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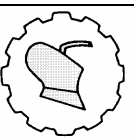

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# ECONOMIC OF MECHANISATION OF THE TOMATO PRODUCTION TECHNOLOGY

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## INTRODUCTION

In this paper the economic investigation of field vegetable production is introduced by using the production technology of the most important vegetable, tomato as examples.

Tomato is one of the most popular vegetables in the world, produced on very large lands. Canning tomato is a very significant vegetable in Hungary as well, traditionally produced on a very large land - 3700-4000 hectares - by transplanting or direct seeding methods.

This paper focuses on introducing the mechanized production technology of direct-seeded canning tomato. The technology was worked out by Róna MgSz (agricultural cooperative) in Szabadszállás.

The paper also aims to promote the popularization of the modern technology of field vegetable production by reviewing production technology and providing useful pieces of information on the operational and economic figures of the machines necessary for production. *(Fenyvesi-Késmárki 2004)* [1]

## THE INTRODUCTION OF THE PRODUCTION TECHNOLOGY

The introduction of the machinery for canning tomato production is shown in Table 1. The table includes the name of operations, the applied machine for each operation and the type of the tractor they are mounted on. The table also show the operational performance of the machine unit (a tractor and a working machine) and the operational performance of the given working machine for the given farming year. It also includes economic data on the investment costs of working machines and tractors, their costs per one operating hour and the costs of operation of the machine unit. *(Gockler-Hajdú 2004)* [2]

Stubble stripping with a disc harrow is very essential to work the stem remains of the fore crop into the soil and to prevent the field from weeding. Stubble stripping is followed by a semi-deep loosening of the soil and then by ploughing. The nutrient supply of soil includes the transport of suspension and spraying. Then the suspension after spraying has to be worked into the soil by a seed-bed former then the surface of the soil has to be levelled a couple of times. Then the appropriate seed-bed has to be formed. The seeds are sowed by twin-row sowing method. Mechanical weed control by using a cultivator is necessary to kill weeds between the rows at least three times during the vegetation period, while nutrient supply is also indispensable. Chemical weed control (spraying) is also necessary at least seven times during the vegetation period. Irrigation in the vegetation period is also very important in order to increase yields and to improve quality. Linear irrigation systems are applied to irrigate onion fields.

In this technology traditional soil cultivation machines are used for preparing the surface of soil. The ACCORD MINIAIR SUPER pneumatic direct seeder is used for sowing, the LINEAR irrigation system is used for irrigation and a row fertiliser broadcaster is used for fertilising crops.

The GUARESI G-89/93 self-propelled tomato harvester – which is equipped with a unit that sorts tomatoes by their colour – is used for harvesting tomato. It lifts, cleans sorts and grades tomatoes in one operation.

### *The introduction of the machines of the technology:*

The ***ACCORD MINIAIR SUPER pneumatic direct seeder*** (Figure 1) is used for sowing vegetables that have small seeds (up to 4 mm). Its parts are: a blow-down-exhaust fan mounted on an axis, adjustable press wheels, a drive and sowing units (with seed discs). The shortest distance between the seeding carts can be 120 mm, but tandem carts can also be applied if necessary, then the distance between the twin-rows will be 80 mm. Coulters, which are appropriate for sowing with 65 mm row distance, can also be mounted on the sowing units. Onion is usually sowed with 12 pieces of twin-sowing units Different seed discs are used for different seeds which means that distance between seeds varies between 20 and 250 mm. Clod sweeps and wheels to compact the soil can be mounted on sowing units in order to achieve better quality sowing.

*Figure 1: ACCORD MINIAIR SUPER pneumatic direct seeder*

The GUARESI G-89/93 self-propelled harvester (Figure 2) is the most important machine in the ***canning tomato production technology***. It lifts tomatoes, separates them from their stem and sorts them by their colour. It is also appropriate for separating stem remains, clods, and damaged tomatoes, and to take the crop to the transport vehicle which is synchronised with the harvester. The performance of the harvester is 20-25 tons an hour if 90 percent of the tomatoes are red. The unit that sorts the tomatoes by their colour can separate 95 percent of green tomatoes from ripe ones.

*Figure 2: The GUARESI G-89/93 self-propelled tomato harvester*

The tomato bushes are lifted from the ground by moving rods and then a knives cuts the roots of the crop just under the surface of the soil. There are rollers under the lifter in order to provide better tracking of the ground and more effective lifting. The lifted bush is taken to a shaker with rods which shakes the tomatoes off their stems by its floating and circular move. Then it takes the stems to the stem wing tripper and the tomatoes to the tomato wing tripper. The stems leave the machine and are dropped on the ground. The tomatoes are taken to the lateral belt and then to the unit which sorts them by their colour. After that they are taken to another sorter and then to the synchronised transport vehicle.

