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**Expenditures, Costs and Profitability
of Vegetative Rootstock Production in the Years 1993-1996**

Nakłady, koszty i opłacalność produkcji podkładek wegetatywnych w latach 1993-1996

Abstract. The level of expenditures of manual labour and tractor work as well as the costs of establishing and cultivating the rootstock production were investigated. The research was carried out in the years 1993-1996. The study was conducted in specialised orchard tree nurseries in the region of Lublin. The data were analysed in detail. In the examined period the manual labour and tractor work expenditures per hectare of a vegetative rootstock nursery were on average 1803 man hours and 181 tractor hours and the average costs of establishing a vegetative rootstock nursery were equivalent to the value of, respectively, 44.2, 59.5, 82.7, 69.9 thousand M9 rootstocks, and the costs of cultivating the nursery in the following years were 28.0, 18.8, 28.1, 27.8 thousand. The increase in the costs of establishing the vegetative rootstock nursery was higher than inflation in that period.

INTRODUCTION

Changes in intensification of fruit production have caused the present situation in Poland, where over 97% of apple trees are cultivated on dwarf and semi-dwarf vegetative rootstocks such as M9, M26, P60 and others (Pa-

nasik 1997). Since the prices of vegetative rootstocks are high and there are problems with buying the rootstocks of an appropriate type and quality, the necessary investment in a modern nursery farm is one's own vegetative rootstock nursery. The decision to establish or reconstruct the existing vegetative rootstock nurseries is influenced by a high capital consumption of such an investment.

In Poland there are not enough data concerning the expenditures and costs of establishing and cultivating vegetative rootstock nursery in the present conditions of production.

MATERIAL AND METHODS

The source materials were data from the years 1993-1996 from specialised nursery farms in the region of Lublin. The analysis of expenditures and costs of establishing a vegetative rootstock nursery in 1993 and 1995 were based on data from 4 farms (of the area of 1.15, 0.72 hectare, respectively) and in 1996 from 5 farms (1.17 hectare). The data from 1995, because of a small area of new plantations, should be treated approximately. The expenditures and costs of cultivation of vegetative rootstock production in subsequent years were analysed on the basis of the data from 5 or 7 farms.

In the research the level and structure of costs and expenditures on each treatment and activity performed in a vegetative rootstock nursery were tested. The costs of establishing and growing the vegetative rootstock nursery were presented in type system of costs.

The data were analysed by using common measures of dispersion. In a vertical analysis of costs separate and chain indexes of dynamics were used. The relations between expenditures and costs and selected variables were analysed by means of correlation method with linear regression model.

RESULTS

In the analysed farms the nurseries constituted about 40% of the agricultural acreage. During the years of studies (1993-1996) the area of pome tree nursery increased. As a result the area of maternal rootstock nurseries went up by nearly 50% and vegetative rootstock production by above 56%. In the species structure of vegetative rootstocks apple rootstocks such as M26 (over 42% total maternal rootstocks) and M9 (over 34%) prevailed. Each of other rootstocks such as P60, P22, M7 and A2 constituted less than 8% of the total number of maternal rootstocks.

The average manual labour and tractor work expenditures in the production of vegetative rootstocks in the years 1993-1996 on the total area of 10 hectare are shown in Tab. 1.

The manual labour expenditures in vegetative rootstock production fluctuated between 1418 and 2263 man hours per hectare and between 142 and 228 tractor hours per hectare. The level of those expenditures is lower than in pome tree in the first year after budding production (between 2780 and 3547 man hours per hectare and 191 and 299 tractor hours per hectare). It was stated that in the analysed farms and in the years of the studies the level of manual labour and tractor work expenditures fluctuated. The level of labour expenditures was determined by the production conditions such as the area of plantation, the age and number of rootstocks per hectare and the size and structure of various types of vegetative rootstocks. The equipment of farms with specialised machinery and the growing method, as well as the organisation of work and the skills of the employed workers were important. That was confirmed by the analysis of the correlation between those variables, which show that the labour consumption in vegetative rootstock production is lower on bigger areas. In practice the work on bigger areas should be better organised and mechanised. Therefore those results concern small areas up to 0.5 hectare. On the basis of high correlation coefficients between manual labour expenditures and the volume of rootstock pro-

