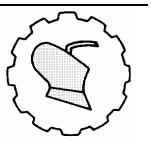
POLJOPRIVREDNA TEHNIKA
✧
Godina XXXI
Broj 4, decembar 2006.
Strane: 43 - 50

Poljoprivredni
fakultet
Institut za
poljoprivrednu
tehniku



UDK: 631.162

ECONOMICAL ANALYSIS OF THE MECHANISED FIELD CUCUMBER PRODUCTION AND GRADING TECHNOLOGY

László Magó, Frigyes Jakovác

Hungarian Institute of Agricultural Engineering,
Hungary - 2100 Gödöllő, Tessedik S. u. 4.
E-mail: laszlomago@fvmmi.hu

Abstract: The cucumber is one our most important vegetable crops, not only the home consumption but the exported quantity is also remarkable. In view of the production area and the quantity produced pickling cucumber is the most significant in Hungary the production area of which is roughly 3-6 thousand hectares.

The annual demand of the canning industry for 6-9 cm and 9-12 cm calibrated cucumber is generally 50-60.000 tons. Though the picking of smaller size-fractions (under 6 cm) reduces the quantity of crop the revenues can be increased notably due to the higher price of this fraction.

The most important link in the chain of production and distribution is the solid inland processing industrial background which is inevitable for the export of fresh produce as well.

The subject of the present study is the mechanized production of pickling cucumber developing rapidly in the last years.

The present essay presents the up-to-date, mechanized foil covered production and post harvest technology of pickling gherkins. The aim of the evaluation and publishing of the experiences and the presentation of the plant and economic indexes of the machinery necessary for the production is to promote the spreading of a modern, market orientated cucumber production technology.

Key words: *foil covered field vegetable production, mechanisation, economic, machine investment- and utilisation cost*

THE MAJOR MACHINES OF THE PRODUCTION TECHNOLOGY

The studied technology is based on drop irrigation, soil-cover cultivation method for which ridge forming machine type HORTUS HPD-165 and foil and tube layer type AF1 (Figure 1) is used. In order to further early ripening and crop safety plant covering foil tubes can be prepared by the machine type AFF-1000 (Figure 2). For harvesting picking machines type STIEGER with picking belt are used by which crop can be harvested on the same territory 2-3-times a week without causing treading damages to the vegetation.

At the local distributional settlements low capacity stringed grading machines type UBV are used, while in the canning factory grading is done by the also string-system high capacity grading machines type FLEISCHMANN. Grading before sale is necessary because the selling price is highly dependent from the size of the produce. During the canning procession different systems of washers, graders, bottle fillers, cap fasteners and sterilizers and palettizers are used.

Figure 1: Ridge forming and foil laying machine type AF1

Figure 2: Tunnel-foil laying machine type AFF-1000

PRESENTATION OF THE PRODUCTION TECHNOLOGY

The machine technology of production is presented on the basis of Table 1. The tables show the denomination of operation, the machine applied for the certain operation, and the type of the power machine connected to it together with the shift performance of the connected machines and the calculated shift performance of the working machine for the given economic year. Some of the economic data are also included: the selling price of the working machine and the power machine in the year 2004, the operational cost of the same per shift hour together with the operational cost of the connected machines.(Gockler-Hajdú 2004) [1]

Stubble ploughing by disc-harrow is unavoidable in order to work the stem remains of the forecrop into the soil and to prevent weeding. This is followed by deeper loosing. The subsequent delivery of nutrients is ensured through spreading of organic manure and fertilizers. These nutrients get into the soil by deep ploughing. The next operation is spring top fertilization which is worked into the soil by ploughing processing. The first step of forming a ground surface of appropriate quality is seed bed preparation followed by levelling of the surface and ridge bed preparation. The next operation is mulching and hauling in the hosepipe. Water and plantlet supply is connected to the operation of planting. Forming of the foil tunnel comes next. In the vegetation period of the cultivated plant dropping system irrigation is necessary in order to achieve a high quality final product and a better crop yield. Plant protection is applied about 12 times.

