# The migration of 14C-assimilates in strawberry

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### INTRODUCTION

The experiments reported constitute a continuation of investigations concerning translocation of photosynthates in strawberry.

In a previous paper (Starck 1966) it was observed, that strawberry runners seem to have a rather low sink power. Almost half of <sup>14</sup>C-substances translocated to the runner, after a few hours of translocation accumulated in its center, mainly in a parenchymatic tissue. After daughter plant removal, a marked decrease of <sup>14</sup>C-translocation to the runner was observed. It may have been the result of same disturbance in water economy or of abolition of the transpiration stream. This supposition results from the experiments of numerous authors, showing a close connection between the xylem and phloem water relations (Weatherley et al. 1959; Peel, Weatherley 1962; Wray, Richardson 1964). Peel and Weatherley (1962) observed an effect of the transpiration rate which caused a tension in the xylem of willow cuttings, on the translocation of sugars in the phloem tissue. Therefore the effect of the transpiration rate on photosynthate translocation in strawberry runners was examined.

The relatively low translocation of <sup>14</sup>C-photosynthates from the blades of the mother plant to the stolon with the daughter plant could have been connected with their photosynthesis "in situ". Therefore in the present study this possibility was verified. The daughter plant was examined as an acceptor as well as a donor of photosynthates in attached and detached runners.

#### MATERIAL and METHODS

Strawberries var. 'Regina' were grown under field conditions and then transferred to soil culture in the greenhouse.

All the conditions and experimental treatments are presented in table 1.

Experiments 1, 2 and 4 were done in three - but expt. 3 - in two replications.

In experiment 1, the whole plant including three leaves and two runners was placed in a plexiglass chamber. The whole younger runner was exposed to <sup>14</sup>CO<sub>2</sub> under light but the older one was enclosed in a darkened glass tube with CaCl<sub>2</sub> (dry series) or saturated with water vapour (humid series). The transpiration of

the runner treated in the manner described with humid atmosphere was reduced more than twice in comparison with that in the dry one.

After 4 hrs. (starting from <sup>14</sup>CO<sub>2</sub> evolution), the plants were quickly frozen in dry ice and separated into organs. The older runners were cut into 7, and younger — into 4 pieces, about 6 cm each. The radioactivity was estimated separately in internal (including: medulla, xylem, phloem and pericyclic fibers) and external tissue (cortical parenchyma, epidermis) by the use of a G-M-counter, as described previously (Starck 1963).

In all the other experiments, blades of daughter plants were enclosed in a plexiglass leaf-chamber (Starck 1967) sealed with modelling clay around the petiole, at the base of the blade. All the other plant organs were placed in natural atmosphere, under light or in darkness. In expts. 2 and 3 the daughter plants were not rooted. Runners in these experiments were cut into several parts: before and beyond the daughter plant, about 5–6 cm each.

In expt. 4 detached runners with rooted daughter plants were used. The blades of older daughter plants were exposed to <sup>14</sup>CO<sub>2</sub>. The runners (about 30 cm long) were cut into 18 short pieces and analysed separately.

#### RESULTS

According to the mass flow theory, translocation in the phloem is conditioned in part, by the influx of water from the surrounding cells to the sieve tubes and it depends on the difference in water potential between the phloem and xylem elements. The change in the water potential caused by introducing osmotica into the xylem (Weatherley et al. 1959) modified the rate of sucrose translocation in isolated willow cuttings.

Table 2 and fig. 1 give a comparison of <sup>14</sup>C-translocation in plants in the "dry" and "humid series".

Radioactivity detected in the older runner treated with dry atmosphere is slightly higher than in the humid one, expressed as radioactivity per organ (table 2), but these differences diminished or became opposite when we compare the participation of the runner in the total radioactivity, translocated from the blades (percentage of translocation) or the radioactivity of particular organs calculated par 1 g of fresh weight.

