RESEARCH ARTICLE **(Open Access)**

Economical effectiveness of vegetative pear nurseries in Albania

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Abstract

Sapling production on vegetative rootsctock is considered as an important agronomic activity while Albanian arboriculture is being oriented towards the world contemporary development. The paper presents the evaluation of economical effectiveness of the vegetative pear nurseries, since the evaluation of the increase of economical effectiveness and farm productivity as a real potential of Albanian farmers. The experiment was carried out during two consecutive years, 2009-2010, by the Department of Horticulture at Agricultural University of Tirana in collaboration with a certified national nursery. A randomized complete block design (RCBD) with 4 replications and 6 variants with a plot size of 50 saplings for variant in each replication was used. Pear cultivars Abate Fetel, Williams and Koshia used as scions grafted over seedy rootsctock of wild pear and vegetative rootsctock of quince clone Anger, (EM – A), were compared. The data showed that different rootstocks affected sapling features and quality. The use of quince vegetative rootstock EM-A provided the highest values of grafting catching rate of 93.7% (V_2,V_4,V_6) and 95.3% standard saplings of both scions (V_2,V_4,V_6). According to the official standards of the Albanian government, considering the qualitative aspect, both pear cultivars grafted over EM-A rootstocks provided higher qualitative saplings. So, for variants V_2 and V_4, saplings with 2-3 sceletal branches represented 88.6% and 84.7%, respectively; while saplings with main shoot length of 31-40 cm for variants V_2, V_4, V_6 represented 18.1%, 23.5% and 24.3%. The achieved results confirms the need of spreading and widely use of "mother" plots for vegetative rootstock production, beside the fact that this sapling category is ready to be planted in open fields one year earlier than saplings with seedy rootstock. The two years data were confirmed statistically by LSD and ANOVA tests.

Keywords: nursery, cultivar, wild pear, EM – A vegetative clone, state standard.

1. Introduction

Pear is one of the most widespread fruit trees in the agricultural farms of our country and its fruit is very prefered in the domestic market. Traditionally, pear has been planted in family plots, while during the period 1960-1990, it has been planted in large orchards, reaching 8% of the total number of tree plants and 4-6% of the total fruit production. During those years, great improvement was made toward cultivar sctructure, enriching it with the best cultivars of the European market such as Williams, Abate Fettel, Koshia, Kaiser, Conference, Gentile Bianca, Passa Crassana, General Leicler, etc [7, 14].

In terms of the new market economy, Albanian seedling producers are adapting their work in order to meet the annual requirements for seedlings. The fact is that, in the past 20 years there have been substantial challenges in production agro-technology, use of vegetative rootstock, mechanization of labour operations, etc, which have provided positive results on economical aspects for the farmers and the national development of arboriculture [1].

In order to evaluate this new reality and to verify the potential of using clonal rootstocks, there was carried out an experiment using two main rootstocks, seedy and vegetative, and three most widespread cultivars of pear production structure [14].

Essentially, the experiment proved that traditional Albanian nurseries have not been yet studied, adopted and generalised the economical activity on its entire elements. Many operations are manually performed, while few elements of modern technology are introduced in production activity. Using of quince vegetative rootstocks and pruning according to the Guilliam system, can produce at full bearing yields of marketable sized fruits threefold greater than those of average commercial orchards [2, 10, 11, 12].

A positive fact is that these last 10 years, the Albanian horticulturists are applying not only experimentally, but practically, the production and using of vegetative rootstocks of appple, pear, plum, peach, etc, producing more qualitative and competitive seedlings, methods which are used through years all over the world [3, 5, 6].

Nowadays, practically the entire expansion of the activity is required as well as the solution to the problem of the variety structure for each region, the selection of the rootsctoks in relation with the soil

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(Accepted for publication 22 November 2012)
***ISSN**: 2218-2020, © Agricultural University of Tirana*

type and cultivar (for some noncompatible cultivars) [9, 14], optimizing working techniques in nurseries and production of certified source plant material, etc [4]. In order to confirm the significance of the experimental data, description analysis, LSD and ANOVA tests must be used [8].

2. Material and Methods

The study was conducted in three consecutive years, 2009-2010, in a mixed fruit tree nursery built up according to Albanian tradition, of 1 ha in size, where there are being produced seedy pear seedlings and vegetative cherry, plum, peach and apple seedlings. The land was flat, with a slight slope, with medium mechanical composition, medium content of nutrients and organic matter, and of good mechanization opportunity. It has an annual production capacity of 25-30 thousands saplings, from which 60–65% are produced from wild rootstocks.

