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RESEARCH ON CORN HYBRIDS BEHAVIOR UNDER THE APPLICATION OF NEW TECHNOLOGICAL CONCEPTS IN OSMANCEA-CONSTANTA AREA

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ABSTRACT

The emergence of new growing concepts aiming to achieve the biological yield potential of crops, soil conservation and the increase in economic efficiency, had also an echo in the agriculture of Dobrogea area. Farmers were involved in finding the best solutions to achieve these goals. Research conducted at SC Micul Agricultor SRL farm, located in Osmancea, Constanta County is an example in this direction. This research aimed to establish the corn hybrids best adapted to the climatic and pedologic conditions of the area, and the most efficient soil tillage system and to optimize crop fertilization.

For this purpose, the behavior of Mas 40 F, Dartona and P 9911 corn hybrids was studied under conventional (plowing) and minimum soil tillage (tiger and disk) for the following fertilization levels: unfertilized, $N_{90}P_{40}K_{40}$ and $N_{90}P_{40}K_{40}$ + Greenstart - 25 kg/ha.

The best results were obtained when using tiger to perform basic soil tillage and fertilizing with $N_{90}P_{40}K_{40}$ + 25 kg/ha Greenstart. For this variant, all hybrids had the highest yields ranging from 13.56 to 13.93 t/ha.

INTRODUCTION

Conventional agriculture, based on plowing as an intensive soil tillage, has disadvantages as high costs and the uneven distribution of inputs compared to the expected efficiency, high energy and labor inputs and low productivity, much more it involves major risks in terms of soil degradation and environmental pollution (Cociu I. Al., 2011).

Used correctly, tillage favor soil self-repairing processes and increase its productive potential (Ankwe M.A., 2007).

Conservative agriculture is of great importance for stopping soil degradation, leads to a good capitalization of rainfalls and irrigation water, diminishing climate change effects, reducing costs and, last but not least, increasing productivity (Sayre K.D., 2010).

Yield level and its quality are the result of the interaction between soil nutrition conditions and climatic conditions (Frye W.W., 1991).

Soil does not need too much tillage. Oxygen surplus leads to burning

soil humus and disturbing soil balance (Berca M., 2011).

Along other factors, soil tillage contributes by nearly 20% to corn yield (Khurshild K., 2006).

The average corn yield recorded under the conditions of INCDA Fundulea, during 2007-2015, was significantly lower under conventional soil tillage (plowing) compared to no-tillage or minimum soil tillage (chisel, scarified) (Cociu Al., 2017).

The energy consumed is different depending on the equipment used for soil tillage, as follows: plowing - 5325 kwh/ha, chisel 20 cm - 5137 kwh/ha, chisel 40 cm - 5219 kwh/ha and disk - 5031 kwh/ha (Marin D.I.,2015).

In sustainable agriculture, fuel costs are lower by 12-58% compared to deep plowing technology. Also, the maximum pollution level was recorded for deep plowing (Šarauskis J., 2015).

Soil tillage has a great influence on weed species development, each tillage system favoring the growth of certain species. Plowing and disk favor *Sorghum halepense* and *Cirsium arvense species* (Duary B., 2016).

Under the conditions of Dobrogea, the optimal sowing period for corn is from April 1st to April 20th (Bîlteanu Gh., 1998).

Corn responds differently to sowing density depending on its genetic potential, different densities having a significant effect on yield (Luque S.F., 2006, Bayram G., 2016).

Conservative soil tillage includes a wide variety of methods, from direct sowing (no-tillage, direct drill) to deep tillage without turning the furrow (Guş P., 2003).

The experience of the countries where the conservative agriculture has expanded shows that this is of great importance in stopping soil degradation, leads to a good capitalization of rainfall water and irrigation water, diminishes climate change effects, reduces costs and, last but not least, increases productivity (Sayre K.D., 2010).

Research on corn hybrids using conventional tillage and minimum tillage has demonstrated the superiority of minimum tillage on morphological and yield characteristics (Oncica Maria Cristina, 2016).

Research on the influence of soil tillage on corn yield confirmed that the smallest yield was achieved by disk tillage (Marin D.I., 2015).

Balanced fertilization is one of the main factors contributing to increased yield and its quality (Filipović Adrijana, 2016).

