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Lana Nastić, M.A.[1]
Marko Jeločnik, M.A.[2]
Jonel Subić, PhD.[3]
Institute of Agricultural Economics, Belgrade

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ANALYSIS OF CALLA LILY AND CUCUMBER PRODUCTION IN GREENHOUSE[4]

Abstract

In the last few decades, vegetable production in greenhouses has been more and more presented within the national agriculture. On small agricultural holdings, in aforementioned form of protected production area, dominate the tomato, cucumber and pepper growing. However, in recent years, beside vegetable crops, flowers are more and more grown (seedlings and cut flowers), where on the territory of Pančevo city, in cut flowers production calla lily becomes particularly interesting to producers.

In paper are presented some specificities in cucumber and calla lily production in greenhouse, with the main goal to easily determine (according to contribution margin analysis in the cut flowers (calla lily) and cucumber production) in which line of plant production can be expected achievement of potentially better financial results. All, for analysis, necessary data were obtained from the small family agricultural holdings located at the territory of Pančevo city (within the Metropolitan area Belgrade - Novi Sad). After analytical calculations based on the variable costs have been made, it can be concluded that producers may generally achieve better production results within the calla lily production.

Key words: *contribution margin, calla lily, cucumber, greenhouse.*

JEL Classification: Q12, Q14.

АНАЛИЗА ПРОИЗВОДЊЕ КАЛЕ И КРАСТАВЦА У ПЛАСТЕНИКУ

Апстракт

Производња повртарских култура у пластеницима је последњих неколико деценија све више присутна у националној пољопривреди. На малим пољопривредним газдинствима у поменутој форми заштићеног простора доминира узгој парадајза, краставца и паприке. Међутим, у последње време се поред повртарских култура све више узгаја и цвеће (расад и резано цвеће), где је код производње резаног цвећа произвођачима на подручју града Панчева посебно интересантна бела кала.

[1] lana_n@iep.bg.ac.rs

[2] marko_j@iep.bg.ac.rs

[3] jonel_s@iep.bg.ac.rs

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У раду су представљене специфичности производње краставца и беле кале у пластенику, са циљем да се на основу анализе марже покрића (бруто финансијског резултата) у производњи резаног цвета (беле кале) и краставца непосредно утврди у којој се линији биљне производње остварују бољи финансијски резултати. Сви неопходни подаци за анализу су црпљени са породичних пољопривредних газдинстава лоцираних на територији града Панчева (унутар метрополитен подручја Београд - Нови Сад). По изради аналитичких калкулација на бази варијабилних трошкова, утврђено је да произвођачи генерално могу остварити боље производне резултате у производњи беле кале.

Кључне речи: *маржа покрића, бела кала, краставац, пластеник.*

Introduction

Production in greenhouses, on the territory of the Republic of Serbia is mostly organized on small agricultural holdings. Mentioned method of agricultural production requires somewhat higher level of intensity, but in most cases it brings much higher incomes per unit of production surface. Also, this type of production represents, due to its usual organization on smaller land complexes (although it requires a lot of labor), suitable production alternative for small agricultural holdings.

Considered research activities were focused on the analysis of greenhouse production of selected plant species (cucumber and calla lily). Observed surfaces under greenhouses are located on the territory of Vojvodina (South Banat region), so during the analysis of results as input were used data obtained from the farms of small agricultural producers from the area of Pančevo city (zone of Central Danube region or Metropolitan area Belgrade - Novi Sad).

Mentioned zone has on disposal around 540,000 ha of agricultural land of good quality, favourable climate conditions for development of primary agriculture, large labour base, as well as vicinity of huge markets, what all represent excellent starting position for development of intensive agricultural production (Subić et al., 2013).

As was mentioned, in focus was greenhouse production of cut flower of calla lily, which from year to year takes up more and more agricultural surfaces, as well as cucumber production that has a relatively long tradition of organization in protected area facilities.