Tab. 1. Manual labour and tractor work expenditures in the production of vegetative rootstocks in nursery farms in the region of Lublin

Specification	Expenditures of work per hectare	
	man hour	tractor hour
Cleaning of rootstocks	95	15
Ridging of rootstocks	257	51
Fertilisation	24	7
Weed control	188	3
Disease and pest control	22	14
Removing of rootstocks and aid work	846	31
Other works	371	60
Weighted average	1803	181
Variability range of averages in the years 1993-1996	1418-2263	142-228
Standard deviation	1134.97	102.25
Variation coefficient %	55.03	55.21
Source: The author's own research		

duction as well as the level of manual labour expenditures on the removed rootstocks it was stated that the manual labour expenditures on that most labour consuming work were influenced by the number of the removed rootstocks.

The yield of rootstocks was the highest when the manual labour expenditures were the highest too and the average nursery area was the smallest (in 1993 — 0.34 hectare and in 1996 — 0.6 hectare). In the tested period an intensive reconstruction in the existing vegetative rootstock plantations was performed. These changes caused a reduction in the yield of rootstock from about 145 to 109 thousand rootstocks per hectare. In 1993, in the structure of rootstock production M9 rootstock prevailed while in 1996 the share of this rootstock decreased as compared to the use of M9 rootstock and other rootstocks such as P22, M7.

The amount of rootstocks produced per unit of the area was determined by the labour expenditures on the most labour consuming work, which is the removal of rootstocks and additional work such as sorting, binding and protecting (on average 846 man hours and 31 tractor hours per hectare, which accounted for 46.9% of direct expenditures of manual labour work and 17% of tractor work). In the structure of expenditures the ridging of rootstocks with sawdust or bark constituted over 14% of manual labour expenditures and 28% of tractor work. Other work connected mainly with the transport of sawdust or bark to the farm constituted respectively 20.6% and 33.1%. In the region of high nursery concentration, the shortage of nearby works producing sawdust causes the situation in which this material as well as bark are transported by railway to Lublin from distant regions and from here by lorries or tractors to farms. This situation reduced the level of tractor work expenditures but increased the costs of ridging of rootstocks, because the costs of railway transport are high.

The level of tractor hour expenditures was influenced by different areas of the tested plantations (from 0.15 to 0.85 hectare) and the manner of doing some jobs such as cleaning, ridging, fertilising of rootstocks, or disease and pest control. In small plantations these activities were done manually or with simple tools. In these plantations the use and maintenance of expensive, specialised machinery is unprofitable.

According to the research by Grzywacz and Zaprzalek (1990) the labour consumption of vegetative rootstock production, with the yield of 130 thousand rootstocks of I and II quality, was higher and it was above 2000 man hours and 200 tractor hours per hectare.

In the years 1993-1996 the total cost of establishing one hectare of vegetative rootstock nursery was equivalent to the value of, respectively, 44.2, 59.5, 82.7, 69.9 thousand M9 rootstock or 6.63, 7.14, 6.36, 8.90 thousand apple trees in the first year after budding on M9 rootstock (Tab. 2). According to the mentioned research by Grzywacz and Zaprzalek (1990), conducted in the year 1989, the costs of establishing and growing of vegetative rootstock nursery were relatively lower, because they were equivalent to the value of about 4 thousand trees in the first year after budding.

In the studied farms the costs of establishing the vegetative rootstock nursery were different. That was caused mainly by the variability of material costs, which were of the highest share in the total costs (from 41.6 to 76.7%). The level of material costs was determined by the rootstock costs. The share of rootstock costs in the total cost was from above 40 to about 73%. High variability of those costs between farms in the year was connected with the use of different types of rootstocks and their prices. Also, the breeding method of the used vegetative rootstocks as well as the number of plants per hectare (from 9.3 to 43.0 thousand rootstocks) related to it was of considerable importance.

