ECONOMIC EFFICIENCY OF ONION CULTURE UNDER THE INFLUENCE OF TECHNOLOGICAL FACTORS

Dan Daniela, D. Măniuţiu, Iulia Bărbuţă
University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca,
Faculty of Horticulture, 3-5 Mănăștur Street, 400372, Cluj-Napoca, Romania;
Email: daniela.bindila@yahoo.com, dan_maniutiu@yahoo.com

Abstract. *In experiments conducted in 2010 in the Reghin vegetable basin the economic efficiency of onion culture under the cultivar influence, the culture method and plant density in culture has been pursued. The higher production costs were recorded at the seedling variations in density of 1400 million plants/ ha, which requires a lot of manual labor. Recorded profit was influenced by the purchase price which is higher for red onion than the white onion. The highest rate of profit has been realized for the red onion hybrid, grown by seedling with density of 700 thousands plants / ha.*

Keywords: onion, economic efficiency, cultivar, cultivation method, density

INTRODUCTION

The vegetable basin Reghin is specialized in onion bulb culture, this area having a tradition well known in this field.

One of the aims of the experiments conducted in 2010 was to determine the economic efficiency of the onions culture under the influence of cultivar, cultivation method and plant density.

To achieve profitable onion crops a certain level of production is necessary, which is estimated to be at 15-20 t/ ha for directly sown onion and 20-25 t/ ha for seedling onions (Dina, 1979, Ciofu, 2003, Apahidean, 2009).

Larger differences, depending on the method of culture and plant density, are found in terms of production costs, especially in terms of demand, cost of labor and that of materials.

Crop by direct seeding with performance machines (grain by grain) can eliminate thinning and by herbicide use are deleted also the mechanical weed control works, so this crop can be fully mechanized.

At the seedling onions culture under the present conditions it cannot be avoided manual seedlings planting which involves a big labor-consuming, different also regarding the expected density of plants.

It is generally estimated that at the crop through direct seeding, the production costs are 32% lower than the other methods of culture (Butnariu, 1992).

A larger volume of work requires also the harvesting, but especially the product conditioning for immediate capitalize or storage. In this case costs are influenced by the level of production and quality of bulbs.

The literature of specialty refers to the need for manual labor in onion culture, depending on the degree of mechanization of works. Thus, at the culture of onions by directly sowing, in terms of complex mechanization, the labor demand is of 465 hours / ha and at the middle level of mechanization is of 597 hours/ ha (Indrea and col., 2009)

Production costs are affected by various taxes, such as those on social security and health insurance that the farmer pays, and also by indirect costs.

MATERIAL AND METHOD

In the experience De Buzău and F1 Nickerson hybrid were used. In the case of De Buzău variety the bulb is large, spherical, with a golden-yellow color. It is resistant to drought and conservation. The Nickerson F1 variety has a bulb that is ovoid, with a red-violet color, both on the outside and on the inside.

To establish the technological sequences of the onion crop grown in the city of Reghin, Mures county, a trifactorial experience was carried out:

Factor A - cultivation with two graduations: a_1 - De Buzău
a_2 - Nickerson F1;

Factor B - culture method with two graduations: b_1 - through direct seeding
b_2 - by seedling

Factor C – density factor with two graduations: c_1 - 70 plants/ m^2
c_2 – 140 plants/ m^2

From the combination of factors eight experimental variants resulted.

The experience has been places in blocks, subdivided in three repetitions. The experimental plot area was of 7.5 m^2.

The culture by direct sowing was established in the 20th of April, 2010, and the one through the seedling was planted in the 15th of May, 2010, and the seedlings occurred during 26.03 – 05.05, having the age of 50 days. Maintenance work was applied, specific to each culture method. Harvesting was done on the 1st of September 2010 for direct sown onions and the 3rd of September 2010 for the seedling onions.

RESULTS AND DISCUSSION

To accurately assess the results there have been established indicators of economic efficiency of variants of experimental culture.

In order to undertake analysis of economic efficiency were considered natural and global productions (production value), based on crop growth, quality and price movement of market capitalization. There were established production costs (direct and indirect costs) and their current price structure.