The distribution of radioactivity along the runners, treated with dry and humid atmosphere is similar in character to the change in fresh weight of the particular runner segments (fig. 1). The higher radioactivity both of the internal and external tissue of runners treated with dry atmosphere seems to be caused by their higher weight, as may be concluded from the data in table 2. The participation of the daughter plant in the total radioactivity of the whole runner was above 20 percent in both series.

The translocation of <sup>14</sup>C-photosynthates to the runner deprived of the daughter plant was significantly reduced in the outer (O) and inner (I) part of the runner,

Table 1 Conditions of all experiments

No.	Transfer from field before		Condition of 14CO <sub>2</sub> exposure	4CO <sub>2</sub> exposur	ę.		Conditions of translocation	Conditions of translocation	CONT.
of expt.	exposure to 14CO <sub>2</sub>	Date	treatment of runner	time	t°C	t°C   µC/plant	time	t°C	-CO <sub>2</sub> assimilated by:
-1 1	7 days	2 June 1966	y.r. — light; <sup>14</sup> CO <sub>2</sub> o.r. — darkness	. 1115—1215	20—23	45	4	18—21	18—21 blade of m.pl.—10.7g f.w. y.r. — 0.6 g f.w.
	27 days	22 June 1966	under light 12CO2	1350—1420	24	∞	7	24—27	24—27 d.pl. — 1.6 g f.w.
	7 days	2 June 1966	in darkness	1115-1215	20—23	45	8	18—21	18—21 d.pl. — 2.7 g f.w. (with the petiole and crown)
	10 days	7 June 1967	After 16 hrs of darkness a) under light <sup>12</sup> CO <sub>2</sub> b) in darkness	1045—1115	20	∞	2 and 4	ŀ	d.pl. — 1.4 g f.w.

Expt 1 and 3 - plants exposed in the same chamber

d.pl. — daughter plant m.pl. — mother plant y.r. — younger runner o.r. — older runner

## Runners in darkness

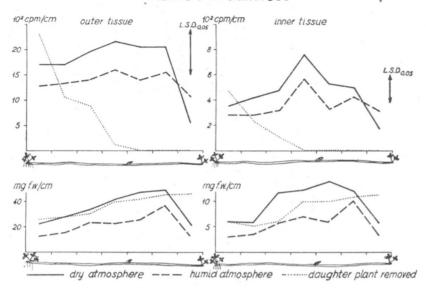


Fig. 1. Effect of dry and humid atmosphere on the translocation of <sup>14</sup>C-photosynthates

The blades of the mother plant were exposed to <sup>14</sup>CO<sub>2</sub>. Stolons were cut into segments, about 6 cm long. (Exp. 1;

4-hr translocation, average of three replications)

The ratio of outer to inner tissue (O/I):

intact plant - fresh weight 4.0, radioactivity 4.1; deprived of daughter plant - fresh weight 4.3, radioactivity 5.2

as has been reported before (Starck 1966). Radioactivity was detected only in the first internode of the stolon.

The radioactivity of outer tissue was much higher than that of the inner one. The ratio of O/I radioactivity was almost the same as the ratio of O/I fresh weight (see fig. 1). In runners deprived of the daughter plant the ratio of O/I radioactivity increased slightly.

The distribution of radioactivity in the younger runners, exposed to light and <sup>14</sup>CO<sub>2</sub> is illustrated in fig. 2. The radioactivity of runners increased markedly in acropetal direction, both in outer and inner tissue. This seems to be the result of translocation of the <sup>14</sup>C-photosynthates from the daughter plant in basipetal direction and/or of the stolon's <sup>14</sup>C-photosynthesis, especially in its younger part where the amount of chlorophyll is usually higher.

In younger runners exposed to  $^{14}\text{CO}_2$ , the ratio of radioactivity in the external and internal tissue was about the same as the comparable ratio of their fresh weight.

The radioactivity of the daughter plant, calculated per 1 g of fresh weight was approximately the same as that of the mother plant blades (table 2).

The differences in the crown and petiole radioactivity in the series of plants with altered transpiration rate of the older daughter plant are difficult to explain.

