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MAIZE CULTIVATION IN NO-TILLAGE SYSTEM BY USING THE REGINA MODEL OF THE GASPARDO SOWING MACHINE

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Abstract

Maize one of is the main plant for the economy of Romania. Many researchers from various countries such as the USA, Italy, Spain, former Yugoslavia, Hungary, Russia and Bulgaria approached the issue of weed control for the specific weeds affecting maize crops.

Studies were also performed in Romania on control of annual and perennial weeds for the no-tillage system and numerous articles were published on this issue at various national and international symposiums by Sarpe and his collaborators (1968, 1970, 1984, 1993, 2000, 2005, 2008).

The results obtained in the specific conditions of the Flood Plain of the Danube river indicate that the maize grain yields recorded have been practically equal for the two systems, conventional and no-tillage. However, big differences have been recorded in terms of fuel consumption. The fuel consumption per hectare amounted to 86 litres in the conventional system, while it went down to a mere 6 litres per hectare in the no-tillage system. The expenses incurred in the conventional system for the mechanical works and manual hoeing sessions amounted to RON 1,305.00/hectare and to only RON 50.00/hectare in the no-tillage system.

INTRODUCTION

I believe that when MAN became a "farmer", he used "at the beginning" the "no-tillage system" in unploughed land and without any other soil tilling. In order to sow the wheat and maize grains he used rudimentary tools made of sharpened stone, flint stone and animal bones. This is why we can assert that the PRIMITIVE no-tillage system is 10,000 or even 20,000 years old. In his book entitled "**Cultivated plants**", Mr. Balteanu Gheorge (1979) says that "*it is estimated that the maize (zea mays) was cultivated as early as **4,400-5,000 years before J.C.***" At that time, of course, the maize was already cultivated in ploughed land, which is by applying the conventional method, and weed control was performed by manual hoeing.

"Minimum tillage" is the method by which the plough is no longer used, it being replaced by the chisel (which mobilizes the soil 15-18 cm deep). This operation is

obviously cheaper than ploughing and in our country it has been applied (and it is still used) in wheat cultivation, especially when autumns are droughty.

Plant cultivation **without ploughing**, as well as without any other soil tilling work was developed by English specialists back in the 1930s, based on using the Reglone herbicide as total herbicide, before the wheat or barley is sowed in unploughed land.

The modern method of the no-tillage system spread around rapidly, being applied on millions of hectares in the USA and Latin America only after 1957, when the Swiss company Geigy synthesized the herbicide atrazin, which is super selective for maize cultivation.

Why did the Americans and the English have the IDEA of cultivating plants in unploughed land? Well, the answer is: the no-tillage system appeared **not as a fashion** but as an **economic necessity** for the following issues to be tackled:

- reduction of fuel consumption;
- reduction of investments in agricultural machines and equipment;
- reduction of human and mechanical labour;
- increased labour efficiency;
- prevention of soil erosion;
- reduction of production costs;
- increase of net profit per cultivated hectare.

Since 1965, the no-tillage system has been studied and many studies were published in specialized magazines, national and international symposiums (Sarpe et al.: 1968, 1970, 1974, 1984, 1986, 1993, 2000, 2004, 2005, 2008).

RESULTS AND DISCUSSIONS

The experiments were performed in the specific conditions of the Flood Plain of the Danube River, at the company named SC Agrofam-Holding, Fetesti, Ialomita County. The results regarding selectivity of used herbicides are presented in Table 1 hereinafter.

Analyzing the data listed in table 1, one can notice that the herbicide Gardoprim Plus Gold 500 SC applied in a dose of 5.0 liters/ha was very selective as far as the maize plants are concerned. Throughout the entire period of vegetation, starting from the springing phase until plant coming into ears, no phytotoxicity symptoms were recorded.

The herbicide Ceredin was applied in the 4-5-leaf stage of the maize plant. Considering the data listed in table 1, we can notice that it was scored with the 1.0 EWRS grade, which means that the maize plants tolerated very well the Ceredin herbicide. The herbicide Mistral Turbo was also applied in the 4-5-leaf stage of the maize plant. Applied in doses of 1.5 and 3.0 liters/ha, this herbicide was also tolerated well by the maize plants. The land where the respective experiment was

carried out was infested mainly by perennial species such as *Sorghum halepense, Cirsium arvense, Senecio vulgaris* and *Polygonum hydropiper*.

