Influence of derootment on the translocation of photosynthates

Part II

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The experiments reported in this paper are a continuation of previous investigations concerning the role of roots in translocation (Starck, Mortimer, Gorham 1962; Starck 1963, 1964). On the basis of the results obtained, the suggestion was presented, that roots exert a certain influence on the translocation acting probably as an acceptor of assimilates. The effect of derootment was different depending on: 1) the length of the translocation period, 2) the species investigated, 3) the share of roots in total translocation. Excision of roots affected translocation only in the cases, when the roots of intact plant accumulated a high proportion of ^{14}C -assimilates. Removal of some part of roots changed the distribution of labelled compounds but to a smaller degree than complete derootment. Excision or cooling of the roots, which accumulated a relatively small proportion of ^{14}C -photosynthates either did not affected translocation or changed slightly the distribution of radioactive substances.

The present paper report some further results dealing with the influence of root excision on the distribution of ^{14}C -assimilates after relatively short term translocation period.

MATERIAL AND METHODS

The experimental plants were: sunflower and bean plant, grown in greenhouse on a nutrient solution (sunflower — on a modified Hoagland solution according to Johnson 1957, and bean plant — on solution described previously: Turnowska-Starck 1960). The plants were exposed to $^{14}\text{CO}_2$ in a plexiglass chamber of about 100 l volume. All the procedures connected with ^{14}C -feeding were performed as previously described (Starck 1963, 1964). In the experiment with sunflower four leaves and in that with bean plants — primary leaves (expt. I) or primary leaves as well as the first trifoliate leaf (expt. II) were fed with $^{14}\text{CO}_2$. During 10 or 15 min. of exposure to $^{14}\text{CO}_2$, the stem and petioles were shaded to prevent photosynthesis. In all exper-

iments any residual $^{14}\text{CO}_2$ was removed by passing air from the chamber through a bottle with 30% NaOH for 10 or 15 min. Then the chamber was opened and a part of the plants was sampled as control, to check the radioactivity of the respective organs at the beginning of the time, when the plants were divided into experimental series (intact and derooted ones). Plants of both series were placed out of-doors to allow translocation of labelled assimilates to continue. Following the period of translocation (varying in particular experiments) the nutrient solution was checked for radioactivity. Only traces of ^{14}C were detected in it. The plants were quickly sampled, frozen in dry ice and particular organs were separated (see Tables 1 and 3). The stem was cut at the cotyledon node. The part above and below the cotyledon was divided into three segments (sunflower — Fig. 3) or into two segments (bean plant, expt. I, Fig. 1). The stem of bean plants in expt. II was cut into six parts: at the cotyledon node, at the primary leaf node, and each of these segments was divided into two parts (see Fig. 2). The petioles of bean plants were also cut into two segments.

The analytical procedure used in the experiments described was mostly the same as before (Starck 1963, 64).

To evaluate the effect of the factors investigated (period of translocation, excision of the roots) and reaction of individual organs to derootment as well as to the interaction of these factors, statistical analysis of variance was performed. For this purpose, mostly relative values of radioactivity were calculated (i.e. expressed in percentage of total ^{14}C in the whole plant). These values were transformed according to the Bliss' table. The variance was calculated by Snedecor's F test, and the deviations between the averages — by Student's t test.

RESULTS

In expt. I with 17-days old bean plants, 100 μc of $\text{Na}_2^{14}\text{CO}_3$ were mixed with $\text{Na}_2^{12}\text{CO}_3$ sufficient to give an initial concentration of about 0,1 per cent of CO_2 (v/v), in the chamber containing 48 plants. The plants were allowed to assimilate $^{14}\text{CO}_2$ for 15 min. at 10 a.m. and to continue translocation for 1,5 and 3 hours (feeding time included). The control plants were sampled 30 min. after the beginning of exposure. The results are presented in Tables 1 and 2 and Fig. 1, expressed as average of duplications (four plants per each) and calculated per one plant. The percentage of total ^{14}C was calculated assuming radioactivity of the whole plant as 100 per cent. In both translocation periods derootment reduced slightly the translocation. These differences are statistically insignificant, after a 1,5 hr period of translocation the differences were at the limit of significance. The effect of derootment on the relative translocation, as calculated for the whole experiment is,