In the series of experiments described below, young, not fully grown blades of daughter plants were exposed to <sup>14</sup>CO<sub>2</sub> in the leaf chamber. The acceptor organs were: petioles, roots and crown as well as the stolon with the younger daughter plant.

In expt. 2 the <sup>14</sup>C-translocation from the relatively young blades to the stolon, attached or detached from the mother plant was compared (Table 3). In the case of detached runner, their cut end was kept freely supplied with water. All the organs of plants, except labelled blades, were kept under light, in normal atmosphere.

# Runners under light in 4CO2

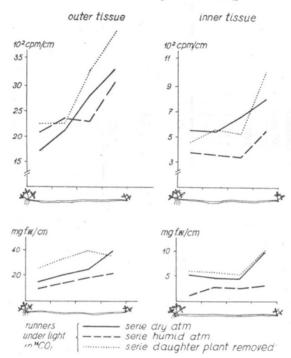


Fig. 2. Distribution of <sup>14</sup>C-photosynthates and fresh weight in younger runner, exposed to light and <sup>14</sup>CO<sub>2</sub> (Expt. 1 — as in fig. 1)

The ratio of outer to inner tissue (O/I): fresh weight 4.8; radioactivity 5.0

Detachement did not significantly effect translocation of <sup>14</sup>C-photosynthates (fig. 3A and table 3). In both experimental treatments, <sup>14</sup>C-migrated in very small amounts to the petioles, crown and runner in a 2-hr period. In the runner, radioactivity was detected mainly in the first segment, in basipetal direction. A very small (almost trace) amount of labelled substances moved acropetally. Generally speaking translocation in this experiment was scarcely 2 percent of total radioactivity of the whole plant.

To investigate the reason of such low translocation from the daughter plant's blade, all the runners, with younger daughter plants, were darkened during the time of exposure to <sup>14</sup>CO<sub>2</sub> and translocation of labelled substances (expt. 3). In this case, in a 3-hr period about 7 percent of <sup>14</sup>C-photosynthates migrated out of the daughter plant\* (table 3). The highest radioactivity was detected again in the first

<sup>\*</sup> The radioactivity of all organs of the daughter plant was estimated jointly.

Table 2

Effect of air humidity and daughter plant detachement on the migration of 14C-photosynthates from the blades of the mother plant (Average of three replications; 4 hrs translocation)

			Ι.,	"Dry serie"		<sup>1</sup> Η"	"Humid serie"		Daughte	Daughter plant removed	noved	Average ner-
.oN	Plant part	1.0	Total radioact.	103 cpm/1g f.w.	radioact.1)	Total radioact.	103 cpm/1g f.w.	radioact.1)	Total radioact.	103 cpm/1g f.w.	radioact.	centage of total fresh weight
1	Blades with apical part		4.173,7	362,3		3.708,9	442,9		5.036,0	423,5	Į.	55,3
7	Petioles		152,6	38,4	36,5	85,2*	38,0	27,8	166,1	39,8	45,4	17,9
3	Crown		6,65	31,5	14,3	30,8*	17,4	10,1	56,3	39,1	15,4	8,8
4	-orn d	hter	29,1	37,3	6,9	24,7	25,2	8,1			1	4,5
2	iw l	er	91,5	47,7	21,9	71,0	60,4	23,2	32,4	16,3	8,9	8,8
9	oldes treated diffwed (dan runner	l ner	120,6	85,0	28,8	7,56	85,6	31,3	32,4*	16,3	8,9	13,3
7	tCO <sup>5</sup>	hter	24,0	363,3	5,8	27,9	382,7	9,1	39,5	223,1	10,8	9,0
- ∞		er	9,77	108,9	14,6	66,3	153,8	21,7	71,5	83,8	19,5	4,1
6	runn Jight	l ner	9,101	472,2	20,4	94,2	536,5	30,8	111,0	306,9	30,3	4,7
10	Total plant except blades		434,7	I	100,0	305,9		100,0	365,8	I	100,0	44,7
11	11 Total plant		1.608,4	1	1	4.014,8	1	1	5.401,8	1	1	100,0

differences statistically significant
 radioactivity of all the organs, except blades, assumed as 100,0%.

segment of the runner in basipetal direction (fig. 3B). The labelled compounds transported in acropetal direction were much more uniformly distributed along the runner than in the basipetal one. Younger daughter plants accumulated in 3-hr period about 13 % of total labelled substances, translocated from the older daughter plant blades.