Applying nitrogen and phosphorus, in the form of complex fertilizers, stimulates the absorption of phosphorus by corn plants (Albineţ E., 2004).

In lack of fertilization yields decrease year after year, due to the decrease in soil fertility (Kumar R., 2000).

Adding a dose of starter fertilizer with nitrogen and phosphorus at the level of seed incorporation had the effect of increasing yield (Muşat M., 2013).

Current progress depends on farmers' interest in practicing a high-performance agriculture, at global standards.

MATERIALS AND METHODS

Research was conducted in 2017 in the field conditions of Osmancea, Constanta County, at the farm SC Micul Agricultor SRL.

The soil type on which the experience was placed was cambic chernozem of the Chernozem group. In the plowing layer, the soil is neutral (pH =7.1), medium supplied in humus (2.38%), well supplied with phosphorus (139.8 ppm), and well supplied with potassium (214.8 ppm).

Osmancea, Constanţa County, is located in a temperate continental area with a multiannual average temperature (average 30 years) of 12.1°C. The average annual temperature, recorded in 2017, was 12.8 °C with 0.7 °C above the multiannual average.

During the analyzed period, although higher than the multiannual average, temperatures were favorable for corn crop. The exception, however, was the minimal April temperatures that were low, prolonging germination. They had a monthly average of 4.2°C. Monthly average crop temperatures (April to August) were higher compared to the multiannual average except April (10.1°C vs. 10.3°C multiannual average).

The normal amount of rainfall for the Osmancea area is 430.2 mm. In 2017, 569.5 mm of rainfalls was recorded, 139.3 mm higher than the multiannual value. This was due to the fact that in the third decade of July the rainfall recorded 113 mm, in the form of a torrential rain that was not properly used by corn crop. Between April and July there were more rainfall compared to the multiannual value, allowing a good development of corn crops. August recorded similar values compared to the multiannual value in term of rainfall (5.2 mm less).

The experiment had a 3 x 3 x 3 split plot design, in three replications with the following factors: Factor A = soil tillage: a_1 = plowing (Ct), a_2 = tiger, a_3 = disk; Factor B = fertilization: b_1 = NPK – 0 (Ct), b_2 = $N_{90}P_{40}K_{40}$, b_3 = $N_{90}P_{40}K_{40}$ + Greenstart – 25 kg/ha; Factor C = hybrid: c_1 = MAS 40 F, c_2 = Dartona and c_3 = P 9911.

Corn was sown after winter wheat (*Triticum aestivum*). Soil tillage and fertilization were performed according to experimental practices. Seedbed was prepared in spring by disking. Sowing was carried out randomized at a density of 63.000 germinating seed/ha at 5 cm depth. Seeds were treated with fungicides and insecticides by the seed supplier.

Weed control was conducted preemergent using the commercial product Wing P (212,5 g/l *dimetenamid-P* and 250 g/l *pendimetalin*) at a dose of 3,5 l/ha. At the stage of 4-6 leafs REKORD™ (0.4 l/ha Callam® (12,5% *tritosulfuron* + *60% dicamba*) + 0,7 l/ha Samson® Extra 6 OD (60 g/l *nicosulfuron*) + 1 l/ha DASH® HC (plant growth regulator) was applied. Weeds extent was determined by the numerical and gravimetric method.

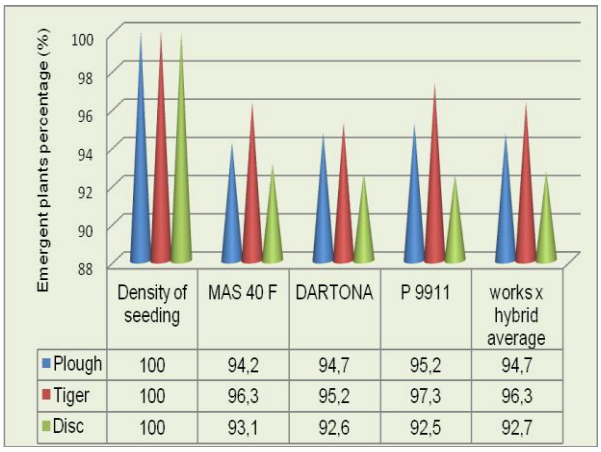
RESEARCH RESULTS

Soil tillage and hybrid influence on corn plants emergence

In 2017, within Micul Agricultor farm, Osmancea it was found that soil tillage and hybrid influenced the percentage of emerged plants. At plowing the percentage of emerged corn plants was 94.2% for MAS 40 F, 94.7% for Dartona and 95.2% for P9911. The percentage of sprouted plants grew when using tiger to 96.3% for MAS 40 F, 95.2% for Dartona and 97.3% for P9911. The use of disk to perform the basic soil tillage resulted in a decrease of the percentage