It is to be kept in mind by harvesting that the frequent picking of cucumber results in a higher proportion of the more valuable smaller size fractions affecting the success and thrift of the total production. In case of plain cultivation picking twice a week is advisable. When picking cucumbers not only the totally intact but also the drossy ones are to be picked as these oppress and weaken the plant. Another important point is to

avoid damages caused to the plant during harvesting the spindles are not to be trodden, turned or torn.

The ***belt cucumber picking carriage type STEIGER*** **(Figure 3)** has been developed in order to satisfy the above demand and to facilitate the manual harvesting of the produce. The machine is – subject to framing – attended by 16-28 hand picking workers working in a lying position in order to avoid treading the vegetation.

The collecting belt of the machine mounted on a tractor collects and forwards the cucumber into the trailer pulled by the power machine. Thanks to its shaping and mode of operation the machine fits in the domestic technological line.

Besides a size proportion of 43 % of the cucumber falling into the standard size range of 5-9 cm the machine can be operated with a territorial performance of 0,20-0,22 ha/h, resp. with a specific mass performance of 63,4 kg/(h x person). For picking up the abandoned produce 2-4 foot-workers need to be employed. According to surveys the performance of the pickers measured in cucumber mass is increased by 20 % by harvesting by picking carriage in comparison to the traditional hand picking.

Figure 3*: Belt cucumber picking carriage type STEIGER*

According to measurements the shaping of the machine creates an appropriate position for the picking workers and fulfils the tasks of transport within the field at the same time.

In the studied technology cucumbers are to be ***graded*** twice, once before commercial takeover and once before canning procession.

The purchase prices depend on the size of gherkins. The smaller size the produce is, the higher the value will be. There is a significant difference among the purchase prices of the individual size fractions it is, therefore, an elemental interest of both the producers and the dealers that the harvested quantity is graded. The hoarded produce gets into the processing factory afterwards where it will be sorted into more size fractions again so that the gherkins in the glasses will be homogeneous.

The grading machines applied by takeover and processing are generally operated on the same grading principle (stringed grading machines) but while the smaller capacity simple pregrading machines are appropriate for takeover the ones operating by the processing plants are more complicated with an expert design and extremely high capacity.

On the stringed grading machines there are plastic covered rolling chain pairs running beside one another with an increasing airspace. The produce to be graded proceeds on either chain pair until the slackening gap is the same size as the diameter of the cucumber. Then it falls down to the forwarding belt situated beneath the chain.

Several different makes and types are used for *pregrading* in Hungary. The present study covers the stringed ***grading machines type UBV-II-AG*** and UBV-III-AG. The machines have been developed to satisfy the demands of small factories and commercial takeover sites.

The rate of charging and the level of attendance of the machines operated under the above circumstances are varying.

The machines consist of conveyer belt, grading chains with grader, and the collecting forwarders. The difference between the two machines is only the number of chain pairs.

It can be stated on the basis of the surveys that the top capacity of the machines is roughly 1 t/h regarding the grading machine UBV-II-AG and 1,4 t/h regarding UBV-III-AG. Practically the utilization of the machines is only 40-80 % owing to the non-optimal attendance. By the application of the machines an exactness of grading by length of about 60 % can be achieved which can modify according to variety, adjustment and mode of operation.

The grading previous to commercial takeover does not meet the requirements of the canning industry. Therefore, grading for canning purposes is necessary. The specific mass is of vital importance hereby as it ensures the steady appearance of the canned product packed in glasses. In order to ensure this the graders applied here sort the raw material not only for the standard size fractions but much more the fraction limits of which overlap each other. The ***grading line made by the company FLEISCHMANN*** is appropriate for this purpose (Figure 4). The line consists of two grading machines with continually growing gap sizes. The workers emptying the containers attend the machines in a way which makes it possible to operate the machines independently as well.

Figure 4: Stringed cucumber grading line type FLEISCHMANN

Investigations prove that the performance of the machine in the productive period is 8,5 t/h. The shift performance is round 60-80 t. The size exactness of the machine regarding diameter and length is 40-50 %.