In the presented calculations the prices of the rootstocks used to establish the vegetative rootstock nursery were their purchase prices. In 1993 the differences between the prices of vegetative rootstocks were from 125 to 800% (the Cydonia rootstock cost 0.2 PZL, M26 rootstock 0.25 PZL, P22 rootstock from 0.45 to 0.5 PZL, P60 from 0.35 to 0.4 PZL and M9 rootstock from 0.5 to 1.6 PZL). In 1996 virus free M26 rootstocks dominating in planted rootstocks cost from 1.2 to 2.21 PZL (import from the USA) and M7 rootstocks cost 1.7 PZL.

The level and structure of costs in the following years of vegetative rootstock nursery cultivation were different. The costs were influenced by the manual labour and tractor work expenditures as well as rates per hour. In the years 1993-1996 the man hour cost respectively 1.50, 1.70, 3.30, 4.0 PZL. The labour cost constituted 26.9 to 35.5% of the total costs of cultivating the vegetative rootstock nursery. The material cost was determined by the pesticide costs as well as the sawdust and bark costs.

In the vegetation period the nurseries were sprayed from 2 to 10 times against disease and pests. On average, the lowest number of sprayings were performed in 1994 — 4.8 and the highest in 1996 — 6.6. In order to control pests and disease in most cases two or three pesticides were used (a fungi-

cide and an insecticide). The most commonly used fungicides were Syllit, Topsin, Rubigan Punch, Nimrod and Dorado, and the insecticides were Owadofos, Metasystox, Fastac, Decis and Pirimor. The difference in costs between the tested farms were determined by varying ways of preparing working fluids (different doses per hectare of the same pesticides in nurseries), the selection of applied pesticides, the frequency of disease and pest control and a considerable variability of prices of these pesticides in the tested period. In the years 1993-1996 the prices of most fungicides (apart from Topsin) increased by above 200%. Out of all insecticides the highest prices were those of Decis (441%) and Fastac (241%).

In the structure of costs the direct costs constituted from above 77 to 84% of the total costs of establishing the maternal rootstock nursery and from 53 to 64% of cultivation cost in the following years.

During the years of the studies the dynamics in the growth of the total costs of establishing the vegetative rootstock nursery was higher than inflation. Especially high dynamics in the growth of the rootstock costs was recorded in the years 1994-1995 (194%) and for the pesticide costs it was in the years 1995-1996 (453%). What influenced the pesticide costs were the selection of pesticide and herbicide, their doses and prices as well as the frequency of disease and pest control. That statement is confirmed by the data from farms, which show the growth in the frequency of spraying in maternal rootstock nurseries, on average by about 1.4 of spraying in each nursery.

Comparing the corresponding indexes of dynamics it was stated that in the years 1993-1996 the growth in the costs of vegetative rootstock production was higher than the growth in efficiency or the value of rootstock production. As a result, beginning from 1995 the profitability in rootstock production in the farms was getting lower. The analysis of cost correlation and the area of the maternal rootstock nursery or the value of vegetative rootstock production showed that there was no essential linear correlation between these variables. These relations might be of somewhat different character.

The economy and production indicators presented in Tab. 3 and in Fig. 1 show that the production of vegetative rootstocks in the years 1993-1996 was profitable. The unit costs of vegetative rootstock production were much lower than the average selling prices of these rootstocks. In the tested period the payability index fluctuated between 351 and 524% and profitability index between 72 and 81%. The profitability of vegetative rootstock produc-