of sprouted seedlings for all hybrids, as follows: MAS 40 F – 93.1%, Dartona – 92.6% and P9911 – 92.5%.

Tiger soil tillage resulted in the highest percentage of sprouted seedlings as an average of the three hybrids, of 96.3% (Figure 1).



	Density of seeding	MAS 40 F	DARTONA	P 9911	works x hybrid average
Plough	100	94,2	94,7	95,2	94,7
Tiger	100	96,3	95,2	97,3	96,3
Disc	100	93,1	92,6	92,5	92,7

Figure 1. Percentage of sprouted plants according to soil tillage and hybrid, Osmancea

Soil tillage influence on weed species composition in the corn crop

Weed species were: *Convolvulus arvensis*, *Sorghum halepense* from seeds and rhizomes and *Xanthium spinosum*. Sun-flower plants were also found due to the fact that it was a pre-plant from 2015.

The highest density was recorded by *Sorghum halepense* from the seeds: 13.1 plants/sqm for plowing, 16.1 plants/sqm for tiger and 38.2 plants/sqm for disk. Throughout the crop, areas of *Sorghum halepense* from rhizomes was reported.

The total number of weeds/sqm increased according to soil tillage, from 20.1 (plowing) to 31.2 (tiger) and to 55.4 (disk).

Weeds fresh biomass varied according to their density/sqm. The highest weeds biomass was recorded for plowing – on average of 45 g/sqm. Tiger and disk, soil tillage systems that do not involve turning the furrow, resulted in a decrease of fresh weeds biomass with values of 32.5 g/sqm and 37.2 g/sqm. Dry biomass of weeds recorded values between 2.4 g/sqm (tiger) and 2.9 g/sqm (disk)(Figure 2).

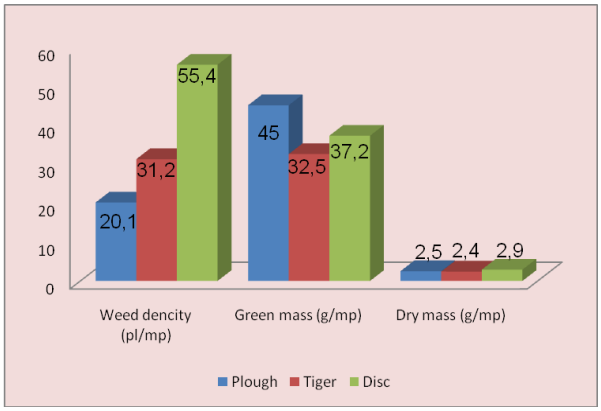


Figure 2. Soil tillage influence on weed species composition in the corn crop, Osmancea

Since the crop was treated with herbicides and harrowed, weeds had not developed and had not influenced corn yield.

Soil tillage and fertilization influence on corn yield

The results of the research carried out under the conditions of Osmancea – Constanţa, at Micul Agricultor farm, highlighted the fact that the basic soil tillage, fertilization and hybrids had a decisive influence on the achievement of large and stable corn yield.

Control value, against which yield increases were calculated in 2017 was the variant plowing and unfertilized for the hybrids MAS 40 F, Dartona, P9911 and their average.

Yield increases for MAS 40 F hybrid compared to the control plowing-unfertilized variant were very significant. The exception was the variant tiger-unfertilized with a yield growth of 0.45 t/ha, which was distinctly significant. When disk tillage was conducted for the unfertilized variant the yield difference recorded compared to control was very significant negative and had a value of 0.97 t/ha (Table 1).