The machine does not cause much damage to the tomatoes. Much more damage is caused during transport, so it is very important to take the crop to the processing company in the shortest possible time.

**The results of the investigations:**

Table 2 shows the results of the economic investigations of tomato production on 100 hectares. The time of the machine operation necessary for the cultivation of 100 hectares was determined for machine units. Then the direct operation costs of machine units were determined which can be calculated as direct machine operation costs per operating hour (Table 1) multiplied by the number of operating hours. Other costs of the machine units were also determined which are affected by the return on fixed and current assets and the fixed costs of farming. The result of the calculations is the costs related to each operation for 100 hectares of land. Adding them the results give the total costs and the specific costs (per hectare) of onion production for 100 hectares.

The operation costs of working machines used in this tomato production technology is 19.876 EUR (15 percent of total machine operation costs) and the operation costs of tractors are 125.772 EUR (85 percent). The total machine operation cost is 145.648 EUR, while its value per hectare is 1456 EUR.

The capacity need of transport during tomato harvest is very high, 2500 operating hours, since in this case crop was directly transported with vehicles of 15 tons of capacity to the processing company which was 80 km away from the place of harvest. Our calculations show that the crop of one hectare requires four turns from transport vehicles. The time of one turn is about 6 hours which means that 4 turns require about 25 hours.

Not surprisingly, 43 percent of the total costs are related to crop transport. It is followed by harvest (25 percent) and the proportion of other operations of the technology is under 4 percent, even under 1 percent in some cases.

The total investment cost of machines in this *canning tomato production technology* is 694.024 EUR of which the cost of working machines is 297.996 EUR (43 percent) and the cost of tractors is 396.027 EUR (57 percent). In this case the investment cost of the self-propelled harvester significantly increases the costs of machines. Despite the fact that machines with low investment and operation costs were applied in this technology for transport tasks, transport costs still remained high. *Canning tomato production* on 100 hectares require 4.698 hours of machine operation of which the transport vehicle works for 2500 hours. The tractor of higher power does not have too many tasks except soil cultivation which means that its operation time is not very high. However tractors of lower power are operated for a much longer period during plant protection and harvest tasks. The operation of the self-propelled harvester is also very significant (500 operating hours). Moreover extra tractor capacity is also required during harvest because it has to draw a trailer synchronised with the harvester to collect the crop because naturally the road transport vehicle is not appropriate for moving slowly beside the harvester.

Harvest is the most costs-demanding of all the operations (75 percent of the total operation cost), followed by soil cultivation (10 percent), plant protection (7 percent), and nutrient supply sowing and irrigation (1-2 percent).

## CONCLUSIONS AND RECOMMENDATIONS

The investigations prove that the machine operation costs of field vegetable production are high. In addition to that the annual utilization level of special harvesters is very low and there are few opportunities to increase it. It is because of the fact that vegetables are produced on smaller territory of land and there is low demand for machine work rent. ***(Nagy 2002).*** [7]

The investigations show that the self-propelled tomato harvester completely utilizes its annual operating hour by harvesting 100 hectares of land, which means that its utilization and specific cost is favourable but very cost-demanding because of the large amount of crops.

92.5 percent of the total machine operation costs of *tomato production* are related to harvest, soil cultivation and plant protection.

The costs of crop transport depend on the distance between the place of harvest and the processing company. Transport costs can be as high as production costs.