According to Subić (2010) vegetable production in greenhouses is very clean ecological process. Plant residues are bringing out the facility and grind, or remain in greenhouse, as like waste after production are not environmental pollutants. The use of fertilizers and other chemicals is relatively small, as the plants are more sensitive to a higher concentration of chemical compounds, so after the production cycle its concentration in soil is negligibly small.

Analyzed production lines are located in the greenhouses that have size of around 250 m^2 of useful area. It is necessary to bear in mind that the production of cut flowers is performed continuously throughout the year, while in cucumber production in one calendar year production area can be also used for another production cycle of certain vegetable (e.g. lettuce), what can contribute making of extra income on observed production area. From the aspect of income, this fact can be of special producers interest, as in following years in Serbia can be also expected increase in food prices, according to its global trend (Pejanović and Njegovan, 2009).

Methodology

For both production lines were made calculations based on variable costs, how it could be determined which of these two productions is more profitable.

According to Vasiljević and Subić (2010), due to relatively simple methodological procedure of calculation, as well as higher possibility for practical application, analytical calculations based on the variable costs are quite a lot in use in professional practice of developed market economies. This calculation was established as a response to the need of common company activities (due to sudden changes in market conditions), in order to find more efficient way for costs determination and analyzing in regard to possible, or incurred changes in production structure, volume and way of business activities operationalization. In other words, it represents more adequate analytical base that will serve to the management for more efficient costs driving and decision-making, as on family agricultural holding, as well as in agricultural enterprise.

Result of analytical calculation based on variable costs is so-called contribution margin (gross financial result), which represents the difference between the value of total production and total variable costs (Jeločnik et al., 2013). Contribution margin can be mathematically presented with the following formula: CM = PV - VC, where are: CM – contribution margin; PV – production value; VC - variable costs of production.

In analytical calculations based on variable costs, cost price is also calculated, where it includes only variable costs, so fixed costs are taken into account only in process of determination of financial results achieved on complete or specified part of agricultural holding (Ćejvanović et al., 2010).

According to results obtained from the calculations based on variable costs, sensitivity analysis was made. Mentioned analysis allows tracking of changes in contribution margin due to change in production value, or due to change in sum of variable costs of production.

In conditions of uncertainty, the estimation of production results in plant species growing can be done by several methods and techniques. So, for assessment of production results in cut flower (calla lily) and cucumber growing in greenhouse, some additional analytical methods were considered, such as: critical price, critical yield and critical variable costs. These indicators reflect critical values at which the contribution margin equals to zero.

According to Subić and associates (2010), presenting of all contribution margin elements can provide a quick and easy overview of business at some agricultural holding in one production year, as well as the calculation of expected economic results, in case of changes in production volume, or switching from one to another production line.

Research results with discussion

Calla lily is a plant of tropical forests. It originates from central and south Africa. Production of calla lily flower requires large amounts of water, considering that this is a plant that grows in wetlands. It is reproduced vegetatively (by underground stem - tubers), while the leaves emerge directly from the root, so there is no visible tree. During the year, calla lily has been passing throughout two periods of vegetation: period of flowering and rest period (hibernation). During the phase of hibernation comes to the establishment of flower buds (it is very important for adequate formation of future flowers). This period lasts from the end of May (beginning of June) until the end of August (early September). Flowering period lasts for 8 months, but the most of the flowers are developed within the period January - March.

Since the root system of calla lily has increased demand for oxygen, planting density is usually at the level of 10 plants/m^2 (in case of mentioned density expected yield can be in range of 10-20 flowers per mature plant), (Đaković, 2012).

Growing conditions in the greenhouse assume the providing of relative humidity in the range of 65-75% (it is necessary for good development and growth of plant). Keeping of determined level of humidity is usually performed in combination of ventilation (air flow), shading and optimal temperature within the greenhouse, since the higher level of humidity can lead to appearance of fungal diseases (botrytis), (Steininger, 2011).