In expt. 4 <sup>14</sup>C-translocation from the blades of the rooted daughter plant to the stolon with younger daughter plant under light or in darkness was compared. The

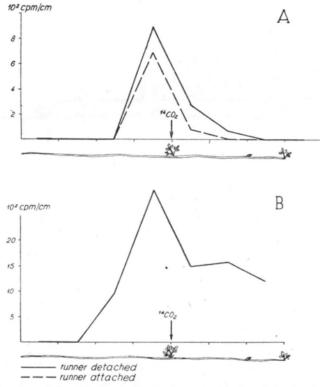


Fig. 3. Migration of the <sup>14</sup>C-photosynthates from the blades of the daughter plant A: effect of runner detachement. Runner under light in <sup>12</sup>CO<sub>2</sub> (Expt. 2; 2-hr translocation, average of three replications). B: runners in darkness (expt. 3; 3-hr translocation, average of two replications)

whole plants of "darkened series" were darkened 16 hrs before <sup>14</sup>CO<sub>2</sub>-exposure. During exposition in <sup>14</sup>CO<sub>2</sub>-atmosphere and translocation period only the stolons with younger daughter plants were in darkness. In 2-hr translocation 6–7 percent and in 4 hr translocation 12–15 percent of labelled photosynthates migrated from the blades of the daughter plant (table 4). The total export of <sup>14</sup>C-photosynthates from the blades of daughter plants did not depend on the darkening of the runner (the differences were not statistically significant); only in the younger part of the stolon, kept in darkness, radioactivity was significantly lower than in the runner exposed to light.

After 2-hr translocation in both series, about one half of the total <sup>14</sup>C-substances exported from the daughter plant blades were detected in the runners (table 4).

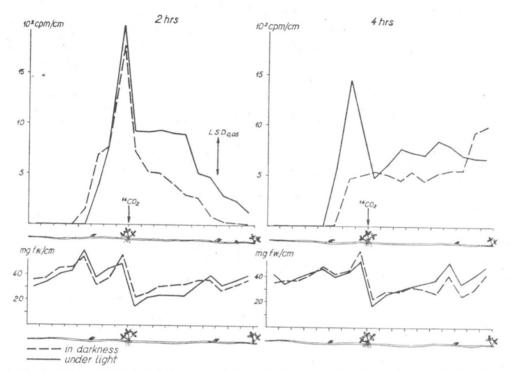


Fig. 4. Effect of light and darkness on <sup>14</sup>C-translocation from the blades of a rooted daughter plant. (Expt. 4; average of three replications)

Table 3

Distribution of <sup>14</sup>C-photosynthates. Exp. 2 and 3 (blades of daughter plant exposed to <sup>14</sup>CO<sub>2</sub>)

;	Connection		<sup>14</sup> C-d	aughter	plant		Rur	nner		Tota
No. Expt.	of runner with mother plant	Radioactivity	Blades	Petio- les	Crown	bey- ond d.pl.	before d.pl.	y.d.pl.	Total	trans- loca- tion
	attached	10 <sup>2</sup> cpm % of translo-	8850	72	52 .	41	10	0	51	175
2		cation	_	41.2	29.7	23.4	5.7	0	29.1	100
	detached	10 <sup>2</sup> cpm % of translo-	12850	69	54	52	18	0	70	193
		cation		35.8	27.9	27.0	9.3	0	36.3	100
3	detached	10 <sup>2</sup> cpm % of translo-		7300	,	192	306	77	575	575
		cation				33.4	53.2	13.4	100	100

beyond d.pl. — part of runner in the basipetal direction before d.pl. — ,, ,, in the acropetal ,, Radioactivity of blades (expt. 2) calculated per 1 g of f.w. attached series 6980·10<sup>2</sup> cpm detached series 6760·10<sup>2</sup> cpm