however, significant. (The interaction between the length of the translocation period and the effect of derootment is insignificant). Excision of the roots did not affect the share of the stem in the total radioactivity (differences insignificant). The distribution of ^{14}C -assimilates in the stem is expressed as percentage of total ^{14}C calculated per 1 cm of its length (Fig. 1). In the stem of control and derooted plants a marked (and statistically significant) descending gradient of radioactivity was observed whereas the labelled assimilates were distributed more uniformly along the stem of intact plants (the differences between the radioactivity of the stem above and below the cotyledons in intact and derooted plants are significant only after a 1,5 hour period of translocation). The only statistically significant effect of derootment was observed in the last stem's segment, of plants after a 1,5 hour period of translocation.

The share of petioles in the total radioactivity after the first 1,5 hour did not depend on the presence of roots, but after a longer period the relative radioactivity of petioles increased in derooted plants as compared with intact ones. In none of the treatments there was a significant radioactivity gradient in the petioles, therefore the figures are not presented. The share of the apical part in the total translocation is a little higher or the same as that of roots in spite of greater fresh weight of these organs.

A negative effect of derootment on the incorporation of labelled compounds into the ethanol insoluble fraction was observed in the apical part (significant) and in the stem, especially after 3 hr of trans-

Fig. 1. Effect of derootment on the distribution of ^{14}C -assimilates in the stem of bean plant (Radioactivity as per cent of total ^{14}C in the whole plant per 1 cm of the length of stem)

1 — intact; 2 — derooted; 3 — control.

location (significant only if calculated jointly for both periods). In the other organs the radioactivity of insoluble fraction was mostly lower in derooted plants than in intact ones, but these differences are non-significant (Table 1). In Table 2 the radioactivity of the insoluble

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Effect of derootment on distribution of radioactivity
(Average of duplicates)

Period of translocation	Treatment	Primary leaves				Petioles				Apical	
		10 ³ cpm		% of total 14C	f.w. (g)	10 ³ cpm		% of total 14C	f.w. (g)	10 ³ cpm	
		total	ethanol insolub.			total	ethanol insolub.			total	ethanol insolub.
30 min.	Control plants	137.16	24.96	80.4	1.26	17.77	-	10.4	0.39	0.58	-
1.5 hours	Intact plants	86.58	26.23	55.5	0.96	25.49	3.26	16.3	0.34	6.50	0.59
	Derooted plants	100.70	27.69	62.8	0.91	26.30	2.84	16.5	0.44	5.04	0.48
	Effect of derootment	+14.12	+1.46	+7.3	-	+0.81	-0.42	+0.2	-	-1.46	-0.11
3.0 hours	Intact plants	92.61	32.41	51.6	1.15	26.06	6.64	14.5	0.41	12.55	3.68
	Derooted plants	84.79	27.73	55.3	0.90	28.39	6.13	18.5	0.30	8.79	1.98
	Effect of derootment	-7.82	-4.68	+3.7	-	+2.33	-0.51	+4.0 ^x	-	-3.76 ^x	-1.90 ^x

^x - Differences significant at P=0.05.

* Total radioactivity - radioactivity of the whole plant.