A randomized complete block design (RCBD) with 4 replications and 6 variants with a plot size of 50 saplings for variant in each replication was used. There were analysed 1200 saplings in total. For the experiment there were used the same annual agro-technologal practices as the rest of the fruit nursery, except of rootstock and scion. The roostock of wild pear and quince vegetative clone EM-A Anger were directly tested using the pear cultivars of *Abate Fetel, Williams and Koshia* as scions. The following variants were used in the experiment:

V_1 - wild pear rootstock, cultivar Abate Fetel as scion

V_2 - EM-A rootstock, cultivar Abate Fetel as scion

V_3 - wild pear rootstock, cultivar William as scion

V_4 - EM-A rootstock, cultivar William as scion

V_5 - wild pear rootstock, cultivar Koshia as scion

V_6 - EM-A rootstock, cultivar Koshia as scion

For all variants, the number of grafted and cathed saplings, number of formed sceletic braches and roots; simple and total cost, and econolmical effectiveness were counted, measured and evaluated. Experimental data were subject of LSD and ANOVA tests to confirm the significant differences.

3. Results and Discussions

3.1. Grafting catching rate (%)

The main analysis regards to the results of grafting which is an important technical process. The verification was done through physical counting of 1200 saplings of all variants and replications of the experiment. Data analysis proved that the best variants were V_5, V_3, and V_6, with 96%, 95% and 94.5% of grafting catching rate, respectively. These results match with the literature, which says that Abate Fetel and William have limited compatibility with EM-A, while Koshia yields higher grafting catching rate [11, 12, 14]. Statistical analysis via LSD test showed that there are significant differences between variants in relation to the kind and behavior of the rootstock and scion, a situation which rises on creating three different homogeneous groups (Table 1).

Table 1. Results of grafting and catching rate (%), according to variants

Variants	*Grafted seedlings*	*Total catched*	*Catching rate (%)*	*Homogeneous groups*
V_1	200	186	93	A
V_2	200	183	91.5	B
V_3	200	190	95	C
V_4	200	187	93.5	A
V_5	200	192	96	C
V_6	200	189	94.5	C
Total	1200	1127		

LSD = 1.65

3.2. Main shoot height (cm)

Saplings with the main shoot height up to 30 cm generally dominate in variants grafted over vegetative clone EM-A (V_2, V_4 and V_6) with 78.1%, 71.7%, and 68.8%, respectively, while they have lower values in variants with seedy rootstocks (V_1, V_3 and V_5) with 62.4 % , 57.9% and 55.7%.

Saplings with the main shoot length of 31-40 cm, rootstocks with wild pear seed dominates. This rootstock type usually yields more vegetatively developed seedlings. For this indicator, the results of V_1, V_3 and V_5, with 31.2%, 33.7%, and 34.4%,

respectively, are practically higher than results of V_2, V_4 and V_6, with 18.1%, 23.5 % and 24.3%. Despite of differences, it is noticed that, vegetative rootstock EM-A with Koshia and Wlliam cultivars gave acceptable positive results [14] (Table 2).

Table 2. Main shoot height (cm), according to variants

Variants	*Main shoot height (cm)* *Saplings in total*	*Up to 30 cm*	*%/total*	*31-40 cm*	*%/total*	*>41 cm*	*%/total*
V_1	186	116	62.4	58	31.2	12	6.4
V_2	183	143	78.1	33	18.1	7	3.8
V_3	190	110	57.9	64	33.7	16	8.4
V_4	187	134	71.7	44	23.5	9	4.8
V_5	192	107	55.7	66	34.4	19	9.9
V_6	189	130	68.8	46	24.3	13	6.9
Total	1127	740	65.66	311	27.59	76	6.7

Statistical analysis confirmed the creation of three homogeneous groups different from V_1. Regarding to the main shoot height, Koshia and Williams cultivars seems to have lower percentages of saplings with a height up to 30 cm compare to Abate Fetel, results which are reflected on the number of sceletal roots/sapling and I^{-st} & II^{-nd} quality saplings.

