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Changes in Sunflower Shoot Structure under Influence of Gibberellic Acid

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Souhrn

Postřik 26denních rostlin slunečnice roztokem 50 γ kyseliny giberelové/ml vyvolal tvarové změny listů a statisticky průkazný vzrůst hodnoty délkošířkového indexu listů. Statisticky průkazně se zvýšil též počet listů na stonku za současného zvětšení hodnoty poměrů váhy sušiny stonků k váze sušiny listů.

Summary

The spraying of 26-day-old sunflower plants with a solution containing 50 μg. gibberellic acid/ml. brought about morphological changes in leaves and a statistically significant increase in the leaf shape index (length : width of leaves). The number of leaves on the stem also increased, together with a rise in the value of the ratio of dry weight of stems to dry weight of leaves.

Introduction

The influence of gibberellic acid (GA) is frequently manifested by an elongation of leaves and sometimes by a simplification of their shape. A considerable number of notes on this phenomenon can be found in the literature but only a few authors publish numerical data. The most striking effect of GA is that on the elongation of leaves and sometimes on the simplification of their shape. This effect was observed e.g. with rice (Hayashi, Takijima and Murakami 1953) with *Galinsoga parviflora* Cavan. (Knapp 1956), tomatoes (Gray 1957,

RAPPAPORT 1957), cucumber (KRIBBEN 1957), tobacco, bean, *Saintpaulia* and red pepper (GRAY 1957), *Hedera canariensis* (ROBBINS 1957), *Phalaris canariensis* L. and *P. tuberosa* (SCURFIELD 1958), *Sesamum indicum* L. (CHAKRAVARTI 1958). Other authors call attention to the changes in leaf size irrespective of their shape (MARTH, AUDIA and MITCHELL 1956; HUMPHRIES 1958; BRIAN 1959). Some authors, working with other plants, observed an increase in the number of leaves, e.g. in the genus *Eucalyptus* (SCURFIELD and MOORE 1958), in potato (FISCHNICH, PÄTZOLD and KRUG 1959).

In more extensive experiments the applicability of GA to sunflower under various conditions of mineral nutrition was investigated. On account of the great dispersion and lack of uniformity of literary data it is attempted in the present communication to call attention to some morphological deviations in the shoot structure which were treated statistically.

Material and Methods

Sunflower (*Helianthus annuus* L., var. Slovenská sivá) seeds were sown on June 8, 1959 into soil; on June 22, 1959, they were transferred in groups of three into flowerpots containing a mixture of three parts of river sand and one part of soil. On July 4, 1959, when the plants were 26 days old (about 5 leaves) mineral nutrients were added to the soil (var. A — no nutrients; var. B — 0·4 g. NH_4NO_3 per 1 kg. soil; var. C — 0·1 g. each of K_2HPO_4, KH_2PO_4, K_2SO_4 per 1 kg. soil, 0·4 g. NH_4NO_3 per 1 kg. soil). There were 22 flowerpots (each with three plants) for each of the above variants. Simultaneously with the addition of nutrients, one-half of the number of plants of each variant were sprayed with an aqueous solution of gibberellic acid of Czechoslovak production (Biotika, Slov. Lupča) at a concentration of 50 μg./ml. The solution adhered readily to the leaves even when no detergent was used. On August 13, 1959, i.e. 40 days after the addition of nutrients (and spraying with GA) the plants were harvested. The total length of stem, number of leaves, total dry weight of stems and leaves, maximum width and maximum length of the 3rd, 4th and 5th leaf (counting from the apex) were determined. The results were evaluated statistically by means of the t-test.

Results and Discussion

The application of GA considerably altered the morphological structure of sunflower plants in addition to its well-known effect on the longitudinal growth of stems. The experimental plants formed on an average three more leaves than the controls (Table 1). The leaves, however, had a deformed elongated shape (Fig. 1), were smaller in size and thinner. The change of leaf shape is best shown by the leaf-shape indices of the experimental and control plants (Table 2). Analogous changes in the leaf-shape index of *Ipomaea coerulea* were observed also by NJOKU (1958).