** Total translocation - radioactivity of all the organs except leaves.

fraction is expressed as an percentage of total radioactivity in particular organs. These relative values could be with some approximation, a measure of the degree of ¹⁴C-incorporation into the ethanol insoluble fraction. In all but the one examined organs, derootment diminished

T a b l e 2

Percentage of ¹⁴C-incorporation into 80% ethanol insoluble fraction*

Experimental series		Leaves	Petioles	Apical part	Stem	Roots
Control plants		18.2	-	-	-	-
1,5 hrs	intact plants	30.3	12.8	9.1	10.3	0.0
	derooted plants	27.5	10.8	9.5	8.3	-
	effect of derootment	-2.8	-2.0	+0.5	-2.0	-
3,0 hrs	intact plants	35.0	25.5	30.9	27.1	8.3
	derooted plants	32.7	21.6	22.5	22.7	-
	effect of derootment	-2.3	-3.9	-8.4	-4.4	-

* Radioactivity of particular organ is assumed as 100%.

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in bean plant (after 15 min. assimilation of $^{14}\text{CO}_2$)
calculated per one plant)

part		Stem				Roots				Total radioactivity* 10 ³ cpm		Total trans- loc.*	% of trans- loc.
% of total ^{14}C	f.w. (g)	10 ³ cpm		% of total ^{14}C	f.w. (g)	10 ³ cpm		% of total ^{14}C	f.w. (g)	total	ethanol insolub	10 ³ cpm	
		total	ethanol insolub			total	ethanol insolub						
0.4	0.05	15.21	-	8.8	0.93	0.0	0.0	0.0	0.83	170.72	24.96	33.56	19.6
4.1	0.05	32.94	3.39	21.1	0.77	4.68	0.0	3.0	0.87	156.19	33.47	69.61	44.5
3.1	0.05	28.40	2.36	17.6	0.70	-	-	-	-	160.44	33.37	59.74	37.2
-1.0	-	-4.54	-1.03	-3.5	-	-	-	-	-	+4.25	-0.10	-9.87	-7.3
7.0	0.07	35.40	9.59	19.8	0.80	12.93	1.07	7.1	0.96	179.55	53.59	86.94	48.4
5.7	0.05	31.41	7.13	20.8	0.74	-	-	-	-	153.38	42.97	68.69	44.7
-1.3	-	-3.99	-2.46	+0.7	-	-	-	-	-	-26.17	-10.62	-18.35	-3.7

the percentage of the ethanol-insoluble fraction, especially after 3 hr period of translocation (these differences calculated for all the organs together were statistically significant). After a long period of translocation the most pronounced decrease in the percentage of incorporation was

Fig. 2. Effect of derootment on the distribution of ^{14}C -assimilates in the stem of bean plant (Radioactivity expressed 10^3 c.p.m. in particular segments calculated per one plant)

1 — intact; 2 — derooted; 3 — control.

Effect of derootment on distribution of
(Averages of three replications)

Species	Treatment	Leaves*			Petioles of primary leaves			Trifoliolate leaves			Petioles trifoliolate	
		10 ³ cpm		f.w. (g)	10 ³ cpm	% of total ¹⁴ C	f.w. (g)	10 ³ cpm		f.w. (g)	10 ³ cpm	% of total ¹⁴ C
		total	insoluble					total	insoluble			
Bean plant	Control	92.77	15.21	1.54	5.88	4.4	0.34	31.52	14.12	0.56	trace	trace
	Intact plants	56.98	16.49	1.42	10.13	8.6	0.34	26.74	14.47	0.45	1.80	1.6
	Derooted plants	70.02	15.05	1.42	12.48	9.4	0.37	32.14	19.60	0.52	1.45	1.1
	Effect of derootment	+13.34	-1.44	-	+2.35	+0.8	-	+5.40	+5.33	-	-0.35	-0.5
Sun-flower	Control	84.28	38.04	1.57	1.90	1.8	0.15					
	Intact plants	62.10	38.56	1.53	1.20	1.3	0.15					
	Derooted plants	74.44	45.71	1.46	1.88	1.6	0.15					
	Effect of derootment	+12.34	+7.15	-	+0.66 ^x	+0.3	-					

* In the case of bean plants—primary leaves.

^x = Differences significant at P=0.05.

observed in the apical part and in the stem. The differences in the reaction of particular organs to derootment are not significant, therefore the interaction between the individual organs and derootment was insignificant.