Because both capitalization prices, labor and materials costs vary from year to year, it was considered that can be used in calculating the values recorded in 2011.

For performing calculations of economic efficiency it was determined for each experimental variant the volume of physical output (commercial) and product quality.

Commercial productions (physical) were used to calculate global output (production value) and calculation of the average global production taking into account an average purchase price per product unit, at the values of 2011, that takes into account the period of capitalization and commercial qualities of the product (Tab. 1).

Purchase prices of onion bulbs generally are higher at red onion, that is also capitalize on the market at prices by about 40-50% higher than yellow onions.

Also the purchase price is influenced by commercial quality product. Differences between first and second quality being not significant, the purchase price is not much different.

Global production has varied greatly at the experimental variants, the highest values occurring at the culture with Nickerson F 1 hybrid, grown by seedling at the density of 700 thousands plants per ha (43,97 thousands lei / ha) and especially at the double density (49,08 thousands lei/ ha).

Local variety "De Buzau" realizes the highest values of global production only at high density (1400 thousands plants / ha) both at the culture by direct sowing (33.96 thousands lei/ ha) and especially at the one through seedlings (38.44 thousands lei / ha).

To establish costs there were prepared separately estimations for each variant of culture, calculating the necessary of manual labor (z.o./ ha), its cost (lei/ ha), mechanical labor costs, demand and cost of materials consumed.

At these costs were added and other direct costs: 27.5% at manual labor representing social security, 20.8% health insurance, 5.2% unemployment fund, 0.5% hedge fund, etc.(about 0.205%) Unique National Fund 0.85%.

At the materials costs was added a spore of 10 % supply costs and 1% other material expenses. At the total amount of direct costs were added 8% shares of indirect costs.

Table 1

Global production in onion culture - experimental variants (Reghin, 2010)

Variant		Physical production t / ha	Qualitative Prod. I%	Average purchase price Acquisition price of lei/ kg	Global production (thousands lei/ ha)
I	De Buzau, sowing, 700 thousands pl/ ha	21,57	61,7	1,2	25,88
II	Nickerson F1, sowing, 700 thousands pl/ ha	13,83	65,1	1,7	23,51
III	De Buzau, seedling, 700 thousands pl/ ha	21,20	35,6	1,3	27,56
IV	Nickerson F1 seedling, 700 thousands pl. / ha	24,43	44,0	1,8	43,97
V	De Buzau, seedling, 1400 thousands pl/ha	28,30	52,8	1,2	33,96
VI	Nickerson F1, seeding, 1400 thousands pl/ ha	22,03	47,5	1,7	37,45
VII	De Buzau, seedling, 1400 thousands pl/ha	29,57	48,0	1,3	38,44
VIII	Nickerson F1 seedling, 1400 thousands pl./ ha	27,27	44,7	1,8	49,08

The amount of consumed seed was of 5, 30 kg / ha at directly sown onion (1400 thousand pl. / Ha), 2, 65 kg / ha for the density of 700 thousand pl / ha and of 4 kg / ha for onion established by seedling. The price of a wire of seedling at De Buzau onions being of 0,009 lei and 0, 01 lei at Nickerson F1 red onion.

Price differences for wire seedling production are due to different cost of a kilo of seed that was of 250 lei of Buzau variety and 830 lei at Nickerson hybrid.

In the technological sheet of the version control (De Buzau, direct sowing) were included a series of costly works as weeding (16,7 z.o. / ha), hand hoeing (11 z.o./ ha) harvesting and conditioning of the product, so that the share of expenditure manual labor is much higher (47, 15% of total expenditures compared with the mechanical work (18,5%) and of materials (7,5%).

In experimental variant II, the culture of Nickerson F 1 hybrid, sown directly in the variant with 700 thousands plants/ ha the ratio between different types of cost changes.

Thus the proportion of expenses with workforce decreases to 40,5% due to lower production and lower costs for crop harvesting and conditioning but increases materials costs due to the higher price of hybrid seed, compared with the costs of control variant I , De Buzau, with 700 thousands plants per ha (Table 2).