3.3. Number of sceletal roots/sapling

The number of saplings with up to 2 sceletal roots was lower in variants with wild pear rootstock, V_1, V_3 and V_5, with 6.5%, 6.3% and 5.7%, respectively, while in variants with EM-A rootstock, V_2, V_4 and V_6, values of this indicator were 10.4%, 11.2% and 9.5%, respectively.

Regarding to the wild pear seedy rootstocks (variants V_1, V_3 and V_5), saplings with 3-4 sceletal roots were 77.9%, 76.8% and 78.7%; while this indicator for variants with EM-A clone as rootstock (V_2, V_4 and V_6) was 80.9%, 78.6% and 79.9 %, respectively (Table 3). Statistical analysis for this indicator confirmed the creation of two homogeneous groups different from V_1 .

Table 3. Number of sceletal roots/sapling, according to variants

Variants	*Evaluation according to number of sceletal root/sapling* *Saplings in total*	*Up to 2 roots*	*%/total*	*3-4 roots*	*%/total*	*>4 roots*	*%/total*
V_1	186	12	6.5	145	77.9	29	15.5
V_2	183	19	10.4	148	80.9	16	8.7
V_3	190	12	6.3	146	76.8	32	16.9
V_4	187	21	11.2	147	78.6	19	10.2
V_5	192	11	5.7	151	78.7	30	15.6
V_6	189	18	9.5	149	78.8	22	11.6
Total	1127	93	8.25	886	79.5	148	13.1

Table 4. Classification of saplings regarding to their quality, according to variants

Variants	*Classification of saplings regarding to their quality* *Saplings in total*	*First quality*	*%/ total*	*Second quality*	*%/ total*	*Out of standard*	*%/total*
V_1	186	153	82.3	27	14.5	6	3.2
V_2	183	142	77.6	30	16.4	11	6
V_3	190	163	85.8	22	11.6	5	2.6
V_4	187	152	81.3	27	14.4	8	4.3
V_5	192	165	85.9	23	12	4	2.1
V_6	189	157	83.1	25	13.2	7	3.7
Total	1127	932	82.7	154	13.7	41	3.6

Significant differences were noticed in relation with grafting compatibility of the cultivars Abate Fetel and Willimas (variants V_2 and V_4), differences that were confirmed by the percentages of catching rate and standard saplings. These data are similar to Valli (2004) [14].

In the case of saplings with over four sceletal roots, there were found greater values in variants with wild pear rootstock (V_1, V_3, V_5), with 15.5%, 16.9% and 15.6%, while in variants with EM-A rootstock, these values were 30-40% less (8.7%, 10.2% and 11.6% for V_2, V_4 and V_6, respectively) [5].

3.4 Classification of saplings, according to their quality

Use of wild pear rootstock (variants V_1, V_3 and V_5) was followed by higher values of first and second quality saplings, with 96.8%, 97.4% and 97.9%, respectively. Highly competitive results were found in variants V_6 and V_4 of EM–A rootstock, with 96.3% and 95.7%, while slightly lower values were noticed in V_2, 94%, which were in accordance to the official Albanian Standards [13]. Statistically, two homogeneous groups, different from V_1, were created which confirm an impact of the schemes in the experiment, where three variants of EM-A were found in the same group (Table 4). Even if the data in table 4 show that "saplings out of standard" in mathematical value or % were not so high, statistical analysis places the results in different homogeneous groups.

3.5 Evaluation of the cost elements and the economical results

In the nursery under study, the ratio of seedy/vegetative rootstock is 65%/35%. The same situation is evident in other nurseries as well. This situation is related to the Albanian nature of work where the sapling production is mainly based on manual labor and there is a little of mechanization, a situation which must be resolved as soon as possible. Concerned to the economical effectiveness, there was found that the main part of the expenditures went to "manual labor" (49.4%), which is a negative indicator that points out the mechnization of the working activities; bank interests represented 11.6 % of the expenditures, which, compare to the EU countries [14], are around two times higher (Table 5), which makes it a serious barrier getting a loan in order to expand the activity.

The real cost of sapling production is 55 ALL, cost with vat 66 ALL, while the wholesale price is 120 ALL. This is a positive fact because it meets the requirements of the farmers in order to plant new fruit orchrds [5]. Regarding to the saplings quality, vegetative rootstocks seems to be enough competitive despite the fact that saplings are one year earlier ready for planting than saplings from seedy rootstocks.

