predicated on the uninterrupted water supply during the whole period of vegetation. At the same time, when sunflower is selected and tested with an eye to its draught resistance, it is necessary to choose forms which can bear draught without substantial changes in the structure and functional activities of the photosynthetic apparatus.