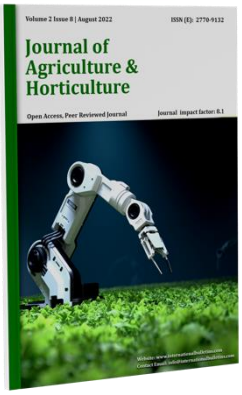

DISTRIBUTION OF PHOTOSYNTHESIS PRODUCTS OF ROOT STOCK AND VARIETY ROOT STOCK COMBINATIONS IN APPLE NURSERIES

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Abstract. This article presents the results of an experiment conducted to study the distribution of photosynthesis products with a deep scientific analysis.

Keywords: root stock, seedling, photosynthetic characteristics, ontogenesis, dwarf and super dwarf root stock.

Introduction

In plants, one of the important features affecting their growth rate is the formation, transport and distribution of nutrients between donor and acceptor organs [1-5].

Plants cannot grow if organic matter is not formed, moved and distributed. The formation of organic substances occurs in the process of photosynthesis. Photosynthesis provides the necessary energy for all biological functions, as well as creates a material and energetic basis (all other biosynthetic processes depend on it) [6-10].

Materials and methods

The experiments were carried out in 2021-2022 at the experimental fields of Hirosaki University, Japan, and in 2023-2024 at the Bandikhon Experimental Farm of the Academician Mahmud Mirzayev Research Institute of Horticulture, Viticulture and Winemaking in the following options:

The leaf surface area was determined using a palette and a curvimeter according to the method recommended by Professor V.A. Potapov (1976).

To study the distribution of photosynthesis products, 4 trees from each options were dug up at the beginning, middle, and end of summer. After that, the bark of the plants was separated in the laboratory and the leaves, roots, bark, and wood of each options were weighed separately before being placed on a drying rack, then dried at 105° C (t°) to constant weight and weighed again.

Research results and discussion

In order to study the distribution of photosynthesis products, we determined the dry weight of roots, leaves, wood and bark (Table 1).

Table 1

Distribution of photosynthesis products in rootstocks in field 1 of the nursery, %, 2023

Root stock	Plant organs			
	bark	wood	leaves	roots
1st decade of June				
M-25	18,4	69,1	3,2	1,3
“Miyabi Fuji”	19,1	68,4	2,2	1,9
MM-102	17,4	69,7	2,7	2,2

MM-104	19,5	69,4	1,5	1,6
MM-106	18,6	67,8	1,1	4,5
Semi-vigorous grower Marubakaido	19,2	68,6	1,3	4,7
2nd decade of July				
M-25	11,9	21,3	27,9	30,9
“Miyabi Fuji”	12,1	31,4	25,6	38,8
MM-102	9,6	26,4	18,6	37,4
MM-104	12,4	30,5	16,2	32,9
MM-106	12,0	36,2	14,6	29,2
Semi-vigorous grower Marubakaido	12,4	33,6	15,9	32,7
3rd decade of August				
M-25	13,0	29,7	22,4	26,9
“Miyabi Fuji”м	13,1	36,5	20,6	34,5
MM-102	11,4	32,6	20,7	27,9
MM-104	10,8	32,0	16,2	31,0
MM-106	9,7	39,4	9,0	33,9
Semi-vigorous grower Marubakaido	10,1	36,	17,4	35,2

The table data show that after planting and grafting, the main weight of the rootstocks fell on wood, that is, it made up from 67.8 to 69.7% of the total dry weight of the plant. During this period, the root weight was 1.3-2.2% in dwarf and semi-dwarf root stocks and 4.5% in the average-growing MM-106 root stock. By the middle of the growing season, the share of dry matter in the total weight of the plant spent on root formation was 29.2-37.4% and in leaves 14.6-27.9%. At the same time, the percentage of wood decreased, which was higher in dwarf and semi-dwarf root stocks than in average-growing ones.

A more pronounced difference in the distribution of photosynthesis products occurred at the end of summer, when the growth processes were completed. Thus, by the third decade of August, as the growth force of the root stock increased, the percentage of wood increased, and the percentage of bark decreased. Moreover, the weaker the growth force of the root stock, the more assimilates were spent on the formation of the leaf apparatus (9% in MM-106, 22.4% in M-25).

Such a high consumption of assimilates in the bark and leaf apparatus may be due to the faster development of the above-ground part of dwarf apple plants compared to the root and their very early entry into fruiting. It should also be noted that the ratio of bark to wood weight in the branches of weakly growing root stocks is higher than that of strong ones (Table 2). Compared with the first field, the nature of the differentiation in fields 2 and 3 is not so sharp, but in general, the predominance of the phloem part over the xylem is preserved in seedlings on dwarf root stocks.

Table 2

Ratio of the weight of the bark of the above-ground part of rootstocks to the weight of its wood in the first field of the nursery

Root stock	Years of research		
	2022	2023	2024
M-25	-	0,423	0,505
MM-102	0,403	0,337	0,367
MM-104	0,373	0,306	0,404
MM-106	0,268	0,233	0,248

The same trend of distribution of assimilations was preserved in fields 2 and 3 of the nursery (Tables 3-4)

Table 3

Distribution of photosynthesis products (%) in seedlings in field 2 of the nursery, 3rd decade of August

Variety-root stock combination	Plant parts			
	bark	wood	leaves	root
Wide David/K2012	11,1	30,6	23,3	26,9
Wide David/MM-102	10,3	28,7	23,7	29,1
Wide David/MM-104	10,8	34,1	25,0	21,6
Wide David/MM-106	9,6	36,4	20,5	25,4

At the same time, the consumption of assimilates for leaf formation differed from the indicators in the first field of the nursery. This may be related to the hormonal system of the grafted plant.

Table 4

Distribution of photosynthesis products (%) in seedlings in the 3rd field of the nursery, 3rd decade of August

Variety-root stock combination	Plant parts			
	bark	wood	leaves	root
Wide David/MM-102	12,2	32,3	19,1	30,4
Wide David/MM-104	9,6	31,1	16,3	35,1
Wide David/MM-106	9,5	37,3	19,7	25,4

Plants on dwarf rootstocks retained a high proportion of leaves in the total plant weight in the second and third fields, but the difference compared to plants in the first field was lower than in vigorous plants. It is known that phytohormones also affect the redistribution of photosynthesis products in fruit plants.

Conclusion

Thus, in the second year of life (in the 1st field of the nursery), the products of photosynthesis are distributed differently in root stocks with different growth vigor. Dwarf root stocks are characterized by rapid growth of the phloem part, and in strong ones - xylem. This phenomenon may be a consequence of hormonal differentiation in them. It is known that if there are many auxins in the shoots, the phloem will form more rapidly, and if there are gibberellins in the agar, then the xylem will form more rapidly. It is also possible that the difference in the amount of bark and wood in the shoots of root stocks with different growth vigor is also due to the difference in the activity of the cambium in them.

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