The leaf deformations and the relatively lower inhibition of formation of stem tissues resulted in a change of the ratio of stem dry weight to leaf dry weight by some 50% (Table 2).

The statistical treatment of these morphological differences nearly always yielded highly significant values. A higher negative effect of GA was best

Fig. 1. Photographic prints of leaves of control (A) and GA-treated (B) plants.

marked in plants cultivated without nutrients when, apparently, the supply of plants with mineral nutrients did not correspond any more to the increased longitudinal growth. The total dry weight of plants treated with GA was lower, particularly in the unenriched variant (by 58%). There was no marked difference between the plants enriched with N (variant B) and those enriched with N, P, K (variant C).

An acceleration of development was observed in GA—treated plants after application of fertilizer—more plants flowered at the end of the experiment (var. B — 5 : 16, var. C — 7 : 19). GA was also observed to bring about ramification of higher parts of stems (5 or 6 plants of each variant).

Tab. 1. Length of stem and number of leaves of sunflower plants following a spray with 50 μg. GA/ml. For description of variants, see text

Variant	GA	Length of stem in cm.			Number of leaves		
		$\bar{x} \pm 3 . s_{\bar{x}}$	Difference caused by GA, in %	P	$\bar{x} \pm 3 . s_{\bar{x}}$	Difference caused by GA, in %	P
A	—	84·4 ± 3 . 2·95	+ 7,5	0·05 sign.	18·2 ± 3 . 0·64	+ 16·5	< 0·01 highly sign.
	+	90·8 ± 3 . 2·14			21·2 ± 3 . 0·82		
B	—	83·4 ± 3 . 3,45	+ 18·2	< 0·001 highly sign.	18·8 ± 3 . 0·79	+ 19·1	< 0·01 highly sign.
	+	98·7 ± 3 . 2·63			22·4 ± 3 . 0·92		
C	—	89·3 ± 3 . 3·24	+ 3·5	0·55 in sign.	19·0 ± 3 . 0·72	+ 16·8	< 0·01 highly sign.
	+	92·4 ± 3 . 3·49			22·2 ± 3 . 0·82		

Tab. 2. Dry-weight index stem : leaves and average leaf-shape index of the 3rd, 4th and 5th sunflower leaves treated with 50 μg. GA/ml. For description of variants, see text

Variant	GA	Dry-weight index stem : leaves			Leaf-shape index of 3rd, 4th and 5th leaves		
		$\bar{x} \pm 3 . s_{\bar{x}}$	Difference caused by GA, in %	P	$\bar{x} \pm 3 . s_{\bar{x}}$	Difference caused by GA, in %	P
A	—	1·49 ± 3 . 0·051	+ 43·0	< 0·001 highly sign.	1·42 ± 3 . 0·023	+ 69·1	< 0.001 highly sign.
	+	2·13 ± 3 . 0·097			2·40 ± 3 . 0·035		
B	—	1·44 ± 3 . 0·059	+ 57·5	< 0·001 highly sign.	1·35 ± 3 . 0·016	+ 50·4	< 0·001 highly sign.
	+	2·27 ± 3 . 0·078			2·03 ± 3 . 0·049		
C	—	1·51 ± 3 . 0·053	+ 48·5	< 0·001 highly sign.	1·30 ± 3 . 0·018	+ 56·9	< 0·001 highly sign.
	+	2·24 ± 3 . 0·122			2·04 ± 3 . 0·047		

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Изменения в строении побега подсолнечника, вызванные гиббереллиновой кислотой

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Резюме

Орошением 26-тидневных растений подсолнечника раствором 50 μг/мл гиббереллиновой кислоты вызваны морфологические изменения листьев и статистически достоверный рост индекса длина / ширина у листьев. Статистически достоверно возросло также число листьев на стебле при одновременном повышении отношения сухого веса стеблей к сухому весу листьев.