

INFLUENCE OF DIFFERENT TILLAGE SYSTEMS ON THE BEHAVIOR OF A CORN HYBRID CULTIVATED IN THE AREA GĂLĂȚUI-CĂLĂRAȘI

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Abstract

This paper present the results obtained for the corn crop grown in 2016 under the pedological and climatic conditions of South Romania, Călărași County. The research aimed to analyze the influence of different soil tillage systems on the development and yield of a hybrid corn belonging to the FAO group 350. The variants studied were part of the conventional tillage system (20 cm plowing, 30 cm plowing) and minimum tillage system (30 cm scarification, 40 cm scarification, 20 cm Tiger 3 MT, 30 cm Tiger 3 MT). Under the influence of different soil tillage systems, the highest grain yield (8,065.3 kg/ha) was obtained at 30 cm plowing, with plants characterized by a height of 220.5 cm, and a LAI of 2.50. The lowest grain yield was generated by the tillage 20 cm Tiger 3 MT and had a value of 4775.7 kg/ha.

Key words: conventional tillage, minimum tillage, corn yield, LAI.

INTRODUCTION

Corn is one of the most important cereal crops, and due to its many uses and to the possibility of being cultivated in different climatic conditions is ranked second in the world, by area cultivated (184.8 million ha), after wheat (Roman et al., 2011; FAO, 2014).

Plants' development, corn's yields and weeds' level of development are directly influenced by tillage (Cociu., 2011; Rusu et al., 2013; Aikins et al., 2012 cited by Ion et al., 2015; Chețan et al., 2016).

The need to reduce input costs, along with the necessity to preserve soil water and other soil resources, determined the extension of research regarding the use of minimum tillage systems in corn's production technology (Hatfield, 1994; Gus et al., 2003; Li and Mu, 2006 Jităreanu et al., 2006; Marin et al., 2011; Gao et al., 2012; Moraru and Rusu, 2013).

Nevertheless, although the use of minimum tillage system ensures a lower consumption of energy, the yield generated can be smaller than the corn yield generated when using a conventional tillage system (Rusu et al., 2009; Gus et al., 2011; Marin et al., 2011; Rusu., 2014; Marin et al., 2015).

Thus, field experiences conducted in Romania, by Rusu et al., (2009) showed that the corn yield generated by the minimum tillage system represented 92.1% to 97.9% of the yield generated by the conventional tillage system.

MATERIALS AND METHODS

The research was conducted in 2016, in Călărași county, village Gălățui (N - 44 15'56 "E - 27° 6'55") at an altitude of 12 m above sea level.

The area is part of Mostiștea Plain, a subdivision of the Romanian Plain. In terms of climate, the area is characterized by a multi-annual thermal regime with values around 11°C and an average annual hydric regime of 500 mm.

The experimental surface was organized by a block design with three replications, using the following experimental variants:

Conventional tillage system:

- V₁ - 20 cm plowing
- V₂ - 30 cm plowing

Minimum tillage system:

- V₃ - 30 cm scarification
- V₄ - 40 cm scarification
- V₅ - 20 cm Tiger 3 MT
- V₆ - 30 cm Tiger 3 MT

An early corn hybrid (FAO 350 - DKC 4590) was used as a biological material, and the previous crop was winter wheat.

Fertilization was made using a complex of macro-elements (NPK) in a dose of 50 kg a.s./ha of each element, applied before sowing.

The sowing was carried out on 9th of April with SPC8 sowing-machine, at a distance of 70 cm between rows, providing a density of 60,000 plants harvested per hectare. Crops maintenance consisted in a pre-emergent application of herbicides (immediately after sowing) using the commercial product ADENGO in a dose of 0.40 l/ha, and a post-emergent use of the commercial herbicide ELUMIS, in a dose of 1.5 l per ha, carried out during the 7-8 leaf stage (61 days after sowing).

RESULTS AND DISCUSSIONS

Soil tillage influence on corn height (cm), Gălățui, 2016

Plants height under the influence of different tillage systems was evaluate when corn plants had the most intense growth. This was determined as shown in Table 1, at 57 days after sowing (June 4th), 61 days after sowing (June 18th) and 85 days after sowing (July 2), when 96% of plants' height was reached.

At 57 days after sowing (Figure 1 - left) the average plant high of the studied tillage systems was 42.5 cm and differences between tillage types were already visible.

Thus, plants height ranged from 37.2 cm (- 12.8% compared to control - 20 cm plowing) obtained at 20 cm Tiger 3 MT to 48.1 cm (+ 6.4% compared to control) recorded at 30 cm plowing.

Table 1. Corn plants' height development in 2016

Variants	Date					
	June 4th (cm)	%	June 18th (cm)	%	July 2 (cm)	%
20 cm plowing (Ct)	45.2	100	84.5	100	213.2	100
30 cm plowing	48.1	106.4	109.5	129.6	220.5	103.3
30 cm scarification	39.6	87.6	75.0	88.8	188.3	88.3
40 cm scarification	42.5	94.0	79.5	94.1	210.4	98.7
20 cm Tiger 3 MT	37.2	82.3	62.5	74.0	176.8	82.9
30 cm Tiger 3 MT	39.4	87.2	66.5	78.7	182.6	85.6
Avg. variants	42.0	92.9	79.6	94.2	198.6	93.1

At 85 days after sowing (July 2, Figure 1 - right), plants average height was 198.6 cm, the highest plants being recorded for 30 cm

plowing (220.5 cm), with 3.3% higher than the height of plants obtained for the control tillage (20 cm plowing). The smallest plant height, 176.8 cm, was obtained when using 20 cm Tiger 3 MT tillage, the height value being 17.1% lower than plants' height obtained for the control tillage (20 cm plowing).