Calla lily requires certain temperature conditions. The ideal will be if the night temperature is around 16°C and daily temperature within the interval 18-20°C. This is a plant that does not require a lot of light. It is also much resistant to the winter temperatures in compare to early-spring vegetable species. It can endure, without major damages, temperature in the range of 6°C, at nights, to 15°C during the days.

Along with its growth, calla lily requires more and more quantities of water (expressed increase in applied quantities of fresh water and frequency of watering begins with the appearance of first leaves), with general recommendation to apply the largest volume of water during the morning hours (Steininger, 2011).

Calla lily responds well to the constant nutrition – fertilizing (couple of times during the vegetation period). It fits the best liquid NPK fertilizers with a formulation closest to the 4:1:3 (such as 16:4:12, or 24:8:16), or fertilizers rich with nitrogen, as it contributes to vigorous growth of plants (Steininger, 2011). Since calla lily is a perennial plant, it is advisable, prior to initiation of production process (optimal production cycle lasts 3 years) to fertilize well all production surfaces with manure.

On the other hand, use of production (land) complex for few years within the one production cycle requires previously detailed suppression of weeds parallel with the process of land cultivation. For this purpose, 2-3 times has to be applied herbicides on the basis of glyphosate, MCPA, MCPP and 2-4D Amin. As it is mentioned above, requirement for higher humidity in production facility can bring to the appearance of condensation on the foil during the nights, what can cause a fungal diseases (as a botrytis), so for this purpose is suggested plants treatment with fungicide few times during the calendar year (Đaković, 2012). Generally are used little quantities of pesticides in greenhouse production of calla lily. Usually are used the preparations for the protection against botrytis (fungicide, such as preparation Signum) and against European red mite (acaricide, such as preparation Abastate).

Individual agricultural producers of calla lily from the territory of the South Banat region most often sell the flowers on the Belgrade Flower market. Mentioned flower achieves the highest price within the period from New Year to March, while outside this period selling prices per flower are significantly lower. One of the major production limitations is recognized in uncertain realization of produced quantities on the national market. During the in-depth interviews with producers, it was claimed that certain efforts regarding the realization of calla lily export in Greece are undertaken, where additional problem occurred to producers (limited production capacities) embodied in ensuring of continuous delivery of certain volume of production on weekly basis (10,000 flowers/week). Fulfilment of required conditions set by potential buyers will initiate the realization of gross price of 1.25 EUR/flower (i.e., after deduction of all accompanying expenses: transportation, custom fees and other, the expected net price will be in range from 0.70 to 0.75 EUR/flower).

After a field research (collection of necessary data throughout the interview with the owners of selected small family agricultural holdings) analytical calculations based on the variable costs realized in the production of cut flower of calla lily in greenhouse were established (Table 1).

Table 1. Calculation of calla lily production in greenhouse (on 250 m^2)

Elements	Quantity	UM	Price per UM (EUR)	Total (EUR)
Calla lily	16,000	piece	0.26	4,126.55
I Total income				**4,126.55**
Seedlings*	533	piece	1.00	531.53
Fertilizers	*	*	*	25.88
Pesticides	*	*	*	18.48
Binder	3.00	kg	2.15	6.45
Labour costs (seasonal)	250.00	hour	1.72	429.85
Transportation costs	*	*	*	300.89
Costs of heating	*	*	*	1,100.41
Costs of irrigation	*	*	*	128.95
II Total variable costs				**2,542.45**
III Contribution margin (I-II)				**1,584.10**

Source: According to internal documentation of IAE Belgrade, 2014.
Note: * As one seedling can be used in production during the three seasons, presented costs are the third part of total costs of seedlings.

Achieved contribution margin in the production of cut flowers (calla lily), in given conditions of production, has a value of 1,584.10 EUR/250 m^2. Within the structure of variable costs, the largest share has the costs of heating, which participation of 43.28%, as well as the costs of planting material (seedlings), around 20.91%.

