# TILLAGE SYSTEMS AND THEIR EFFICIENCY IN SUGAR BEET CROP AT ALMOS ALFONS MOSEL HANDELS GMBH

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***Abstract.*** *Tillage systems are sequences of operations (tilling, planting, fertilization, pesticide application, harvesting and residue chopping or shredding) which affect the physical and chemical properties of the soil, which in turn affect plant growth. It is essential to develop a right tillage system in crop production, in order to achieve high yields, using machines rationally and effectively. This paper has been released to emphasize the importance of tillage and the importance of choosing the tillage system, in order to achieve qualitative and quantitative superior yields, protecting in the same time the environment. In Almos Alfons Mosel Handels Group, during 2015-2017, sugar beet crop was cultivated in two tillage systems: conventional system and conservative system. The varieties used in this two tillage systems are Magistral and Damian. Efficiency is presented only for these common varieties, to highlight the differences between two variants of tillage systems. In addition to the evolution of soil properties and the efficiency of the tillage system on the biotic factor, we followed the evolution of economic indicators that establish economic efficiency. Economic efficiency is an instrument for evaluating activity, which helps us make the best decisions. The calculation of economic efficiency, at Almos Alfons Mosel Handels Gmbh, represent an important activity because it shows the connection between the resources used and the results achieved. The indicators analysed ware: average production, total expenses, sales revenue, agricultural subsidy, turnover, gross profit, net profit, profit rate. These indicators have been calculated on the basis of the technological data, specific to each tillage system and each year in the study. The turnover, gross profit and net profit have set higher values under no-tillage system, represented by sowing directly in the crop debris of the pre-crop (mustard). Thus, we can conclude that this no-tillage system has a rate of profit that is higher than that obtained under the conventional tillage system.*

***Keywords****: sugar beet crop, tillage systems, economic efficiency*

## INTRODUCTION

Agriculture represent the basis for life, offering to the current generations and future generatios social and economic opportunities. Agrotechnology, focuses on technological processes used in agriculture, has a strong place during this science.

Tillage systems are sequences of operations (tilling, planting, fertilization, pesticide application, harvesting and residue chopping or shredding) which affect the physical and chemical properties of the soil, which in turn affect plant growth. It is essential to develop a right tillage system in crop production, in order to achieve high yields, using machines rationally and effectively.

This paper has been released to emphasize the importance of tillage and the importance of choosing the tillage system, in order to achieve qualitative and quantitative superior yields, protecting in the same time the environment.

## MATERIAL AND METHODS

In Almos Alfons Mosel Handels Group, during 2015 - 2017, sugar beet was cultivated in two tillage systems: conventional system and conservative system. The main feature of conventional tillage system is plowing - which involves inversion of the soil, a conventional

way of seedbed preparation. Conservative system is represented by sowing directly in the crop debris of the precending crop (mustard).

The varieties used in this two systems were Magistral and Damian.

Magistral is a variety of sugar beet crop produced by SES VanderHave with the following characteristics: high tolerance to *Cercospora beticola*, tolerance to abiotic stress, high sugar content, high purity coefficient of the juice.

Damian is a variety of sugar beet crop produced by Strube with the following characteristics: high tolerance to *Cercospora beticola*, tolerance to abiotic stress, late harvest.

The indicators used to establish economic efficiency were: average production, total expenses, sales revenue, agricultural subsidy, turnover, gross profit, net profit and profit rate. The sales revenue calculation is simple. It is the average yield multiplied by the sale price.

Turnover is a useful measure of a business's health and is represented by the revenue from the sale yield plus subsidy.

The gross profit is calculated as sales revenue minus overall expenditure. If profit tax is deducted from the result, we get net profit.

These indicators have been calculated on the basis of the technological data, specific to each tillage system and each year in the study. All of them shows the connection between the resources used and the results achieved.