The second experiment was undertaken with older, 22-days old bean plants, with the first trifoliolate leaf partially expanded. The plants were allowed to assimilate ¹⁴CO₂ for 10 min., at 10 a.m. 30 plants in the chamber, ¹⁴CO₂ was liberated from Na₂¹⁴CO₂ of total radioactivity — 60 μ c, initial concentration of CO₂ — 0.06 per cent (v/v). The experiments included four series: control, sampled just at the moment of derootment — (20 min. after the beginning of assimilation), intact plants, derooted plants and those with roots immersed in nutrient solution at 10° C, during the translocation period. The last three series were collected after 1 hour of translocation (feeding time included). The data related to the series with cooling of the roots are not presented, because the plants had wilted seriously and wide dispersion between replications was noted. In all of these plants the cooling of roots produced a decrease of the relative translocation, especially to the lower part of the stem. This might have been due to the wilting process which may influence translocation (Weeb, Gorham 1963; Wiebe *et al.* 1963).

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^{14}C -assimilates in sunflower and bean plants
calculated per one plant)

of leaves	Apical part			Stem			Roots			Cotyledons		Total radio-act. 10^3 cpm	Total trans-locat. 10^3 cpm	% of total trans-locat.
	f.w. (g)	10^3 cpm	% of total ^{14}C	f.w. (g)	10^3 cpm	% of total ^{14}C	f.w. (g)	10^3 cpm	% of total ^{14}C	f.w. (g)	10^3 cpm	% of total ^{14}C		
0.11	0.21	0.2	0.18	4.52	3.3	0.85	0	0	1.56	-	-	134.90	10.61	7.9
0.13	0.74	0.6	0.14	19.27	16.5	0.87	1.91	1.6	1.63			117.27	33.85	28.9
0.13	0.54	0.5	0.15	15.38	11.6	0.94	-	-	-			132.01	29.85	22.6
-	-0.20	-0.1	-	-3.89 ^x	-4.9	-	-	-	-			+14.74	-4.00	-6.3
	4.97	4.8	0.28	9.93	9.5	1.77	0.35	0.6	2.61	1.93	1.8	103.46	19.18	18.5
	11.95	12.4	0.34	13.50	14.0	1.58	8.95	7.1	3.99	0.76	0.8	96.47	34.37	35.6
	13.66	12.0	0.26	22.66	19.9	1.75	-	-	-	1.21	1.1	113.63	39.39	34.6
	+1.71	+0.4	-	+9.16 ^x	+5.9	-	-	-	-	+0.45	+0.3	+17.36	+5.02	-1.0

All the other data are presented in the Tables 3 and 4 and Fig. 2, as average of triplications three plants in each). The increase of the total radioactivity in derooted plants in comparison with intact ones was insignificant (L.S.D. = 33,67 at $P = 0,05$). Derootment showed a tendency to decrease the relative translocation (the differences are near the limit of significance), and reduced the share of the stem in the total radioactivity. Removal of the roots produced a marked negative effect on the translocation to the stem below the cotyledon node but there was no differences between radioactivity of the stem above the node of primary leaves in both series of plants (therefore the interaction between radioactivity of the particular segments in experimental series is statistically significant).

Excision of the roots affected ^{14}C -incorporation into the ethanol insoluble fraction in primary leaves differently than in the trifoliate ones. The radioactivity of the ethanol-insoluble fraction in the primary leaves was almost the same in all experimental series (Table 3), independently on the different translocation period, but the percentage of incorporation was significantly lower in derooted plants (Table 4). In trifoliate leaves derootment produced the increase of radioactivity of the insoluble fraction expressed, both: as c.p.m. as well as percentage

Table 4
Percentage of ^{14}C -incorporation into 80%-ethanol insoluble fraction*

Experimental Series	Bean plant		Sunflower	
	primary leaves	trifoliolate leaves	leaves	stem
Control plants	16.4	44.8	46.2	-
Intact plants	29.1	54.1	62.1	13.7
Derooted plants	21.5	61.6	61.4	10.9
Effect of derootment	-7.6 ^x	+7.5 ^x	-0.7	-2.8 ^x

* Radioactivity of particular organ is assumed as 100%.