It can be stated on the basis of the surveys that the stringed grading machines type UBV-II-AG, UBV-III-AG and FLEISCHMANN fit well in the domestic technological line. The performance and the operational exactness of the machines are up to the present commercial requirements.

THE RESULTS OF THE ECONOMIC SURVEY

The results of the economic survey of cucumber production on a 20 hectare area are shown in Table 2. Apparently, the machine working time necessary for the cultivation of the 20 hectare growing area in case of connected machines has been stipulated related to the individual operations. On this basis the direct operational cost of the connected machines can easily be calculated by multiplying the *direct operational cost of the machine per shift hour* (Table 1) with the effective working time. Furthermore, the additional cost of connected machines has also been stipulated which is affected by the

capital return on fixed and current assets as well as by the general costs of farming. As a result the cost of the individual operations related to 20 hectare growing area has been defined the total of which equals the total production costs of cucumber production on 20 hectares and also the specific cost per hectare has been stipulated. The costs of field cucumber production, harvesting and grading are specified in the table.

It can be stated on the basis of the results that the operational cost of the working machines (11.196 EUR) is the half of that of the power machines (22.567 EUR). The total operational cost amounts to 33.763 EUR, 1688 EUR per hectare.

Taking the manipulation costs amounting to 2238 EUR into consideration the total cost of machine utilization is 36.001 EUR, 1800 EUR per hectare.

The investment cost of the machines applied in the production technology amounts to 593.996 EUR out of which the purchasing price of the working machines amounts to 197.300 EUR, which equals about 33 % of the total investment cost while the purchasing price of the power machines is 313.096 EUR, about 53 % of the total cost of machines. The purchase price of manipulating machines is 83.600 EUR, about 14 % of the total investment.

In case of power machines it can be stated that one power machine with an engine capacity of 140 kW is needed for the hard cultivation works, while the tasks of nutrients delivery, ridge-bed preparation, mulching, hauling the hosepipe, planting, foil tunnel preparation, plant protection, harvesting and tractor delivery are fulfilled by a 70 kW main and a 60 kW aid machine. For the road transport of the produce a low-cost trailer can be used. With the above method of applying power machines lower acquisition costs and a more effective utilization of power machines can be achieved.

Cucumber production on 20 ha demands 1080 shift hours of machine work, out of which the two lower capacity tractors represent a great proportion, about 800. In comparison to this the 44 shift hour performance of the high capacity power machine in the course of cultivation is negligible. Road transport with its 150 shift hour capacity demand is one of the most time-demanding operations.

The time demand of manipulation is over 500 shift hours, in which the working hours of the smaller capacity machine type UBV are dominant.

CONCLUSIONS AND PROPOSALS

The surveys conducted have proved that the machine work costs of field foil covered cucumber production compared to the production costs of other field vegetable varieties are high.

The significant hand labour demand is characteristic of this product by planting as well as by the preparation of the foil tunnel but first of all by harvesting when the expert and quality work of 28 persons might as well be needed.

A high quality final product can be ensured through hand picking. But it comes at a price. The picking personnel of 16-28 persons represents a remarkable loan cost but knowing the domestic wage levels this cost is not so very remarkable and the competitiveness of production can be ensured.

The present study focuses on the costs of machine operations only the production cost is, therefore, 15 Euro Cent/kg besides a calculated average yield of about 12 t/ha. The cost of hand labour applied during production and the costs of material and other inputs necessary for production were not defined. All these demand further substantial expenditure adding further to the production cost and the cost of the final product.