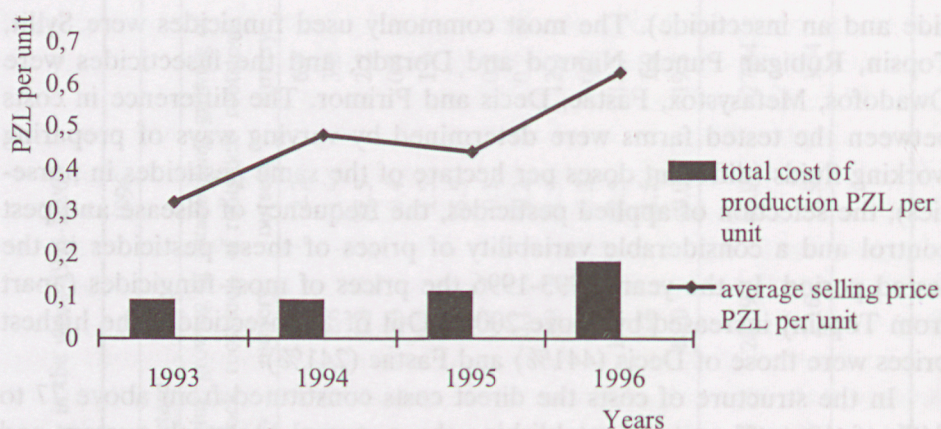


Fig.1. Total cost of production per rootstock and average selling prices in the years 1993-1996

tion was getting lower beginning from 1995 because of the high dynamics in the costs of maternal rootstock nursery cultivation and the low yield of rootstocks. In 1995 the average selling prices of rootstocks such as M9 or P60 were lower compared to 1994.

Tab. 3. Costs and profitability of rootstock production in the years 1993-1996

Specification	1993	1994	1995	1996
Total costs of production thousand PZL per hectare	12.62	11.26	14.04	19.49
Rootstock production thousand units per hectare	145.36	122.24	127.09	108.88
thousand PZL per hectare	46.85	59.08	57.96	68.41
Net income thousand PZL per hectare	34.23	47.82	43.92	48.92
Cost of production PZL per unit	0.09	0.09	0.11	0.18
Average selling price PZL per hectare	0.32	0.48	0.45	0.63
Payability index %	371	524	413	351
Profitability index %	73	81	76	72

Source: The author's own research

CONCLUSIONS

1. Compared to the tree in the first year after budding the rootstock production is less labour consuming. In the tested farms the expenditures of manual labour and tractor work per hectare in vegetative rootstock nursery were on average 1803 man hours and 181 tractor hours. The level of those expenditures was determined by the yield and the existing production conditions.

2. In the years 1993-1996 the total costs of establishing the vegetative rootstock nursery were equivalent to the value of respectively 44.2, 59.5, 82.7, 69.9 thousand M9 rootstocks or 6.6, 7.1, 6.4, 8.9 thousand apple trees in the first year after budding on M9 rootstock of best quality. The level of the costs of establishing the maternal rootstock nursery was determined by the rootstock cost, which constituted from above 40% of the total costs in 1993 to 73% in 1996.

3. The costs of rootstock cultivation in the following years of rootstock production were equivalent to the value of, respectively, 28.04, 18.77, 28.09, 27.84 thousand M9 rootstock or 4.21, 2.25, 2.16, 3.54 thousand apple trees in the first year after budding on M9 rootstock. The costs were determined by the level of manual labour and tractor work expenditures as well as the rate per hour.

4. In the years 1993-1996 the vegetative rootstock production was profitable since with the yield of 109 to 145 thousand rootstocks, the unit costs were 0.09, 0.09, 0.11, 0.18 PZL per rootstock and the average selling prices were, respectively, 0.32, 0.48, 0.45, 0.63 PZL.

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STRESZCZENIE

Badano poziom nakładów pracy ręcznej i ciągnikowej oraz koszty zakładania i uprawy matecznika podkładek wegetatywnych w latach 1993-1996. Materiał źródłowy stanowiły dane ze specjalistycznych gospodarstw szkółkarskich położonych na Lubelszczyźnie. Uzyskane dane poddano szczegółowej analizie poziomej i pionowej. W badanym okresie nakłady pra-

cy ręcznej i ciągnikowej na hektar matecznika wynosiły średnio 1803 robotnikogodzin i 181 ciągnikogodzin, a średnie koszty zakładania matecznika podkładek vegetatywnych równoważyły wartość odpowiednio 44,2, 59,5, 82,7, 69,9 tys. sztuk podkładek M9, a jego uprawy w następnych latach 28,0, 18,8, 28,1, 27,8 tys. sztuk. Wzrost kosztów założenia matecznika podkładek vegetatywnych w latach 1993-1996 był wyższy niż inflacja.