Table 1

Soil tillage and fertilization influence on corn yield of the hybrid MAS 40 F (t/ha), Osmancea

Soil tillage	Fertilization	MAS 40 F		
		Yield (t/ha)	(%)	Diff. (t/ha)
Plowing	Unfertilized	8,71	100	Ct
	$N_{90}P_{40}K_{40}$	10,75	123	2,04***
	$N_{90}P_{40}K_{40}$+Gr	13,47	155	4,76***
Tiger	Unfertilized	9,16	105	0,45**
	$N_{90}P_{40}K_{40}$	12,80	147	4,09***
	$N_{90}P_{40}K_{40}$+Gr	13,77	158	5,06***
Disk	Unfertilized	7,74	89	-0,97ooo
	$N_{90}P_{40}K_{40}$	9,57	110	0,86***
	$N_{90}P_{40}K_{40}$+Gr	11,04	127	2,33***

Dl 5%=0,33 t/ha; Dl 1%=0,49 t/ha; Dl 0,1%=0,75 t/ha
Gr = Greenstart-25kg/ha

Table 2

Soil tillage and fertilization influence on corn yield of the hybrid Dartona (t/ha), Osmancea

Soil tillage	Fertilization	DARTONA		
		Yield (t/ha)	(%)	Diff. (t/ha)
Plowing	Unfertilized	8,55	100	Ct
	$N_{90}P_{40}K_{40}$	11,01	129	2,46***
	$N_{90}P_{40}K_{40}$+Gr	13,00	152	4,45***
Tiger	Unfertilized	8,96	105	0,41*
	$N_{90}P_{40}K_{40}$	12,11	142	3,56***

	$N_{90}P_{40}K_{40}$+Gr	13,56	159	5,01***
Disk	Unfertilized	7,5	88	-1,05ooo
	$N_{90}P_{40}K_{40}$	9,84	115	1,29***
	$N_{90}P_{40}K_{40}$+Gr	11,35	133	2,8***

Dl 5%=0,41 t/ha; Dl 1%=0,57 t/ha; Dl 0,1%=0,79 t/ha
Gr = Greenstart-25kg/ha

Dartona hybrid achieved very significant yield increases for all variants compared to control, except for tiger-unfertilized variant, with a yield increase of only 0.41 t/ha, not significant in statistical terms. For disk soil tillage in the unfertilized variant, yield recorded was lower compared to control, with a very significant difference of 1.05 t/ha (Table 2).

Yield increases compared to control, plowing-unfertilized variant, for the hybrid P9911 were not significant (0.05 t/ha) for the variant tiger-unfertilized, very significant negative for disk-unfertilized (1.12 t/ha), distinctly significant positive for disk and fertilization level $N_{90}P_{40}K_{40}$ (0,78 t/ha) and very significant for the other variants (table 3).

Table 3

Soil tillage and fertilization influence on corn yield of the hybrid P9911 (t/ha), Osmancea

Soil tillage	Fertilization	P9911		
		Yield (t/ha)	(%)	Diff. (t/ha)
Plowing	Unfertilized	9,1	100	Ct
	$N_{90}P_{40}K_{40}$	11,44	126	2,34***
	$N_{90}P_{40}K_{40}$+Gr	13,64	150	4,54***
Tiger	Unfertilized	9,05	99	-0,05ns
	$N_{90}P_{40}K_{40}$	12,37	136	3,27***
	$N_{90}P_{40}K_{40}$+Gr	13,93	153	4,83***
Disc	Unfertilized	7,98	88	-1,12oo
	$N_{90}P_{40}K_{40}$	9,88	109	0,78**
	$N_{90}P_{40}K_{40}$+Gr	12,28	135	3,18***

Dl 5%=0,56 t/ha; Dl 1%=0,80 t/ha; Dl 0,1%=1.17 t/ha
Gr = Greenstart-25kg/ha

Considering the average yield of the three hybrids for the variant plowing-unfertilized as control, yield increases of other variants were very significant (except tiger and disk for the unfertilized level).

Yield increase of tiger-unfertilized compared to control was not statistically significant.

Yield difference of disk variant compared to control was very significant negative with a value of 1.05 t/ha (table 4).