Table 1

Selectivity of the herbicides applied to maize crop
SC Agrofam Holding, Fetesti, 2005-2008

Applied herbicides	Rates (l/ha)	Time of application	EWRS grades
I. Conventional System			
1. Mechanical hoeing (hoed 3 times)	—	—	1.0
2. Not hoed	—	—	1.0
II. No-tillage system			
3. Untreated	-	-	1.0
4. Gardoprim Plus Gold 500 SC	5.0	preem.	1.0
5. Gardoprim Plus Gold 500 SC +	5.0	preem.	1.0
Ceredin EC	1.0	postem.	1.0
6. Gardoprim Plus Gold 500 SC +	5.0	preem.	1.0
Ceredin EC + Mistral Turbo	1.0 + 1.5	postem.	1.0
7. Gardoprim Plus Gold 500 SC +	5.0	preem.	1.0
Ceredin EC + Mistral Turbo	1.0 + 3.0	postem.	1.0
EWRS Grades = 1.0 without any phytotoxicity symptom 9.0 The ratio in which the plants are destroyed amounts to 90-95% plants are destroyed			

The results regarding the level of chemical weed control are presented in table 2.

The level of weed control recorded in the no-tillage system depended on the herbicides applied. In variant number 4 treated with Gardoprim Plus Gold 500 SC, only the annual weeds were controlled, and all the perennial weeds proved to be resistant to the respective herbicide. That is why the level of chemical control recorded in variant number 4 was of only 52%. However, in variant 5, when the Ceredin herbicide was added, which controlled very well the perennial dicotyledonous species such as *Cirsium arvense* and *Polygonum hydropiper*, the level of weed control went up to 75%, no control being recorded in *Sorghum halepense.* In variant number 6 the herbicide Mistral Turbo was applied postemergently at the same time with the herbicide Ceredin. Because of the fact that the Mistral Turbo was applied in a small rate of only 1.5 liters/ha, *Sorghum halepense* was controlled only partially – the control level amounting to 82%. In this variant, *Sorghum halepense* **regenerated** – new viable offshoots and rhizomes appeared.

Table 2

Chemical weed control recorded in maize crop
SC Agrofam Holding, Fetesti, 2005-2008

Dominant weed species			
1. Sorghum halepense	*5. Senecio vernalis*		
2. Echinochloa crus-galli	*6. Cirsium arvense*		
3. Chenopodium altum	*7. Amaranthus retroflexus*		
4. Abutilon theophrasti	*8. Polygonum hydropiper*		
Applied herbicides	**Rates (l/ha)**	**Time of application**	**Weed control (%)**
I. Conventional system			
1. Mechanical hoeing (hoed 3 times)	—	—	93
2. Not hoed	—	—	0
II. No-tillage system			
3. Untreated	-	-	0
4. Gardoprim Plus Gold 500 SC	5.0	preem.	52
5. Gardoprim Plus Gold 500 SC	5.0	preem.	75
+ Ceredin EC	1.0	postem.	
6. Gardoprim Plus Gold 500 SC	5.0	preem.	82
+ Ceredin EC + Mistral Turbo	1.0 + 1.5	postem.	
7. Gardoprim Plus Gold 500 SC	5.0	preem.	100
+ Ceredin EC + Mistral Turbo	1.0 + 3.0	postem.	

In the no-tillage system, the best control rate of all the weeds including *Sorghum halepense*, that is a 100% rate, was recorded in variant number 7, in which three herbicides were applied: Gardoprim Plus Gold 500 SC in a rate of 5.0 liters/ha, Ceredin 1.0 liter/ha + Mistral Turbo in a rate of 3.0 liters/ha – the last one destroying totally the *Sorghum halepense*.

In table 3 hereinafter we present the grain yield recorded.

Analyzing the data from table 3, we can see that the conventional system, in variant number 1, the grain yield recorded amounted to 9,980 kg/ha – the annual and perennial weeds being destroyed by 3 mechanical hoeing operations between the rows and 3 manual hoeing operations on the maize row. As for the 2nd variant, which was not hoed, because of the weeds, only an insignificant yield of maize grains of 1,397 kg/ha was obtained.

In the no-tillage system, in the 3rd variant, which was not treated with herbicides, the maize grain yield recorded was very low, namely 1,396 kg/ha. The grain yield recorded in the variant number 4, treated only with Gardoprim Plus Gold 500 SC was of only 5,109 kg/ha, as the respective herbicides does not control the perennial weed species such as *Cirsium arvense, Polygonum hydropiper, Sorghum halepense*, etc. In the variant number 5, which beside the Gardoprim was also

treated postemergently with Ceredin, the grain yield amounted to 7,484 kg/ha. The grain yield was even higher, namely to 8,483 kg/ha in the variant number 6, treated with the herbicides Gardoprim + Ceredin + Mistral Turbo. However, in the no-tillage system the highest grain yield was recorded again in the 7th variant, which was treated with 3 herbicides: Gardoprim Plus 500 SC in a rate of 5.0 liters/ha + Ceredin CE in a rate of 1.0 liter/ha + Mistral Turbo in a rate of 3.0 liters/ha. We must mention that pursuant to the application of these three herbicides, al the annual and perennial weeds, including *Sorghum halepense* were completely, meaning 100% destroyed.