At (De Buzau) onion culture by seedlings with lower density (70 plants/ m^2) increases labor costs due to manual work of planting seedlings, compared to variant culture by direct sowing.

Red onion, Nickerson hybrid F_1 with density of 70 plants/ m^2, grown by seedling requires approximately the same volume and manual labor costs as yellow onions (De Buzau) but in terms of materials it is added extra the higher cost of the hybrid seed.

Increasing the number of plants from 700 thousands plants/ ha to 1400 thousands/ ha will lead to increase costs of materials and manual labor.

At the crop by direct seeding, with De Buzau variety these costs increase by about 750 lei/ ha at materials and with 538 lei/ ha for manual works.

At the red onion culture (Nickerson $F_{1)}$ sown directly, doubling plant density per unit area increases the volume costs of materials purchased with 3074 lei/ ha and increases their cost share from 9,3% to 21,65% in the share of total costs compared with the onion crop De Buzau with the same density.

The largest expenses are recorded at onion crops by seedlings, with increased density from 70 to 140 plants/ $m^{2.}$

For the variety of De Buzau, obtaining seedlings, in large number, leads to material cost increase to 12984 lei from only 6684 lei / ha in the crop with lower density, situation in which the weight of this expenditures chapter increases to 37,18% of total.

Also the volume and cost of manual labor increases because of the manual work of planting but also costs with harvesting and conditioning of production surplus achieved at this variant.

At the red onion, with Nickerson F_1 hybrid, cultivated by seedlings and with double density, material costs reach over 14 thousands Euro / ha and 40,38% from total, making this variant to register the largest expenses at 35613 lei per ha, up from 17717 lei/ ha to control variant.

Analyzing the key economic indicators of onion crop, cultivated by two methods: direct sowing and seedlings and with two different densities of plants per unit area (70 and 140 plants / $m^{2),}$ at two cultivars (De Buzau and Nickerson $F_{1)}$ in specific conditions of agriculture in 2010, significant differences are found between the versions.

Thus, at the direct sowing culture through the variety of De Buzau, with 70 plants / m^2 considered as a control (version I) under conditions of relatively low cost is obtained a satisfactory profit, with a rate of 46,34%.

At the variant culture of red onion, the Nickerson F1 hybrid directly sown with a density of 70 plants / $m^{2,}$ although the production is lower and costs are higher due to the better price of capitalization is obtained a relatively high gross income (0, 53 lei/ kg) and a profit rate practically equal to that realized in version control.

The most unfavorable economic indicators have been registered at onion culture, De Buzau variety, in the version with seedlings and low density (70 plants / $m^{2).}$

At a relatively low production and of poor quality (quality I = 35, 6%) obtained at a higher cost price due to manual work of planting, the unit profit is only 0, 18 lei / kg and the rate of profit is 16, 07%.

At the red onion, with Nickerson F $_1$ hybrid, in the same culture formula as in the VIII, that is, by seedlings with 70 plants / m ^{2,} the economic results are better, even if the cost price exceeds 1 leu/ kg due to higher production and capitalization at higher price the profit rate reaches 69, 8%.

Increasing plant density from 70 to 140 plants / m ^{2} at onions culture both in version with direct sowing and also at the one by seedling, leads to, as shown to the increase of production but at the same time leads to higher costs.

At De Buzau variety culture by direct sowing with a double density of plants, the economic indicators are better with a profit rate of 60% from 46, 3% in control.

Red onion, Nickerson F $_{1,}$ cultivated by direct sowing at high density (140 plants / m $^{2)}$ provides higher production, higher gross income (0,64 lei/ kg) and a profit rate of 60,4% much higher than the case of growing at low density.

At onion crops by seedlings greatest productions are made by doubling the number of plants at m ^{2} in both cultivars but because of the high costs of buying and planting the seedlings, bulbs cost price increases a lot and so the unit profit decreases.

Thus, at the culture with De Buzau variety is obtained the lowest rate of profitability (10, 66%) and higher costs, compared to other variants.