Table 4

Soil tillage and fertilization influence on corn yield (hybrids average) (t/ha), Osmancea

Soil tillage	Fertilization	Hybrids average		
		Yield (t/ha)	(%)	Diff. (t/ha)
Plowing	Unfertilized	8,8	100	Ct
	$N_{90}P_{40}K_{40}$	11,1	126	2,28***
	$N_{90}P_{40}K_{40}$+Gr	13,4	121	4,58***
Tiger	Unfertilized	9,1	68	0,27ns
	$N_{90}P_{40}K_{40}$	12,4	137	3,64***
	$N_{90}P_{40}K_{40}$+Gr	13,8	111	4,97***
Disk	Unfertilized	7,7	56	-1,05ooo
	$N_{90}P_{40}K_{40}$	9,8	126	0,98***
	$N_{90}P_{40}K_{40}$+Gr	11,6	118	2,77***

Dl 5%=0,43 t/ha; Dl 1%=0,62 t/ha; Dl 0,1%=0,90 t/ha

1000 grains weight (TGW)

Compared to the average 1000 grains weight of the three hybrids for the control variant plowing-unfertilized, it was found that most of the tested variants recorded very significant positive differences with values between 3.1 and 93.9 g, except for disk – unfertilized variant.

Soil tillage performed with tiger influenced 1000 grains weight of all hybrids, thus TGW for this variant compared to control was 9.6 g higher in the unfertilized variant, 63.2 g higher in the variant fertilized with $N_{90}P_{40}K_{40}$ and 93.9 g higher in the variant fertilized with $N_{90}P_{40}K_{40}$ and Greenstart.

1000 grains weight for the variant disk-unfertilized was lower compared to control with a very significant negative difference of 22.5 g. For the fertilization level $N_{90}P_{40}K_{40}$ 1000 grains weight of the three hybrids was by 3.1 g higher compared to control, while by using starter fertilization, TGW increased by 36.1 grams (table 5).

Table 5

Soil tillage and fertilization influence on 1000 grains weight (g), Osmancea

Soil tillage	Fertilization	Hybrids average		
		TGW (g)	(%)	Diff. (g)
Plowing	Unfertilized	232,8	100	Ct
	$N_{90}P_{40}K_{40}$	267,3	114,8	34,5***
	$N_{90}P_{40}K_{40}$+Gr	315,2	135,4	82,5***

Tiger	Unfertilized	242,3	104,1	9,6***
	$N_{90}P_{40}K_{40}$	296,0	127,2	63,2***
	$N_{90}P_{40}K_{40}$+Gr	326,7	140,3	93,9***
Disk	Unfertilized	210,2	90,3	-22,5ooo
	$N_{90}P_{40}K_{40}$	235,9	101,3	3,1***
	$N_{90}P_{40}K_{40}$+Gr	268,9	115,5	36,1***

Dl 5%=1,25 g; Dl 1%=1,68 g; Dl 0,1%=2,23 g

CONCLUSIONS

Climate conditions, soil tillage, and hybrids have influenced the percentage of emerging plants. Tiger had the greatest influence on the percentage of sprouting seedling, which was on average 96.3% hybrids. For this variant P9911 hybrid recorded the highest percentage of 97.3%.

Soil tillage also influenced the number of weeds and their dry and fresh biomass. Due to the fact that the weeds were control by rational crops rotation, the floral composition was limited to weed species more difficult to control: *Convolvulus arvensis, Sorghum halepense* from seed and rhizomes and *Xanthium spinosum*. The basic soil tillage carried out with disk resulted in the largest number of weeds per sqm - 55.4. Plowing and turning the furrow, led to the lowest number of weeds per sqm - 20.1.

Soil tillage, fertilization and hybrids influenced corn yield and 1000 grains weight. The best yield results were obtained for tiger and the fertilization level $N_{90}P_{40}K_{40}$ + 25 kg / ha Greenstart was fertilized. Under these conditions, MAS 40 F hybrid achieved 13.77 t/ha, DARTONA hybrid recorded 13.56 t ha and P9911 hybrid obtained 13.93 t/ha. The average yield of the hybrids was 13.8 t/ha.

1000 grain weight recorded the highest value of 326.7 g in the tiger variant, fertilized with $N_{90}P_{40}K_{40}$ + 25 kg / ha Greenstart.

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