In Table 2 is presented the sensitivity analysis in production of calla lily. Analysis is done based to the results of analytical calculation, where in same time was followed the changes of contribution margin, as due to changes in production value, as well as due to changes in the sum of achieved variable costs of production.

Table 2. Sensitivity analysis of calla lily production

PV (Production value), EUR/250m^2	VC (Variable costs), EUR/250m^2				
	1,938.37	1,951.08	2,542.45	3,133.83	3,146.54
3,146.08	1,207.71	1,195.00	603.63	12.25	-0.46
3,166.71	1,228.35	1,215.63	624.26	32.89	20.17
4,126.55	2,188.18	2,175.47	1,584.10	992.72	980.01
5,086.38	3,148.02	3,135.30	2,543.93	1,952.56	1,939.84
5,107.02	3,168.65	3,155.94	2,564.56	1,973.19	1,960.48

Source: According to internal documentation of IAE Belgrade, 2014.

Critical decline of production value, with simultaneous increase of variable costs, ranges within the interval 23.26-23.76%. Specifically, contribution margin equals to zero after production value was decreased, simultaneously with increase of variable costs for 23.75321% (i.e. when their values are equal, and in mention case amounts 3,146.36 EUR/250 m^2).

Critical values (Table 3), or values at which the contribution margin equals to the zero, in defined production conditions are:

- Critical price amounts 0.16 EUR/flower;
- Critical yield amounts 9,857.93 flowers on production area of 250m^2;
- Critical variable costs amounts 4,126.55 EUR/250m^2.

Table 3. Critical values in calla lily production

Indicator	EUR(flower)/250m^2
Expected yield - average (EY)	16,000
Expected price - average (EP)	0.26
Subsidies (S)	0.00
Variable costs (VC)	2,542.45
Critical price: CP = (VC - S) / EY	**0.16**
Critical yield: CY = (VC - S) / EP	**9,857.93**
Critical variable costs: CVC = (EY x EP) + S	**4,126.55**

Source: According to internal documentation of IAE Belgrade, 2014.

Cucumber production in greenhouse on the territory of the Republic of Serbia is usually organized as spring or autumn production. As initial growth and development of cucumber requires higher temperatures, seedlings production is established in warm seedbeds, glasshouses or greenhouses with heating. Sowing is usually done on the beginning of February, while in the organization of fall production cycle it is usually done in late May, or early June (Popović and Lazić, 1989).

In terms of environmental conditions cucumber has much higher requirements. For normal growth and development, light intensity of 8-9 thousand lx (lux) and daylight length of 10-12 hours are requested. Cucumber is especially sensitive to temperature (in all development stages). The optimal temperature, within the production process, ranges within the interval 28-32^{0}C, while the optimal value for relative humidity varies between 85-95% (Bjelić, 1999).

Planting should be done in a well-prepared and well-manured soil, with inter-row spacing of 100-120 x 40-50 cm. During the vegetation period, regular care measures has to be applied, such as irrigation, hoeing, additional fertigation, protection from diseases and pests, supports (poles) installation, pruning, etc. Cucumber is very sensitive to powdery mildew and plasmopara viticola. Harvest should be well-timed, given that the cucumber fruits have to be classed (according to the determined fruit dimensions), (Marković, 2009).

Observed farm is selling the cucumber, partly on green market in Pančevo city and partly on wholesale market for agricultural products located in Belgrade. As the production is based on greenhouse conditions, producer usually succeeds to realize great part of cucumber production few weeks before regular season, achieving on that way relatively higher prices.

In the greenhouse production of cucumber, in compare to the production of cut flowers of calla lily, it was achieved relatively worse production results, so contribution margin in mentioned production amounts 737.75 EUR (Table 4).