At Nickerson F 1 hybrid culture because of the better price for economic efficiency capitalization is better than the one at De Buzau variety.

Table 3

The values of indicators of economic efficiency and labor productivity of experimental variants used in onion culture (Reghin, 2010)

Variants		Production physical (t / ha)	Global Production (Lei / ha)	Force of work zo / ha	Production work lei / zo	Costs of production lei / ha	Benefit (Profit) Lei	Rate profit %
I	De Buzau, sowing, 700 thousands pl. / Ha	21.57	25.88	120.622	214.584	17717	8163	46.34
II	Nickerson F1, sowing, 700 thousands pl. / Ha	13.83	23.51	96.24	244.29	16202	7308	45.29
III	De Buzau, seedling, 700 thousands pl. / Ha	21.20	27.56	126.47	217.90	23772	3788	16.07
IV	Nickerson F1 seedling, 700 thousands pl. / ha	24.43	43.97	136.63	321.84	25996	17974	69.81
V	De Buzau, sowing, 1.4 thousands pl. / Ha	28.30	33.96	141.85	239.4	21352	12608	60.00
VI	Nickerson F1, sowing, 1400 thousands pl. / Ha	22.03	37.45	122.07	306.79	23361	14089	60.37
VII	De Buzău, seedling, 1400 thousands pl./ha	29,57	38,44	152,84	251,5	34915	4245	10,16
VIII	Nickerson F1, seedling, 1400 thousands pl./ha	27,27	49,08	145,60	336,97	35613	13467	38,46

Labor productivity is a major economic indicator especially in cultures that use a larger amount of manual labor, as it is in onion culture (Tab. 3). Of all the experimental variants the highest labor productivity was recorded in variant VIII, red onion (Nickerson F 1) of seedlings, with high density (140 plants / m 2) which made 336,97 lei per working day, equivalent to 187,2 kg bulbs.

Based on data regarding physical and value production, labor requirements and production costs, labor productivity has been established, the benefit and profit rate for each variant (Tab. 3).

Table 2

Onion crop production costs depending on the cultivar, method of culture and density

No.	Items of expenditure (T / ha)	V I		V II		V III		V IV		V V		V, VI		V VII		V VIII	
		lei / ha	%	lei / ha	%	lei / ha	%	lei / ha	%	lei / ha	%	lei / ha	%	lei / ha	%	lei / ha	%
	Materials expenses																
A	Purchased Materials	1323	7,46	2860	17,65	6684	28,11	7384	28,40	1985	9,30	5059	21,65	12984	37,18	14384	40,38
2	Supply costs (10%)	132,3	0,75	286	1,76	668	2,81	738	2,83	198,5	0,93	505,9	2,16	1298	3,71	1438	4,03
3	Expenses with mechanical works	3281	18,52	2519	15,54	2956	12,43	3279	12,61	3966	18,57	3339,1	23,81	3793	10,86	3565	10
4	Water value for irrigation	900	5,07	900	5,55	1200	5,04	1200	4,61	900	4,22	900	3,85	1200	3,43	1200	3,36
5	Other materials costs (1%)	56	0,31	66	0,40	115	0,48	126	0,48	70	0,32	98	0,41	193	0,55	206	0,57
	I. Total materials expenses	5748	32,44	6631	40,92	11623	48,89	12727	48,95	7120	33,34	9902	42,38	19468	55,75	20791	58,38
	Expenses with manual labor																
6	Expenditures with manual works	8355	47,15	6563	40,50	8144	34,25	2 8893	34,20	9917	46,44	8462	36,22	10083	28,87	9551	26,81
7	Social Security Contributions (20.8%)	1738	9,80	1365	8,42	1694	7,12	1850	7,11	2063	9,66	1375	5,88	2097	60,06	1987	5,57
8	Social security and health contributions (5.2%)	434	2,44	341	2,10	423	1,77	462	1,77	516	2,41	1760	7,53	524	1,50	497	1,39