Effect of runner treatment with light and darkness on the distribution of 14C-photosynthates (Expt. 4, average of three replications)

			2-hr translocation	location					4-hr translocation	location			
Plant organs		light*)		þ	darkness			light		P	darkness		% of fresh
Cipal	102cpm	(**%	102cpm/1g	102cpm	%	102cpm/1g	102cpm	%	102cpm/1g	102cpm	%	102cpm/1g	weight (Average)
14C-blades	6920.8	I		6622.9		4303.4	6664.6	I	4801.6	5637.5	1		26.6
petioles	95.3	17.0	39.9	93.3	21.4	39.9	131.2	11.3	40.0	105.0	13.2	43.2	8.4
apical part with									r.				
crown	9.76	17.4		96.4	22.1		319.7	27.5	34.2	237.5	29.7		13.5
roots of d.pl.	76.5	13.7	19.4	39.7	0.6	18.7	266.2	22.9	54.1	185.0	23.2	41.9	6.2
(stolon	290.5	51.8		207.6	47.5		439.4	32.9	165.8	264.4	26.4		44.1
Runner   y.d.pl	0.3	< 0.1		0.0	0.0		6.3	5.4	15.7	0.9	7.5		4.8
[total	290.8	51.9		207.6	47.5		445.7	38.3	14.4	270.4	33.9		48.9
Total plant	7481.0	1	1412.8	7059.9	1	_	7827.4	1	1262.6	6435.4	1		100.0
Plant without	5	-						ne					
14C-blades	560.2	100.0	1	437.0	100.0	1	1162.8	100.0		6.767	100.0	I	73.4
		The same of the same of											

\*) conditions for runner during 14C-translocation

\*\*) radioactivity of all the organs, except 14C-blades, assumed as 100 percent d.pl. - daughter plant

v.d.pl. - younger daughter plant

The relative share of the runner and petioles in the <sup>14</sup>C-compounds exported from the blades decreased with time, probably owing to the high sink power of the roots and the crown, estimated with the apical part.

The general pattern of <sup>14</sup>C-distribution did not depend on the light conditions. The highest radioactivity was detected beyond the <sup>14</sup>C-daughter plant. In 2-hr translocation under light, a decreasing gradient of radioactivity in acropetal direction was observed (fig. 4). The traces of labelled photosynthates were revealed in younger daughter plants. In darkness this gradient was steeper and no <sup>14</sup>C-substances were detected in the small daughter plant. After 4 hrs translocation the highest radioactivity was detected also in the segment of the runner beyond the daughter plant, on a very short distance, as observed before. The radioactivity of the darkened runner was also lower than in the illuminated one\* but the differences were not statistically proved. The labelled substances were more uniformly distributed in the particular segments of the runner in acropetal direction and some <sup>14</sup>C-photosynthates were detected in the younger daughter plant (table 4).

In the lower part of the picture (fig. 4) the average fresh weight of stolons calculated per 1 cm, is illustrated. The weight of each internode increased up to the node owing to their thickening.

#### DISCUSSION

If the rate of transpiration in strawberry runners exerts some direct or indirect influence on the translocation of organic substances, as observed by Peel and Weatherley (1962) in willow cuttings, translocation of <sup>14</sup>C-assimilates in runners treated with dry atmosphere (higher transpiration) should be lower according to the mentioned authors.

Experiments with strawberry set up to examine these possibilities, did not reveal positive results supporting this suggestion. Therefore the effect of daughter plant removal on the translocation does not seem to be connected with abolition of transpiration, but rather generally with water relations in the stolon.

In the runner deprived of the daughter plant changes in the conductivity of vascular bundles may have been expected as the consequence of the penetration of air through the cut end.