Table 3

Yield of maize grains
SC Agrofam Holding, Fetesti, 2005-2008

Applied herbicides	Rates (l/ha)	Time of application	Weed control (%)	
			kg/ha	%
I. Conventional system				
1. Mechanical hoeing (hoed 3 times)	—	—	9.980	100
2. Not hoed	—	—	1.397	14
II. No-tillage system				
3. Untreated	-	-	1.396	14
4. Gardoprim Plus Gold 500 SC	5.0	preem.	5.189	52
5. Gardoprim Plus Gold 500 SC + Ceredin EC	5.0 1.0	preem. postem.	7.485	75
6. Gardoprim Plus Gold 500 SC + Ceredin EC + Mistral Turbo	5.0 1.0 + 1.5	preem. postem.	8.483	85
7. Gardoprim Plus Gold 500 SC + Ceredin EC + Mistral Turbo	5.0 1.0 + 3.0	preem. postem.	10.279	103

When calculating the economic efficiency of the two technological systems: conventional and no-tillage, only the mechanical works were taken into account. Herbicide application was not taken into account, as the respective herbicide application operations were executed equally in both technological systems. Weed control in the conventional system was achieved by performing 3 mechanical hoeing rounds and 3 manual hoeing rounds. In the minimum and the no-tillage system, weed control was performed by chemical means, namely by application of the herbicides Gardoprim Plus Gold 500 SC, Ceredin EC and Mistral Turbo.

The fuel consumption recorded is presented in table 4 hereinafter. Analyzing the data thereof, we shall see that the consumption recorded in the conventional system for the various mechanical works performed (ploughing, disking etc.) amounted to 86 liters of diesel fuel per hectare.

The lowest fuel consumption was recorded in the no-tillage system. For the sowing round performed by the Regina model of Gaspardo sowing machine, a low consumption of only 6 liters per hectare was recorded. In conclusion, 80 liters of fuel were saved in the no-tillage system as compared to the conventional system.

Table 4

Fuel consumption at two technological systems
SC Agrofam Holding, Fetesti, 2005-2008

Conventional system		**No-tillage system**	
Mechanical works performed	Consumption (litres/ha)	Mechanical works performed	Consumption (litres/ha)
1. Autumn ploughing + harrowing	30.0	1. ----------	—
2. Springtime harrowing	14.0	2. ----------	—
3. Springtime disking + harrowing	14.0	3. ----------	—
4. Springtime disking + harrowing	5.0	4. ----------	—
5. Laboured by combinator			
Mechanical works performed	6.0	5. ----------	—
	Consumption litres/ha	Mechanical works performed	Consumption litres/ha
6. Sowed by SPC 8	5.0	6. Sowed by Gaspardo Regina	6.0
7. 1st mechanical hoeing round	4.0	7. ----------	—
8. 1st manual hoeing round	-	8. ----------	—
9. 2nd mechanical hoeing round	4.0	9. ----------	—
10. 2nd manual hoeing round	-	10. ----------	—
11. 3rd mechanical hoeing round	4.0	11. ----------	—
12. 3rd manual hoeing round	-	12. ----------	
Total consumption	**86.0**	**Total consumption**	**6.0**

The data presented in table 5 and regarding the expenses incurred with the mechanical and manual works in the two technological systems are even more important from an economical point of view. Analyzing the information provided in table 5, we can see that the expenses made for the mechanical and manual works in the conventional system amounted to an aggregate of RON 1,305.00/hectare.

A dramatic diminution of the expenses was achieved in the no-tillage system, where they amounted to a mere RON 50.00/hectare, which is RON 1,255.00 /hectare less as compared to the conventional system.

Table 5

Cost of mechanical and manual works performed at the two technological systems SC Agrofam Holding, Fetesti, 2005-2008

Conventional system		No-tillage system	
Mechanical works performed	RON/ha	Mechanical works performed	RON/ha
1. Autumn ploughing + harrowing	250.00	1. ----------	—
2. Springtime harrowing	30.00	2. ----------	—
3. Springtime disking + harrowing	60.00	3. ----------	—
4. Springtime disking + harrowing	60.00	4. ----------	—
5. Laboured by combinator	35.00	5. ----------	—
6. Sowed by SPC 8	48.00	6. Sowed by Gaspardo Regina	50.00
7. 1st mechanical hoeing round	24.00	7. ----------	—
8. 1st manual hoeing round	250.00	8. ----------	—
9. 2nd mechanical hoeing round	24.00	9. ----------	—
10. 2nd manual hoeing round	250.00	10. ----------	—
11. 3rd mechanical hoeing round	24.00	11. ----------	—
12. 3rd manual hoeing round	250.00	12. ----------	—
Total expenses	**1,305.00**	**Total expenses**	**50.00**

CONCLUSION

1. Compared to the conventional system, in the no-tillage system there is a significant reduction in terms of fuel consumption, 80 liters of Diesel fuel per hectare being saved.
2. Any agricultural company can buy a Regina sowing machine (or almost two sowing machines of the said type) with the money saved by using less fuel if they sow 1,000 hectares of maize and soybean in one single year.

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