Table 5. Cost elements and the economical outcome of the nursery (ALL and %)

No.	Cost elements	Annual balance sheet	
		In ALL	In %
1.	Seeds	30 000	2.1
2.	Mechanization in total	110 000	8.1
3.	Labor force	680 000	49.4
4.	Pesticides in total	40 000	2.9
5.	Crystalline fertilizers	25 000	1.8
3.	Watering	100 000	7.3
4.	Electrical energy	120 000	8.7
8.	Uprooting & selection	110 000	8.1
9.	Bank interests, rents, etc.	160 000	11.6
10.	Gross sum of expenditures	**1 375 000**	100
11.	Saplings in total	**25 000**	-
11.	Real costs	55	-
12.	Vat	275 000	20
13	Expenditures in total	**1 650 000**	**120**
14.	Market cost	66	120
15.	Wholesale price	120	100
15.	**Gross profit (wholesale)**	**3 000 000**	
16.	**Income + or -**	**+ 1 350 000**	

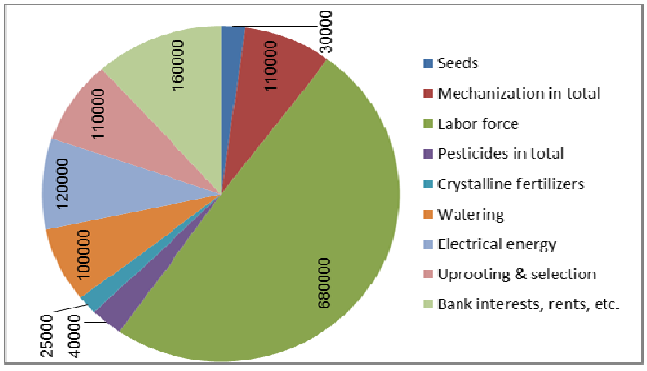

Figure 1. Cost elements of the nursery (in ALL)

Table 6. ANOVA: Two-Factor Without Replication for quality indicators and economical effectiveness

SUMMARY	*Count*	*Sum*	*Average*	*Variance*		
V1	4	214.8	53.7	1531.927		
V2	4	195.6	48.9	1928.973		
V3	4	227.3	56.825	1489.189		
V4	4	205.3	51.325	1910.223		
V5	4	229.4	57.35	1471.323		
V6	4	212	53	1713.273		
Source of Variation	***SS***	***df***	***MS***	***$F_{accounted}$***	***P-value***	***F crit***
Rows (Variants)	***208.2283***	***5***	***41.645667***	***3.801984***	***0.010062***	***2.901295***
Columns	***29970.42***	***3***	***9990.14***	***912.0362***	***3.42E-17***	***3.287382***
Error	***164.305***	***15***	***10.953667***			

Statistical analysis of saplings quality indicators and economical effectiveness, using dispersive analysis ANOVA tests *(Two-Factor Without Replication),* showed that the impact of rootstock type was significant, which was confirmed by the values of $F_{calculated}$ and *P-value* for variants (rows) where $\boldsymbol{F_{calculated} = 3.801984 > F_{crit} = 2.901295,}$ and $\boldsymbol{P - value = 0.010062 < \acute{a} = 0.05}$ (Table 6).

Statistical calculated values confirmed the rootstock impact not only the sapling quality, but the economical aspects, as the utilization of vegetative rootstocks fullfil in a comparable way saplings requirements faster than seedy rootstocks. This conclusion is a strong technical and economical argument which must be promoted and supported on production practice of the newly experienced and age Albanian nurseries.

4. Conclusions

- The experiment showed that the basic indicators of the pear saplings on vegetative rootstock such as, % of grafting catching, main shoot height, number of sceletal roots and branches, and the economical income of the nursery reaches the trend of acceptable standards for a free market economy.
- Vegetative rootstock EM – A provided high competitive results, an average grafting catching rate of 93.7% and I^{st} & II^{-nd} quality saplings of 94% (V_2), 95.7% (V_4) and 96.3% (V_6).
- Lower percentages of grafting catching rate on EM-A for Abate Fetel and William cultivars are not considered as a problem for the saplings. Furthemore it does not impact the economic income which means that there are no difficulties on using the quince clone rootstock EM-A and increasing the number of plants for unit area in new pear orchards**.**
- The traditional method of sapling production must be removed gradually by applying contemporary elements such are plastic bags, vegetative clone rootstocks, mechanization of labor work processes, etc.

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