^x differences significant at $P=0.05$

— see Table 3 and 4. (The interaction between the percentage of incorporation into the ethanol — insoluble fraction and these kinds of leaves, in the respective series, is significant). The reason of this reversal effect of derootment may be due to the different age of both groups of leaves. Trifoliolate leaves incorporated relatively more ^{14}C -compounds into the ethanol insoluble fraction than older, primary leaves, in all series.

This process seems to be connected with growth. In all the other organs the radioactivity of the insoluble fraction constituted: about 2—5 per cent of total radioactivity found in the stem or apical part and up to 8—10 per cent — in the petioles (data not presented).

Fig. 3. Effect of derootment on distribution of ^{14}C -assimilates in the stem of sunflower (Radioactivity in particular segments, calculated per one plant, in 10^3 c.p.m.)

1 — intact; 2 — derooted; 3 — control.

The third experiment was performed with 22-days old sunflower. The plants were allowed to assimilate $^{14}\text{CO}_2$ for 10 min. at 1 p.m. (total radioactivity — 60 μc , initial concentration of CO_2 — 0.06 per cent, v/v, 27 plants). All results presented in Table 3 and 4 are average of

triplications (three plants in each). Derootment did not affect either total or relative translocation. A considerable proportion of ^{14}C -photosynthates was already translocated from the fed leaves after 20 min. Derootment produced a marked increase of the stem radioactivity in all segments (Fig. 3). This effect was rather uniform in the particular segments, therefore the empirical curves of ^{14}C -distribution in the stem of intact and derooted plants are quasi parallel and there is no interaction between the factors investigated. The share of petioles in the total radioactivity of intact and derooted plants was lower than that of control ones. (The effect of derootment on the radioactivity of the petioles is statistically significant). The share of the apical part in the total radioactivity is even higher than that of roots in spite of their greater fresh weight.

In the leaves a large proportion of the ^{14}C -assimilates was incorporated into the ethanol-insoluble fraction. Derootment did not affect this process in the leaves (differences insignificant), but decreased it in the stem (Table 4).

DISCUSSION

The results obtained in the reported experiments confirm in general the facts observed in previous investigations (Starck 1963, 1964). The greatest difficulty in the interpretation of results already recorded lay in the variability of the replications and many facts, connected with the relatively long term translocation period. These facts were as follows: 1) the loss of radioactive substances in respiration by intact plants was probably greater than in derooted ones, due to their greater weight, 2) leakage from the translocation channel into the surrounding tissues, 3) effect of derootment on the degree of incorporation of ^{14}C into the ethanol insoluble fraction, and probably some others (see discussion — Starck 1964). Most of these difficulties in interpretation were greatly reduced in the experiments described because of the greater number of plants used in each replication and of the shortened translocation period. In bean plants and in a lesser degree in sunflower a great proportion of the total radioactivity in the apical part, stem and petioles corresponded to the ethanol-soluble fraction, after one hour period of translocation. Nevertheless even after this relatively short period, derootment produced some decrease in the percentage of ^{14}C -incorporation into the ethanol insoluble substances, in both species examined. A similar effect of excision the roots was already observed in lupine, sunflower and bean plants in most of the experiments described before (Starck 1963, 1964). This might have been due to the direct

or indirect influence of roots on some processes but this still requires a study in detail.

From all the results obtained it seems that derootment influenced also the translocation by the change of ^{14}C -distribution. Similar fact was observed already in the soybean plant by Nelson and Gorham (1959). The general trend of translocation in the plants examined was mainly towards the roots. Excision of the roots of bean plants caused a decrease of radioactivity first in the lower part of the stem, accompanied by a small reduction of relative translocation. These differences diminished with the lapse of time and subsequently an increase of radioactivity of the petioles of derooted plants was observed.