*Table 1: The economic figures of the operations of canning tomato production*

| Name of operation | Machines in the technology | | Operational performance | Costs of machines | | Direct machine operation costs | | |
|---|---|---|---|---|---|---|---|---|
| | working machines | tractors | | working machines | tractors | working machines | tractors | total |
| | type | | (ha/h) | (EUR) | | (EUR/h) | | |
| Stubble stripping | KÜHNE KNT-770-7,2 | NH G 190 DT | 3,5 | 18788 | 106910 | 9,7 | 26,6 | 36 |
| Semi-deep loosening | KÜHNE KML-700-3 with 3 knives | NH G 190 DT | 0,8 | 5349 | 106910 | 4,2 | 26,6 | 31 |
| Ploughing | KUHN VARIMASTER 151 5T | NH G 190 DT | 1 | 19341 | 106910 | 6,8 | 26,6 | 33 |
| Levelling of the surface | S-2 H/M | NH G 190 DT | 4,8 | 7306 | 106910 | 7,1 | 26,6 | 34 |
| Suspension transport | DETK-115 | NH TS 90 DT | 6 | 6667 | 54902 | 4,3 | 14,5 | 19 |
| Suspension spraying | HUNIPER HDE 3000MT/18RQ | NH TS 100 DT | 6 | 32714 | 57451 | 34,9 | 15,9 | 51 |
| Working in the suspension | UNIMAT 6,6 | NH G 190 DT | 4,1 | 8384 | 106910 | 9,5 | 26,6 | 36 |
| Levelling of the surface | NSH-3 430/550 | NH TS 90 DT | 3 | 1545 | 54902 | 1,4 | 14,5 | 16 |
| Forming the seed-bed | RAU Terramax | NH G 190 DT | 4,1 | 26114 | 106910 | 13,7 | 26,6 | 40 |
| Sowing in twin rows | ACCORD MINIAIR 12 twin-row | NH TS 100 DT | 2,8 | 47059 | 57451 | 37,6 | 15,9 | 54 |
| Cultivatoring (3 times) | ZSMK 12-row | NH TS 90 DT | 2,4 | 3902 | 54902 | 5,0 | 14,5 | 20 |
| Solid suspension transport | MBP 6,5R | NH TS 100 DT | 4 | 5898 | 57451 | 2,0 | 15,9 | 18 |
| Solid suspension spraying | RCW 5 | NH TS 90 DT | 4 | 8000 | 54902 | 5,9 | 14,5 | 20 |
| Spray transport (7 times) | DETK-115 | NH TS 100 DT | 4,8 | 6667 | 57451 | 4,3 | 15,9 | 20 |
| Spraying (7 times) | GAMBETTI GB EXP 1500/16 | NH TS 90 DT | 4,8 | 15918 | 54902 | 8,9 | 14,5 | 23 |
| Irrigation | VALMANT linear irrigation system | | 1 | 96078 | 0 | 16,5 | 0,0 | 16 |
| Harvest | | GUARESI G-89/93 | 0,2 | | 143706 | | 55,0 | 55 |
| Crop transport | HL 92.02 (road) | IFA L 60 1218 DSK | | 7388 | 33059 | 2,5 | 19,5 | 22 |

*Table 2: The economic figures of the operations of canning tomato production on 100 hectares*

| Name of operation | Machine operation | Direct operation costs of the machine unit | Other costs of the operation of the machine unit | Total machine operation costs | | Operation costs |
|---|---|---|---|---|---|---|
| | | | | working machines | tractors | |
| | (h) | (EUR) | (EUR) | (EUR) | | (EUR) |
| Stubble stripping | 28 | 1016 | 205 | 341 | 880 | 1221 |
| Semi-deep loosening | 125 | 3844 | 778 | 690 | 3932 | 4622 |
| Ploughing | 100 | 3336 | 688 | 879 | 3145 | 4024 |
| Levelling of the surface | 20 | 673 | 141 | 186 | 628 | 814 |
| Suspension transport | 16 | 301 | 62 | 82 | 281 | 363 |
| Suspension spraying | 16 | 812 | 172 | 679 | 305 | 984 |
| Working in the suspension | 24 | 865 | 156 | 266 | 755 | 1021 |
| Levelling of the surface | 66 | 1047 | 216 | 101 | 1162 | 1263 |
| Forming the seed-bed | 24 | 967 | 214 | 426 | 755 | 1181 |
| Sowing in twin rows | 35 | 1872 | 598 | 1803 | 667 | 2470 |
| Cultivatoring (3 times) | 123 | 2398 | 500 | 732 | 2166 | 2898 |
| Solid suspension transport | 25 | 447 | 91 | 61 | 477 | 538 |
| Solid suspension spraying | 25 | 510 | 111 | 182 | 439 | 621 |
| Spray transport (7 times) | 140 | 2826 | 565 | 718 | 2673 | 3391 |
| Spraying (7 times) | 140 | 3283 | 877 | 1694 | 2466 | 4160 |
| Irrigation | 100 | 1647 | 532 | 2179 | | 2179 |
| Harvest | 500 | 27515 | 9148 | | 36663 | 36663 |
| Crop transport | 2.500 | 54989 | 1608 | 7035 | 55741 | 62776 |
| **T o t a l** | **4.698** | **120.277** | **25.371** | **19.876** | **125.772** | **145.648** |
| ***Per one hectare (EUR/ha)*** | | | | | | **1456** |

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## EKONOMSKI ASPEKT MEHANIZOVANE PROIZVODNJE PARADAJZA

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***Sadržaj:*** Paradajz je jedna od najzastupljenijih povrtarskih kultura u svetu. Paradajz, namenjen konzerviranju, posebno je atraktivan u Mađarskoj gde se proizvodi na površini od 3700-4000 ha u tehnologiji sadnje ili direktne setve.

U radu je data ekonomska analiza tehnologije proizvodnje paradajza sa akcentom na tehničke sisteme direktne setve. Cilj rada je introdukovanje savremenih tehnologija proizvodnje povrća primenom povratnih ekonomskih i organizacionih informacija sa terena.