9	Contribution to unemployment fund -0.50%	42	0,23	33	0,20	41	0,17	44	0,16	50	0,23	42,31	0,18	50	0,14	48	0,13
10	Contributions to fund risk and accidents (0.205%)	17	0,09	13	0,08	17	0,07	18	0,016	20	0,09	17,35	0,07	21	0,06	20	0,056
11	Unique National Fund (0.85%)	71	0,400	56	0,34	69	0,29	76	0,29	84	0,39	71,93	0,30	86	0,28	81	0,22
	II. Total expenditure living labor	10657	60,15	8371	51,66	10388	43,48	11343	43,63	12650	59,24	11729	50,20	12861	36,83	12184	34,21
	III. Total direct costs (I + II)	16405	92,60	15002	92,59	22011	92,59	24070	92,59	19770	92,59	21631	92,59	32329	92,59	32976	92,59
	IV. Indirect costs (8%)	1312	7,40	1200	7,40	1761	7,40	1926	7,40	1582	7,41	1730	7,40	2586	7,40	2638	7,40
	V. Total production costs	**17717**	100,00	**16202**	100,00	**23772**	100,00	**25996**	100,00	**21352**	100,00	**23361**	100,00	**34915**	100,00	**35615**	100,00

As seen from the information contained in the table, the most profitable are the following variants: IV (Nickerson F 1, seedling, 1400 thousands pl / ha), VI (Nickerson F 1, sowing, 1400 thousands pl / ha) and V (De Buzau, sowing, 1400 thousands pl / ha), which records a profit rate of 69, 81% in the first case, 60, 37% in the second and 60% for V version.

Experimental variant VII (De Buzau, seedling, 1400 thousands pl / ha) has recorded the lowest profit rate of 10, 16%.

Also is to be noted the variant IV, red onion cultivated by seedlings with the density of 70 plants / $m^{2.}$

At De Buzau onions, the best labor productivity is found both in cultures by direct sowing and by seedlings at the density of 140 plants / $m^{2.}$

CONCLUSIONS AND RECOMMENDATIONS

Based on the production results obtained in the experience (2010) and assessments of the economic indicators of the 8 variants of the onion crop there can be drawn the following conclusions:

1. The highest production level is obtained from De Buzau variety cultivated with 1400 thousands plants / ha, followed by Nickerson F1, cultivated by seedling.
2. High production costs per hectare are recorded at the versions created by seedling which requires a lot of manual labor and which are having a high density 1400 thousands pl / Ha.
3. Nickerson F_1 hybrid, cultivated by seedlings at an increased density requires the largest expenditure, due to the cost of planting material and planting works.
4. Best labor productivity is achieved with red onion culture (Nickerson $F_{1)}$ with seedlings and with an increased density due to the high level of global production.
5. Registered profit is influenced by the purchase price which is much higher at red onion than the white onion. The higher profit 0, 74 lei / kg, is recorded at IV version where was cultivated the red onion by seedling with a density of 700 thousands pl. / ha.
6. Rate of profit differed a lot at onion crop in the experimental variants. The highest rate of profit (69.81%) was achieved by the red onion hybrid, grown by seedlings with the density of 700 thousands plants / ha.

REFERENCES

1. Apahidean S., 2003, *Cultura legumelor*, Ed. Academic Pres, Cluj-Napoca.
2. Butnariu, H, D. Indrea, C. Petrescu, P. Soviţchi, Pelaghia Chilom, Ruxandra Ciofu, V. Popescu, Gr. Radu, N. Stan, 1992, *Legumicultura*, EDP, Bucureşti;
3. Ciofu Ruxandra, N. Stan, V. Popescu, Pelaghia Chilom, S. Apahidean, A. Horgoş, V. Berar, K. F. Lauer, N. Atanasiu, 2003, *Tratat de legumicultură*, Ed. Ceres, Bucharest;
4. Indrea D., Al. S. Apahidean, Maria Apahidean, D. Măniuţiu, Rodica Sima, 2009, *Cultura legumelor*, Ed. Ceres, Bucureşti;
5. Indrea, D., H. Butnariu, Elena Florescu, Tinca Panait, Gh. Dina, 1979, *Legumicultură*, EDP, Bucureşti;