The total relative translocation in sunflower did not change regardless of the presence of roots. Excision of the roots produced an increase of the radioactivity of the stem and petioles. Temporary storage of assimilates in the stem of plants after excision of the main acceptor of assimilates (Birecka et al. 1963; Birecka, Skupińska 1963; Starck 1963, 1964), or in the stem (Tanaka 1961, Stoy 1963) and in the petioles of intact plants (Okanencko 1936) in the period of very intensive translocation were reported several times. This might suggest that in some cases the stem can be an important acceptor of assimilates. The accumulation of radioactivity in the stem depends among other things, on the competition between various sinks of assimilates. The roots, being a great sink of assimilates seem to stimulate longitudinal transport and diminish the tangential one as observed by Peel (1964) on rooted willow cuttings. Tangential movement was found in cuttings with limited root growth.

Petioles might be considered with some approximation as a transit organ, especially in relatively short term experiments, when the lateral leakage can be neglected.

The radioactivity of the petioles depends mainly on the differences between the rate (or velocity) of entrance of ^{14}C -substances from the leaf (v_e) and the rate or velocity of outflow (v_L) to the stem. The increase of petioles radioactivity in derooted plants might be possibly explained at least by one of the following three ways:

1. The rate or velocity of entrance v_e would be higher in derooted than in intact plants ($v_e^{\text{der.}} > v_e^{\text{int.}}$), but the rate of $v_L^{\text{int.}} = v_L^{\text{der.}}$. In this case the total translocation could also decrease in intact plants.

2. The rate or velocity of entrance v_e does not depend on the presence of roots, but the outflow from the petioles of derooted plants is reduced:

$$v_e^{\text{int.}} = v_e^{\text{der.}} \text{ but } v_L^{\text{int.}} > v_L^{\text{der.}}$$

In this case the total translocation could be the same in intact and derooted plants.

Table 5
Effect of derootment on the velocity of translocation

V	Treatment	Length of period after derootment			
		bean plants			sunflower
		exp. I		exp. II	exp. III
		60 min.	150 min.	140 min.	40 min.
v_e	intact plants	24.9	28.8	21.0	27.1
	derooted plants	17.6	25.1	16.7	18.1
v_L	intact plants	19.0	24.7	18.7	17.6
	derooted plants	11.5	17.0	12.1	13.2
v_e/v_L	intact plants	1.31	1.16	1.13	0.97
	derooted plants	1.53	1.45	1.21	0.99

3. The velocity of both: entrance and outflow of assimilates from petioles decreases after derootment:

$$v_e^{\text{int.}} > v_e^{\text{der.}} \quad \text{and} \quad v_L^{\text{int.}} > v_L^{\text{der.}}$$

In this case the share of petioles in total radioactivity would depend on the ratio $v_e^{\text{der.}} : v_L^{\text{der.}}$ in comparison with $v_e^{\text{int.}} : v_L^{\text{int.}}$. The increase of this ratio of derooted plants would be correlated with the greater decrease of outflow from the petioles than the decrease of entrance and consequently with the increasing temporary accumulation of assimilates in these organs. In this case, the total relative translocation could decrease as a consequence of root excision.

Considering the decrease of the radioactivity in the fed leaves as some indicator of velocity (or rate) of entrance of assimilates in to the petioles and the increase of radioactivity in all the other organs as an indicator of the velocity (or rate) of outflow from the petiole in the period examined, the above-mentioned formulas were used. All calculation were performed on the relative values (Table 5). Velocity of translocation after different periods of time cannot be compared, because of the continuous dilution of radioactive assimilates (formed during 10 or 15 minutes of exposure to $^{14}\text{CO}_2$) by ^{12}C -assimilates. Therefore the comparison may be done only between particular series examined at the same time.