Table 1: The basic economical data of the operations of cucumber production

Denomination of operation	Type of machine applied in the technology		Shift perfor-mance (ha/h)	Price of		Direct cost of operation		
	working machine	power machine		working machine	power machine	working machine	power machine	total
				(EUR)		(EUR/h)		
Stubble ploughing	Kühne 770-7,2 disc harrow	John Deere 8120	3	19164	141560	10	29	39
Medium deep loosing	RABA 10-14/5	John Deere 8120	1,2	3644	141560	3	29	32
Spreading organic manure	AGRO 65 TSZ tandem	John Deere 6220	0,7	7132	65492	4	16	19
Fertilizer transport	MBP 6,5 R	John Deere 6220	4	6016	65492	2	16	18
Spreading of fertilizer	Tornado 5	John Deere 6620	4	9604	72324	6	19	26
Deep ploughing	Kühne 720-7/6-16-M-TJ	John Deere 8120	1,5	8312	141560	6	29	36
Fertilizer transport	MBP 6,5 R	John Deere 6220	4	6016	65492	2	16	18
Spreading of fertilizer	Tornado 5	John Deere 6620	4	9604	72324	6	19	26
Ploughing processing	S-2 H/M	John Deere 8120	4,8	7452	141560	7	29	37
Seed bed preparation	Lemken Korund 600 K	John Deere 8120	4	14952	141560	9	29	39
Levelling the surface	Kühne KH - 5,6 S	John Deere 6220	3,8	5740	65492	4	16	19
Ridge bed preparation	Hortus HPD-165	John Deere 6620	0,4	10384	72324	12	19	31
Mulching, hauling in the hosepipe	AF 1	John Deere 6620	0,25	4336	72324	3	19	22
Water supply	DETK-115 tanker	John Deere 6220	0,9	6800	65492	4	16	20
Transport of plantlets	MBP - 6,5	John Deere 6220	4	6016	65492	2	16	18
Planting	Fedele Mario	John Deere 6620	0,1	3696	72324	4	19	24
Preparation of foil tunnel	AFF-1000	John Deere 6620	0,2	7480	72324	14	19	33
Irrigation	Nadir		0,25	8800	0	24	0	24
Spray mixture transport (12x)	DETK-115 tanker	John Deere 6620	4,8	6800	72324	4	19	23
Spraying (12x)	Gambetti GB Export 1500/16 v	John Deere 6220	4,8	16236	65492	9	16	25
Picking	Steiger	John Deere 6620	0,2	44000	72324	16	19	35
Transport	MBP - 6,5 – 2 pcs	John Deere 6220		12032	65492	4	16	20
Transport following pregrading	HL 92.02 road	IFA L 60 1218 DSK		7536	33720	3	20	22

The basic economical data of the operations of cucumber manipulation

Denomination of operation	Applied machine acc. to technology		Shift performance	Price of the machine	Cost of electricity	Direct cost of operation	Cost of energy
	type	engine-capacity					
		kW	(t/h)	(EUR)	(EUR/kWh)	(EUR/h)	(EUR/h)
Pregrading	UBV - II	1	0,5	4400	0,088	1,5	0,1
Grading	Fleischmann	8	7	79200	0,088	26,9	0,7

Table 2: The economical indexes of the operations of cucumber production on 20 ha

Denomination of operation	Machine working hour	Direct operational cost of connected machines	Additional operational cost of connected machines	Total operational cost		Cost of operation
				working machine	power machine	
	(h)	(EUR)	(EUR)	(EUR)		(EUR)
Stubble ploughing	6	235	49	74	210	284
Medium deep loosing	16	515	101	54	562	616
Spreading organic manure	28	544	128	141	531	672
Fertilizer transport	5	87	19	12	94	106
Spreading of fertilizer	5	127	26	39	114	153
Deep ploughing	13	465	88	96	457	553
Fertilizer transport	5	87	19	12	94	106
Spreading of fertilizer	5	127	26	39	114	153
Ploughing processing	4	145	31	37	139	176
Seed bed preparation	5	194	40	59	175	234
Levelling the surface	5	96	22	24	94	118
Ridge bed preparation	50	1559	399	812	1146	1958
Mulching, hauling in the hosepipe	80	1743	377	286	1834	2120
Water supply	22	437	94	114	417	531
Transport of plantlets	5	87	19	12	94	106
Planting	200	4708	1065	1188	4585	5773
Preparation of foil tunnel	100	3330	840	1878	2292	4170
Irrigation	80	1920	468	2388		2388
Spray mixture transport (12x)	48	1127	224	251	1100	1351
Spraying (12x)	48	1182	321	591	912	1503
Picking	100	3524	917	2149	2292	4441
Transport	100	1967	440	507	1900	2407
Transport following pregrading	150	3365	479	433	3411	3844
Production technology - total	**1.080**	**27571**	**6192**	**11196**	**22567**	**33763**
Cost per hectare (EUR/ha)						**1688**
The economical indexes of the operations of cucumber manipulation on 20 ha						
Pregrading	480	718 + 42 (Cost of electricity)	218		978	978
Grading	34	915 + 24 (Cost of electricity)	321		1260	1260
Prod. tech. and Grading - total	**1.594**	**29270**	**6731**	**11196**	**24805**	**36001**
Cost per hectare (EUR/ha)						**1800**