Table 4. Calculation of cucumber production in greenhouse (on 250 m^2)

Elements	Quantity	UM	Price per UM (EUR)	Total (EUR)
Cucumber (total yield)	3,650	kg	0.404	*
I class (80%)	2,920	kg	0.43	1,255.60
II class (20%)	730	kg	0.30	219.00
I Total income				**1,474.60**
Seed	650	seed	0.048	31.20
Costs of sowing	4	hour	1.72	6.88
Fertilizers	*	*	*	25.88

Pesticides	*	*	*	45.45
Pullback of vines	8	hour	1.72	13.76
Costs of harvesting (picking)	40	hour	1.72	68.80
Packing (wooden vegetable crate)	360	piece	0.3	108.00
Mulch foil	150	m^2	0.12	18.00
Drip irrigation tape	150	m	0.07	10.50
Bender	4	piece	2.15	8.60
Costs of binding	25	hour	1.72	43.00
Costs of rototilling	3	hour	4.3	12.90
Other costs (electric, transport, irrigation, heating, etc.)	*	*	*	343.88
II Total variable costs				**736.85**
III Contribution margin (I-II)				**737.75**

Source: According to internal documentation of IAE Belgrade, 2014.

Within the structure of variable costs dominates the group of other costs, which includes the costs of electricity, transport, heating, etc., with share of 46.67%. They are followed by the cost of packaging, which has share of 14.66%.

As like in the case of the production of cut flower of calla lily, in the production of cucumber in the greenhouse is also made a sensitivity analysis based on the results from the analytical calculation of variable costs of production (Table 5).

Table 5. Sensitivity analysis of cucumber production

PV (Production value), EUR/250m²	**VC (Variable costs), EUR/250m²**				
	490.96	494.65	736.85	979.05	982.74
982.53	491.56	487.88	245.68	3.47	-0.21
989.90	498.94	495.25	253.05	10.85	7.16
1,474.60	983.64	979.95	737.75	495.55	491.86
1,959.30	1,468.34	1,464.65	1,222.45	980.25	976.56
1,966.67	1,475.71	1,472.03	1,229.82	987.62	983.94

Source: According to internal documentation of IAE Belgrade, 2014.

In the cucumber production, critical decrease of production value, with simultaneous increase of variable costs, ranges in interval 32.87-33.37%. So, contribution margin equals to the zero when production value is reduced and variable costs are increased for 33.3605%, in other words when their values are equal and amount 982.67 EUR/250 m^2.

Table 6. Critical values in cucumber production

Indicator	**EUR(kg)/250m²**
Expected yield - average (EY)	3,650.00
Expected price - average (EP)	0.40
Subsidies (S)	0.00
Variable costs (VC)	736.85
Critical price: CP = (VC - S) / EY	**0.20**
Critical yield: CY = (VC - S) / EP	**1.823.89**
Critical variable costs: CVC = (EY x EP) + S	**1,474.60**

Source: According to internal documentation of IAE Belgrade, 2014.

Values when, in specified production conditions, contribution margin equals to the zero, i.e. critical values presented in previous table are (Table 6):

- Critical price amounts 0.20 EUR/kg;
- Critical yield amounts 1,823.89 kg for the production area of 250m^2;
- Critical variable costs amounts 1,474.60 EUR/250m^2.

Conclusion

Comparison of the production results of produced cut flower of calla lily and cucumber in greenhouse was made according to results of analytical calculations based on variable costs, sensitivity analysis and presentation of the critical values of production.

By focus on the results of analytical calculations based on variable costs in greenhouse production (for cut flower of calla lily and cucumber), which has been conducted on small agricultural holdings, following are noted:

- Contribution margin (gross financial result) in both types of greenhouse production have a positive value, but better results were achieved in the production of cut flowers of calla lily;
- Movement of critical fall of the production value, with a simultaneous increase of variable costs, is more expressed in the cucumber production.

Achieved production results indicate the fact that in given business conditions, small family agricultural holdings focused on cut flower of calla lily are achieving better results in compare to holdings directed to cucumber production in greenhouse.

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