In the first node of the runner deprived of the daughter plant, the lateral movement of <sup>14</sup>C-substances increased slightly as compared with that in the intact one, in contrast to similar experiments described in a previous paper (Starck 1966). The ratio of outer to inner tissue, both in intact stolons and especially in those deprived of the daughter plants, was higher in the presented study, than in the previous one, probably owing to the higher fresh weight of the outer part (O/I tissue ratio

<sup>\*</sup> During the experimental procedure two plants were disturbed by accident, so the light series, (4 hr translocation), includes only one replication.

is about 4,0-4.8 figs. 1 and 2). The thicker layer of parenchymatous tissue would have accumulated more <sup>14</sup>C-organic substances transported in lateral direction.

The reported experiments seem to support only in part the suggestion that production of photosynthates in very young daughter plant blades or in the stolons satisfying their own carbon requirement would have been partly the reason of the low 14C-translocation from the blades of the mother or daughter plant to the runner. Darkening of the runner, abolishing its photosynthesis, did not increase translocation of <sup>14</sup>C-photosynthates from the leaves. It seems possible, that some other organs could supply young daughter plants with organic substances. The crown, which accumulated a relatively high amount of photosynthates, or even the parenchymatous tissue of the stolon could have been their donors. It was observed that in the crown, incorporation of 14C-photosynthates into the 80% ethanol-insoluble fraction amounts in older plants, in 4-hr translocation to above 20 percent of the total crown's radioactivity and to about 30 percent in younger ones, in a 2 hr period (see table 5), and up to 40-50 percent - in the mature crown of the mother plant (unpublished data). This indicates that the crown mobilized a great part of the photosynthates in the insoluble fraction and probably at some stage of development it may export them to other organs.

Table 5

Incorporation of <sup>14</sup>C-assimilates into 80% ethanol insoluble fraction (total radioact, in particular organ assumed as 100%)

Dont of alout	Expt. 1	Expt. 2	Expt. 3	Exp	t. 4
Part of plant	4 hrs	2 hrs	3 hrs	2 hrs	4 hrs
Blades	56,6	63,4	)	21,8	27,8
Petioles	34,2	31,4	54,5	11,2	35,6
Crown	22,5	32,9	J	16,5*)	27,2*)
Runners	11,0	-	6,0		_

<sup>\*)</sup> crown estimated with apical part and very small leaf

The effect of darkening on the translocation involved many aspects; according to Hartt's experiments (1964) the darkened area of the blades created a more active sink for assimilates. Hartt (1966, 1967) in her latest papers suggests, that translocation of organic substances in plants is activated by light (phototranslocation).

Taking into account all the above mentioned possibilities the differences between <sup>14</sup>C-translocation to the illuminated and darkened runner would be the resultant of many factors. Nevertheless in the case of the strawberry runner, light seems to have a rather small, if any, effect on the translocation of <sup>14</sup>C-photosynthates.

The variation in the translocation investigated in particular experiments would have been the resultant of the effect of other factors, like age and/or physiological stage of daughter plants and stolons. Almost complete cessation of <sup>14</sup>C-migration from the leaves of the mother plant was observed in experiments, performed at the end of October (Starck 1966), the very small export of <sup>14</sup>C-photosynthates

from the blades in experiment 2 could depend on their relatively young stage of development. Usually the younger tissue incorporated more <sup>14</sup>C-substances into the ethanol insoluble fraction. These blades incorporated a higher amount of <sup>14</sup>C-assimilates into 80 % ethanol-insoluble fraction, than blades in the other experiments (see table 5).

The blades of older, rooted, daughter plants in expt. 4, exported more <sup>14</sup>C-substances; the <sup>14</sup>C-substances incorporated into the ethanol-insoluble fraction was lowest in them as compared with that in other experiments. The same is partialy true for their petioles.

The other problem investigated was the direction of photosynthates migration in the runner, when the daughter plant was their main donor. It results clearly from the experiments, that photosynthates could be transported not only from the mother to the daughter plant, but also from older to younger daughter plants, as well as in basipetal direction, even in a detached runner. The migration of some photosynthates to the detached part of the runner would be connected with the localization of vascular bundles in the runner, conducting assimilates from the blades to the stolon. This supposition has to be anatomically proved.