**RESULTS AND DISCUSSIONS**

Between 2015 - 2016, Magistral Variety was used in tillage systems. The technology applied within the conventional tillage system and conservative tillage system can be seen in the following tables:

*Table 1*

Conventional tillage system, Magistral Variety, 2015 - 2016

| Crop technique | Characteristics |
|---|---|
| Variety | Magistral variety |
| Crop rotation | Precending crop: winter wheat |
| Fertilisation | - complex fertilizer, 16/16/16 - 600 kg/ha dose;<br>- phase fertilizer, Nitrocalcar ( 27% N) - 160 kg/ha dose;<br>- foliar fertilizer, Ferticig (19/19/19) - 2.5 kg/ha dose. |
| Soil tillage | - stubble turning;<br>- plowing 25 cm;<br>- disking;<br>- seedbed preparation. |
| Sowing | - beetwen 23.03.2016 – 28.03.2016;<br>- soil temperature 3-4°C;<br>- seeding rate 1.2 UG/ha;<br>- sowing depth 2 – 3 cm;<br>- line spacing 45-50 cm. |
| Weeds control | - pre-emergent herbicide: Frontier Forte - 0.81 l/ha dose, Pyramin -2.02 l/ha dose, Bostat - 0.27 l/ha dose;<br>- post-emergent herbicide: Tornado - 1.58 l/ha dose, Belvedere - 1.05 l/ha dose, Cliophar - 0.34 l/ha dose, Safari - 0.03 l/ha dose, Gramin - 1.5 l/ha dose. |
| Disease and pests control | - systemic fungicide Score - de 1.09 l/ha dose. |
| Harvesting | Ropa Eurotiger |
| Average yield | - 41500 kg/ha |

*Table 2*

Conservative tillage system, Magistral Variety, 2015 - 2016

| Crop technique | Characteristics |
|---|---|
| Variety | Magistral variety |
| Crop rotation | Precending crop: mustard |
| Fertilisation | - complex fertilizer, 16/16/16 - 520 kg/ha dose;<br>- phase fertilizer, Nitrocalcar ( 27% N) - 140 kg/ha dose;<br>- foliar fertilizer, Ferticig (19/19/19) - 1 kg/ha dose. |
| Soil tillage | - |
| Sowing | - in crop debris of the mustard;<br>- date 22.03.2016 ;<br>- soil temperature 3-4°C;<br>- seeding rate 1.2 UG/ha;<br>- sowing depth 2 cm;<br>- line spacing 45-50 cm. |
| Weeds control | - pre-emergent herbicide: Frontier Forte - 0.8 l/ha dose, Pyramin - 2 l/ha dose, Clinic - 4 l/ha dose;<br>- post-emergent herbicide: Tornado - 1.5 l/ha dose, Belvedere - 1 l/ha dose, Cliophar - 0.34 l/ha dose, Safari - 0.02 l/ha dose, Gramin - 1.05 l/ha dose. |
| Disease and pests control | - systemic fungicide Score - 1 l/ha dose. |
| Harvesting | Ropa Eurotiger |
| Average yield | - 43150 kg/ha |

The indicators used to establish economic efficiency shall record the following specific values:

*Table 3*

Economic efficiency - Conventional tillage system, Magistral Variety, 2015 - 2016

| Indicators | Unit | Value |
|---|---|---|
| Average yield | kg/ha | 41500 |
| Overall expenditure | ron/ha | 6680 |
| Production cost | ron/kg | 0.16 |
| Sale priece | ron/kg | 0.17 |
| Revenue from the sale of yield | ron/ha | 7055 |
| Subsidy | ron/ha | 3510 |
| Turnover | ron/ha | 10565 |
| Gross profit | ron/ha | 375 |
| Net profit | ron/ha | 315 |
| Profit rate | % | 5.61 |

*Table 4*

Economic efficiency - Conservative tillage system, Magistral Variety, 2015 - 2016

| Indicators | Unit | Value |
|---|---|---|
| Average yield | kg/ha | 43150 |
| Overall expenditure | ron/ha | 6452 |
| Production cost | ron/kg | 0.15 |
| Sale priece | ron/kg | 0.17 |
| Revenue from the sale of yield | ron/ha | 7335.5 |
| Subsidy | ron/ha | 3510 |
| Turnover | ron/ha | 10845.5 |
| Gross profit | ron/ha | 883.5 |
| Net profit | ron/ha | 742.14 |
| Profit rate | % | 13.69 |

Between 2016 - 2017, Damian Variety was used in tillage systems. The technology applied within the conventional tillage system and conservative tillage system can be seen in the following tables:

*Table 5*

Conventional tillage system, Damian Variety, 2016 – 2017

| Crop technique | Characteristics |
|---|---|
| Variety | Damian variety |
| Crop rotation | Precending crop: winter wheat |
| Fertilisation | - complex fertilizer, 16/16/16 - 600 kg/ha dose;<br>- phase fertilizer , Urean ( 32% N) - 180 kg/ha dose. |
| Soil tillage | - stubble turning;<br>- scarification;<br>- plowing 25 cm;<br>- disking;<br>- seedbed preparation. |
| Sowing | - beetwen 25.03.2017 – 29.03.2017;<br>- soil temperature 3-4°C;<br>- seeding rate 1.2 UG/ha;<br>- sowing depth 2 – 3 cm;<br>- line spacing 45-50 cm. |
| Weeds control | - pre-emergent herbicide: Frontier Forte - 1 l/ha dose, Pyramin - 2.12 l/ha dose;<br>- post-emergent herbicide: Tornado- 1.52 l/ha dose, Belvedere - 1.01 l/ha dose, Pantera - 0.94 l/ha dose, Lontrel - 0.34 l/ha dose, Gramin - 1.26 l/ha dose, Safari - 0,02 l/ha dose, Trend - 0.20 l/ha dose. |
| Disease and pests control | - treatment with boron - 3 l/ha dose. |
| Harvesting | Ropa Eurotiger |
| Average yield | - 42000 kg/ha |

*Table 6*

Conservative tillage system, Damian Variety, 2016 - 2017

| Crop technique | Characteristics |
|---|---|
| Variety | Damian variety |
| Crop rotation | Precending crop: mustard |
| Fertilisation | - complex fertilizer, 16/16/16- 540 kg/ha dose;<br>- phase fertilizer, Urean ( 32% N) - 160 kg/ha dose. |
| Soil tillage | - |
| Sowing | - in crop debris of the mustard;<br>- date 24.03.2017 ;<br>- soil temperature 3-4°C;<br>- seeding rate 1.2 UG/ha;<br>- sowing depth 2 cm;<br>- line spacing 45-50 cm. |
| Weeds control | - pre-emergent herbicide: Frontier Forte - 1 l/ha dose, Pyramin - 2 l/ha dose;<br>- pre-emergent herbicide: Tornado- 1.7 l/ha dose, Belvedere - 1 l/ha dose, Pantera - 0.90 l/ha dose, Lontrel - 0.24 l/ha dose, Gramin - 1.18 l/ha dose, Safari - 0,02 l/ha dose, Trend - 0.30 l/ha dose. |
| Disease and pests control | - systemic fungicide Score - 1.2 l/ha dose. |
| Harvesting | Ropa Eurotiger |
| Average yield | - 43500 kg/ha |

The indicators used to establish economic efficiency shall record the following specific values:

*Table 7*

Economic efficiency - Conventional tillage system, Damian Variety, 2016 – 2017

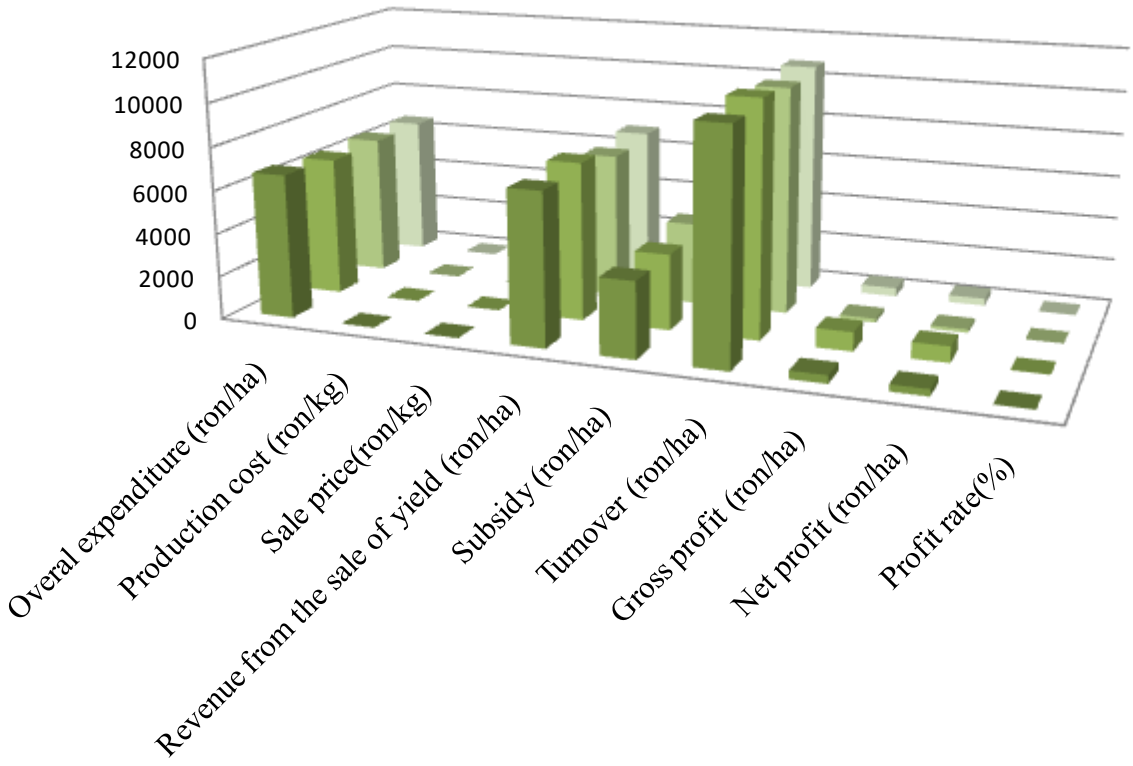
| Indicators | Unit | Value |
|---|---|---|
| Average yield | kg/ha | 42000 |
| Overall expenditure | ron/ha | 6532 |
| Production cost | ron/kg | 0.15 |
| Sale priece | ron/kg | 0.16 |
| Revenue from the sale of yield | ron/ha | 6720 |
| Subsidy | ron/ha | 3800 |
| Turnover | ron/ha | 10520 |
| Gross profit | ron/ha | 188 |
| Net profit | ron/ha | 157.92 |
| Profit rate | % | 2.88 |

*Table 8*

Economic efficiency - Conventional tillage system, Damian Variety, 2016 – 2017

| Indicators | Unit | Value |
|---|---|---|
| Average yield | kg/ha | 43500 |
| Overall expenditure | ron/ha | 6560 |
| Production cost | ron/kg | 0.15 |
| Sale priece | ron/kg | 0.16 |
| Revenue from the sale of yield | ron/ha | 6960 |
| Subsidy | ron/ha | 3800 |
| Turnover | ron/ha | 10760 |
| Gross profit | ron/ha | 400 |
| Net profit | ron/ha | 336 |
| Profit rate | % | 6.10 |

The efficiency of conventional and conservative tillage systems, at sugar beet crop, Magistral and Damian varieties, beetwen 2015 - 2017, is summarized in the next figure:




| | Overal expenditure (ron/ha) | Production cost (ron/kg) | Sale price(ron/kg) | Revenue from the sale of yield (ron/ha) | Subsidy (ron/ha) | Turnover (ron/ha) | Gross profit (ron/ha) | Net profit (ron/ha) | Profit rate(%) |
|---|---|---|---|---|---|---|---|---|---|
| Conv., Magistral | 6680 | 0,16 | 0,17 | 7055 | 3510 | 10565 | 375 | 315 | 5,61 |
| Cons., Magistral | 6452 | 0,15 | 0,17 | 7335,5 | 3510 | 10845,5 | 883,5 | 742,14 | 13,69 |
| Conv., Damian | 6532 | 0,15 | 0,16 | 6720 | 3800 | 10520 | 188 | 157,92 | 2,88 |
| Cons., Damian | 6560 | 0,15 | 0,16 | 6960 | 3800 | 10760 | 400 | 336 | 6,10 |

Figure 1. The evolution of economic indicators, sugar beet crop, 2015-2017

## CONCLUSIONS

Under no-tillage system, sugar beet plants were more vigorous, well developed foliar apparatus and the sugar beet root recorded a higher weight. The average yield has set higher values in conservative system.The revenue from the sale of yield were influenced by average yield and influence the gross profit .

The gross profit, as the figure from results and discussions show, have higher values under no-tillage system. Also, the rate of profit is higher than that obtained under the conventional tillage system.

Thus, we can conclude under conservative system, represented by sowing directly in the crop debris of pre-crop (mustard), economic indicators have registered higher values.

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