Figure 1. Corn crop at Gălățui (Călărași): Left - June 4th; Right - July 2; (original photo)

Soil tillage influence on corn leaf area index (LAI), Gălățui, 2016

In 2016, average LAI of corn cultivated at Gălățui (Călărași) under different tillage systems was 2.01 (Tabel 2).

Table 2. Soil tillage influence on corn leaf area index (LAI)

Variants	LAI	%	Diff.	Signf.
20 cm plowing (Ct)	2.31	100	Ct	-
30 cm plowing	2.50	108.2	0.19	***
30 cm scarification	1.79	77.5	- 0.52	Ooo
40 cm scarification	2.24	97.0	- 0.07	Ns
20 cm Tiger 3 MT	1.44	62.3	- 0.87	Ooo
30 cm Tiger 3 MT	1.80	77.9	- 0.51	Ooo
Avg. variants	2.01	87.2	- 0.30	Ooo

LSD 5% = 0.07; LSD 1% = 0.10; LSD 0.1% = 0.14

The highest LAI value recorded was 2.50, obtained for 30 cm plowing, this value was 8.2% higher than the value generated by the control tillage (20 cm plowing), the difference being statistically assured.

The lowest LAI value was recorded at 20 cm Tiger 3 MT, 1.44 respectively, being 37.7% smaller than the value obtained in control. The LAI difference between 20 cm plowing (control) and 20 cm Tiger 3 MT was strongly negative.

Soil tillage influence on corn yield, Gălățui, 2016

The conventional tillage system (20 cm plowing, 30 cm plowing) assured, in the field conditions of Gălățui, an average corn yield of 7,753.5 kg/ha, while the minimum tillage system generated an average corn yield of 5,920.7 kg/ha (Table 3).

The corn yield in minimum tillage system was lower compared to the yield obtained in the conventional tillage system. Thus, the yield for the minimum tillage system accounted for 76.4% of the yield recorded in the conventional tillage system. The yield difference obtained as a result of applying minimum tillage, compared to conventional tillage (control), was -1,832.7 kg/ha, which is very significant in statistical terms.

Table 3. Corn yield conventional tillage vs. minimum tillage, 2016

Variants	Kg/ha	%	Diff. kg	Signf.
Conventional tillage	7,753.5	100	Ct	-
Minimum tillage system	5,920.7	76.4	1,832.7	ooo
Average	6,837.1	88.2	-916.4	oo
LSD 5% = 357.2 kg/ha; LSD 1% = 655.5 kg/ha LSD 0.1% = 1450.5 kg/ha				

In the soil and climatic conditions of the research area, for the agricultural year 2015 - 2016, data in Table 4 highlights that the tillage system affects the grain yield of corn.

The best corn yield of 8,065.3 kg/ha was obtained for 30 cm plowing, with a distinctly significant yield increase of 8.4% compared to the yield obtained in control tillage (20 cm plowing), with a value of 7,444.16 kg/ha. Increased production resulting from 30 cm plowing was statistically assured.

Table 4. Corn yield influenced by different tillage systems, 2016

Variants	Kg ha ⁻¹	%	Diff.	Signf.
20 cm plowing (Ct)	7,441.6	100	Ct	-
30 cm plowing	8,065.3	108.4	623.7	**
30 cm scarification	5,863.5	78.8	-1,571.1	ooo
40 cm scarification	7,631.2	102.5	189.6	ns
20 cm Tiger 3 MT	4,775.7	64.2	-2,665.9	ooo
30 cm Tiger 3 MT	5,412.5	72.7	-2,029.1	ooo
Avg. variants	6,531.6	87.8	-910.0	ooo
LSD 5% = 250.0 kg/ha; LSD 1% = 345.6 kg/ha; LSD 0.1% = 477.7 kg/ha				

Regarding the minimum tillage system works, they recorded lower yields compared to conventional tillage (20 cm plowing), and

differences were in most cases statistically assured. Thus, for the 20 cm scarification tillage the yield was with 1,571.1 kg/ha lower than the yield obtained for the control variant, the difference being highly significant in statistical terms.

Regarding the 30 cm scarification tillage, yields for this tillage type was slightly higher compared to Control (20 cm plowing), with a difference of +189.6 kg/ha, but the yield increase was not statistically assured. For the soil tillage using 20 cm Tiger 3 MT the yield obtained had a value of 4,775.7 kg/ha, with 2,665.9 kg smaller than the yield obtained for 20 cm plowing (control), the statistical difference being highly significant. The 30 cm Tiger 3 MT tillage generated a corn yield of 5,412.6 kg/ha, representing 72.7% of the yield obtained for 20 cm plowing (control). Thus, the yield obtained for this tillage system was -2,029.1 kg/ha smaller than the yield obtained for Control (20 cm plowing), the difference between the two variants being statistically.

CONCLUSIONS

The influence of different tillage systems on the behavior of the corn hybrid researched in the soil and climatic conditions of Gălățui area is reflected by differences in plants' development and in grain productions obtained depending on the applied soil tillage, as follows: plants' height recorded the best value (220.5 cm), for 30 cm plowing (conventional system), with 3.3% higher than the height obtained for the control tillage; Leaf area index ranged from 1.44 (minimum system - 20 cm Tiger 3 MT) to 2.50 (30 cm plowing - conventional system); corn yield recorded values between 4,775.7 kg/ha (-35.8% compared to 20 cm plowing-control), when applying soil tillage 20 cm Tiger 3 MT, and 8,065.3 kg/ha (+8.4% compared to 20 cm plowing- control) when applying 30 cm plowing.

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