ACKNOWLEDGEMENTS

This paper was supported by the ***János Bolyai Research Scholarship*** of the *Hungarian Academy of Sciences.*

REFERENCES

[1] Gockler L., Hajdú J.: Mezőgazdasági gépek ára és üzemeltetési költsége 2004-ben (The Purchase Price and Running Costs of Agricultural Machines in 2004), Mezőgazdasági Gépüzemeltetés 2004. No.1., FVM Mezőgazdasági Gépesítési Intézet. Gödöllő, 2004.
[2] Hajdú J., Jakovác F.: A szántóföldi zöldségtermelés speciális gépei. In: Dimény I., Fenyvesi L., Hajdú J.: Piactudatos zöldségtermelés. MGI könyvek, FVM Mezőgazdasági Gépesítési Intézet, No. 3. 2004, 234. p.
[3] Magó L., Hajdú J., Jakovác F.: Economic of Mechanisation of the Tomato Production Technology, Agricultural Engineering Scientific Journal, Belgrade-Zemun, Serbia and Montenegro, December 2005. Vol XXX. No 4., p. 1-7.
[4] Magó L., Jakovác F.: Economic of the Mechanisation of Foil Covered Field Vegetable Production Technology, Proceedings of the 3rd International Conference "Within the European Union", Mosonmagyaróvár, 6-7. April 2006. Proc. p. 94., CD.
[5] gg Magó L., Hajdú J., Nagy I.: The Economic of the Mechanisation of Field Root Vegetable Production by Ridge-till Technology, Collection of Extent Abstracts of the "2006 CIGR Section VI International Symposium on Future of Food Engineering", Warsaw, Poland, 26-28 April 2006. Proc. p. 136, CD.

EKONOMSKA ANALIZA MEHANIZOVANOG UBIRANJA KRASTAVCA I TEHNOLOGIJA SORTIRANJA

László Magó, Frigyes Jakovác

Hungarian Institute of Agricultural Engineering,
Hungary - 2100 Gödöllő, Tessedik S. u. 4.
E-mail: laszlomago@fvmmi.hu

Sadržaj: Krastavac je jedna od najznačajnijih povrtarskih biljnih vrsta kako za domaću upotrebu tako i kao proizvod namenjen izvozu. Od proizvedenih količina krastavca najznačajnije mesto zauzima krastavac namenjen konzerviranju. Mađarska krastavac gaji na 3000 do 6000 ha.

Godišnja potreba industrije za konzerviranje se kreće od 50 do 60000 t krastavca čije su dimenzije 6-9 cm i 9-12 cm. Iako ubiranje manjih plodova (manji od 6 cm) smanjuje prinos, prihod ostvaren ovom prilikom može biti značajan.

Najbitnija karika u proizvodnom i distributivnom lancu je dobra domaća prerađivačka industrija koja je uslov profitabilnosti i kod izvoza svežeg povrća.

Tema trenutnih istraživanja je mehanizovana proizvodnja krastavca namenjenog za konzerviranje.

Rad daje analizu dosadašnjih tehnološko-tehničkih sistema proizvodnje krastavca na foliji. Cilj analize je prezentovanje dosadašnjih iskustava i rezultata u proizvodnji krastavca a sa aspekta indeksa ekonomičnosti tehničkih sistema potrebnih u ovom proizvodnom sistemu.

Ključne reči*: gajenje na foliji, mehanizacija, ekonomija, investiranje u tehničke sisteme, troškovi korišćenja.*