In all examined cases derootment of bean plants (exp. I and II) produced a decrease of both: v_e and v_L . The $v_e:v_L$ ratio slightly increased as a consequence of root excision. This is not true for sunflower, where both v_e and v_L as well as the $v_e:v_L$ ratio seem to be the same in intact and derooted plants.

All these considerations seem to point to a different reaction of the examined species to derootment. In bean plant some decrease of velocity

(or rate) of translocation was observed, whereas excision of the roots of sunflower produced only higher accumulation of assimilates in the stem and partially — in the other organs; this possibly depending on the different role of particular organs, especially the stem, as acceptors of assimilates in both species.

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SUMMARY

The effect of derootment on translocation of labelled assimilates in sunflower and bean plant was investigated. The reaction of both to the excision of the roots was not the same. Derootment of the bean plant reduced slightly the percentage of translocation and caused an increase of the share of petioles in the total radioactivity of the plant, after a 3 hour period of translocation. The gradient of radioactivity in the stem below the fed leaves after 1 and 1,5 of hours translocation was steeper in derooted than in intact plants. These differences diminished with the lapse of time.

Excision of the sunflower's roots did not affect either total or relative translocation, but produced an increase of the share of stem and petioles in the total radioactivity.

The cause of change of ^{14}C -assimilates' distribution due to derootment, mainly the possibility of a decrease of translocation velocity (or rate) is discussed. Derootment seems to decrease the velocity (or rate) of translocation in bean plant but not in the sunflower.

All results obtained seem to indicate that the effect of derootment depend on the capacity of particular organ as a sink of assimilates (in reported experiments—mainly roots and the stem).

Derootment produced also some decrease of the percentage of ^{14}C -incorporation into the ethanol-insoluble fraction.

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Wpływ odcięcia korzeni na przemieszczanie asymilatów. Cz. II.

Streszczenie

Opisane doświadczenia stanowią kontynuację badań, których celem jest określenie roli systemu korzeniowego w przemieszczaniu asymilatów, znakowanych radioaktywnym węglem (^{14}C). Jako roślinę doświadczalną stosowano: fasolę i słonecznik. Okres przemieszczania był stosunkowo krótki i wynosił 1, 1,5 i 3 godziny.

Wykazano, że oba badane gatunki reagowały w różny sposób na odcięcie korzeni. U fasoli zabieg ten powodował bardzo nieznaczne obniżenie procentu przemieszczonych asymilatów. Początkowo różnice zaobserwowano w dolnej części łodygi, a po dłuższym okresie stwierdzono znaczny wzrost udziału ogonka w ogólnej radioaktywności. Słonecznik po odcięciu korzeni gromadził stosunkowo duże ilości radioaktywnych asymilatów w łodydze i w ogonkach, natomiast procent przemieszczania asymilatów nie zależał od obecności korzeni.

Przedyskutowano przyczyny wpływu odcięcia korzeni na rozmieszczenie radioaktywnych asymilatów, analizując głównie możliwość zmian w szybkości (lub intensywności) przemieszczania. Wydaje się, że odcięcie korzeni u fasoli obniżało szybkość badanego procesu, czego nie obserwowano u słonecznika.

Poza wpływem korzeni na rozmieszczenie radioaktywnych asymilatów w poszczególnych organach, zaobserwowano pewne obniżenie procentowej zawartości związków nierozpuszczalnych w 80% etanolu (w przeliczeniu na radioaktywność ogólną danego organu, przyjętą za 100%). Podobne zjawisko zaobserwowano w poprzednich badaniach, prowadzonych na: słoneczniku, fasoli i łubinie. Wyjaśnienie przyczyn obniżenia stopnia inkorporacji związków organicznych do frakcji nierozpuszczalnej w etanolu, jako wynik bezpośredniego lub pośredniego wpływu odcięcia korzeni wymaga dalszych, szczegółowych badań.