The bidirectional movement of some substances between the daughter plants joined by the stolon results also from the Guttridge experiments (1959) concerning the transfer of photoperiodical induction as well as <sup>32</sup>P-movement (Guttridge 1959; Norton 1963). Radioactive phosphate moved more freely from the older to the younger plant than in the opposite direction, except when the parent plants were partially defoliated or when the younger plants were exposed to full light in contrast to the partially darkened, mother plant. Guttridge supposes, that there is a good correlation between the movement of phosphate and translocation of assimilates.

All these facts seems to indicate a very complex interaction between the particular strawberry organs as far as their supply with photosynthates is concerned. This problem will be the subject of further investigations.

#### SUMMARY

The effect of daughter plant removal (decreasing translocation of photosynthates) on the migration of labelled substances, does not seem to be connected with the rate of transpiration stream.

<sup>14</sup>C-translocation was observed not only from the mother, but also from the daughter plant blades in attached and detached runners. In all the cases a high peak of radioactivity was detected in the stolon, near the daughter plant, in basipetal direction, but much more of the <sup>14</sup>C-photosynthates was transported in acropetal direction, towards the younger daughter plant. Within 2—4 hrs, at least one half of the labelled substances translocated from the blades was revealed in the petioles, crown and roots of daughter plant.

The production of photosynthates in the daughter plant as well as in the stolon itself seems to be only one of the reason of rather low translocation of <sup>14</sup>C-photosynthates from the leaves, because darkening of the runner, abolishing their photosynthesis did not increase translocation of <sup>14</sup>C-photosynthates from the leaves of <sup>14</sup>C-donor plants. The variation in the translocation rate

investigated in particular experiments, seems to be the resultant of the effect of the physiological stage of daughter plants and the stolons.

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# Przemieszczanie asymilatów w truskawce

#### Streszczenie

Przedstawione w niniejszej pracy doświadczenia stanowią kontynuację badań, dotyczących przemieszczania asymilatów w truskawce.

Obniżenie intensywności transpiracji rozmnóżki nie wpłynęło w istotny sposób na przemieszczenia <sup>14</sup>C-asymilatów w rozłogach. Z uzyskanych wyników wyciągnięto wniosek, że zahamowanie transportu asymilatów w rozłogach, pozbawionych rozmnóżki paczkowej, nie jest spowodowane wyeliminowaniem w nich prądu transpiracyjnego. Nie wyklucza to jednak możliwości pewnych zakłóceń w gospodarce wodnej rozłogów, na skutek ich zranienia i ewentualnej możliwości wnikania powietrza do tkanek przewodzących przez miejsce cięcia.

Wydaje się, że mała aktywność rozłogów, jako akceptorów asymilatów przemieszczanych z liści starszej rozmnóżki, może wynikać tylko częściowo z fotosyntezy samych rozłogów i liści młodszej rozmnóżki. Zacienienie rozłogów na okres 16 godzin nie zwiększyło bowiem przemieszczenia znakowanych asymilatów z blaszek liściowych starszej rozmnóżki pączkowej. Wysunięto przypuszczenie, że donorem asymilatów dla rosnącej rozmnóżki pączkowej mogą być w pewnych przypadkach nie tylko liście, lecz również pęd skrócony lub też tkanki zewnętrzne, głównie parenchymatyczne, gromadzące znaczną ilość <sup>14</sup>C-asymilatów, transportowanych do stolonów.

Stwierdzono, że asymilaty przemieszczają się z liści rozmnóżki pączkowej w obu kierunkach rozłogu, przy czym największą radioaktywność stwierdzono w części stolonu bezpośrednio przylegającej do rozmnóżki, w kierunku bazipetalnym. W dalszych odcinkach tej części stolonu nie stwierdzono radioaktywnych substancji. Główna masa radioaktywnych asymilatów była przemieszczana jednak w kierunku akropetalnym, do młodszej romnóżki pączkowej.