INFLUENCE OF DIFFERENT CROP MANAGEMENT SYSTEMS FOR SUNFLOWER IN SOUTHERN OF ROMANIA

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ABSTRACT

Field experiments were conducted during the period 1990-1999 at the Research Institute for Cereals and Industrial Crops of Fundulea - Romania, on a cambic chernozem soil with 2.8% organic matter and 33.8% clay content in arable layer. The paper presents some aspects regarding the influence of different soil tillage methods (mouldboard plow, chisel, paraplow, disking), sowing time and plant density, on sunflower yield under dryland conditions. Conventional tillage had a major action in weed control and ensured the best soil conditions for plant growing, such as a better air porosity index and low values of bulk density in all soil layers. No-tillage method was not beneficial for sunflower cropping. The results have shown constant yield levels from year to year in mouldboard plow as compared to no-tillage which determined yield decreasing up to 16.8% after ten years of experimentation. Sowing time and plant density influenced the yield level. Generally, climatic conditions (rainfall, air temperature) were the main factors which determined the levels of both yield and quality for sunflower seeds. Sowing in the first decade of April, using 45,000-55,000 seeds/ha led to the highest yields. Reduced tillage, usually, worsened soil drainage capacity, increased soil compaction, weed infestation and didn't, however, guarantee good conditions for crop growth.

Key words: seed quality, soil physical properties, soil tillage, sowing time, sunflower yield, weed infestation.

INTRODUCTION

Reduced tillage presents both advantages and disadvantages. Among the most important advantages there are: controlling soil erosion (Schertz, 1988), decreasing fuel and labour and increasing soil water infiltration (Hill and Blevins, 1973; Blevins et al., 1983). Among disadvantages very significant are weed infestation and grain yield reduction (Milton et al., 1986; Sin et al., 1995).

Our objectives were to show the effect of different soil tillage methods on some soil physical properties, weed infestation, sunflower yield and its quality.

MATERIALS AND METHODS

The studies were conducted between 1990-1999 at the Research Institute for Cereals and Industrial Crops, Fundulea. The soil is a medium cambic chernozem, well drained, formed on loess, with 33.8% clay content and 2.8% organic matter in arable layer.

The experiments were stationary, organized in 4 replications.

Soil tillage methods consisted in mouldboard plow (conventional tillage) at 28-30 cm depth, chisel, paraplow, disking and no-tillage.

Studies about the effect of sowing time and density were organized with the following treatments: sowing at April 10-15, May 1-5 and May 20-25 and 3 levels of density, i.e. 25,000 seeds/ha, 45,000 seeds/ha and 65,000 seeds/ha.

Observations and measurements concerning changes of soil physical properties, yield components and the main yield indices were also made. The results were calculated by conventional statistical methods for field trials.

RESULTS AND DISCUSSIONS

Tillage of agricultural soils is defined as the manipulation, generally mechanical, of soil properties in order to modify soil conditions for crop production. Specific reasons for tilling a soil include: weed control, incorporation of different materials (amendments, fertilizers, pesticides or crop residues) and modification of soil physical properties, thereby improving soil conditions for crop establishment, growth and yield.

Soil bulk density has a major impact on soil-water relationships and crop root development and, consequently, on crop growth and yield.

The data from table 1 show the highest bulk density of 1.50 g/cm^3 in no-tillage plot in all layers of soil.

It can be seen a moderate soil compaction near traffic zones in plowing, chisel, paraplow and disking treatments. No-tilled plot shows a secondary effect on soil compaction in 10-20 cm layer, determined by annual traffic.

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Table 1. Effect of soil tillage methods on main physical indices of the soil (before sowing). Fundulea, 1990 – 1999

Soil physical properties (Indices)	Soil tillage methods	Layer of soil, cm				
		0 - 10	10 - 20	20 - 30	30 - 40	0 - 40
Bulk density (g/cm^3)	Plowing (Control)	1.26	1.35	1.46	1.44	1.40
	Chisel	1.25 a*	1.39 a	1.47 a	1.46 a	1.39 a
	Paraplow	1.31 a	1.42 a	1.49 a	1.46 a	1.42 a
	Disking	1.35	1.45 b	1.44 a	1.43 a	1.41 a
	No-tillage	1.51 b	1.53 c	1.49 a	1.48 a	1.50 b
	LSD (P=0.05)	0.10	0.09	0.08	0.09	0.09
Total soil porosity (%)	Plowing (Control)	52.9	46.9	45.7	46.5	48.1
	Chisel	53.5 a	48.2 a	44.7	45.5 a	47.9 a
	Paraplow	51.2 a	45.8 a	44.6 a	45.7 a	46.8 a
	Disking	49.6 a	47.0 a	46.4 a	46.5 a	47.4 a
	No-tillage	43.5 c	42.7 b	44.3 a	45.1 a	43.9 b
	LSD (P=0.05)	4.5	3.2	3.4	2.9	4.1
Air soil porosity (%)	Plowing (Control)	21.3	11.6	9.2	8.1	12.3
	Chisel	22.2 a	12.8 a	11.5 a	10.3 a	14.2 a
	Paraplow	18.4 a	11.7 a	6.4 a	8.5 a	11.2 a
	Disking	15.6 a	7.5 a	6.5 a	6.7 a	9.1 a
	No-tillage	9.5 c	9.3 a	7.4 a	5.6 a	7.9 b
	LSD (P=0.05)	6.8	5.4	4.2	2.7	4.3

*) The values followed by the same latter are not significantly different at the P=0.05 confidence level according to Duncan's new multiple range test.

Table 2. Effect of soil tillage methods on available water (m^3/ha) at sowing time. Fundulea, 1990-1999

Soil tillage methods	Layer of soil, cm		Average, cm	
	0 - 50	50 - 100	100 - 150	0 - 150
	---------- m^3/ha ----------			
Plowing (Control)	805	734	682	2221
Chisel	755 a*	733 a	678 a	2166 a
Paraplow	782 a	736 a	713 a	2231 a
Disking	743 a	696 a	657 a	2096 b
No-tillage	706 b	723 a	738 a	2167 a
LSD (P=0.05)	93	84	78	85

*) The values followed by the same latter are not significantly different at the P=0.05 confidence level according to Duncan's new multiple range test.

Total soil porosity (%) and aired porosity (%) are indirectly correlated with bulk density. We can notice a significant decreasing of these indices in no-tillage plot which was maintained in all soil depth layers analysed (Table 1).

Regarding the available water at sowing time it is obvious that conventional tillage and no-tillage have determined a higher conservation of water in soil, as compared with disking method (Table 2). This similar effect could be explained by the maintaining of crop residues on the soil surface in no-tillage treatment, which decreases soil water evaporation and increases water infiltration on 0-150 cm soil layer.

In no-tillage and disked plots weed infestation increased significantly up to 80.2% at the beginning of growing period and up to 379.4% at harvesting, as compared to conventional tillage (Figure 1). An intermediate weed infestation was found in the case of chisel and paraplow treatments. The mouldboard plowing decreased the weed infestation up to 57.4% as compared to no-tillage treatment. Direct drilling had a higher weed infestation by 14.3 g/m^2 before first weeding and presented the same aspect at harvesting by 135.9 g/m^2 dry matter weeds.

The tillage methods concerning soil physical properties as well as available water content at sowing time and weed infestation influenced the seed yield. Sunflower seed yield was more or less the same in mouldboard plow, chisel, paraplow and disked, as compared with no-tillage (Table 3).

Direct drilling determined an important decreasing of seed yield by 7.8 q/ha as compared with mouldboard plow treatment.

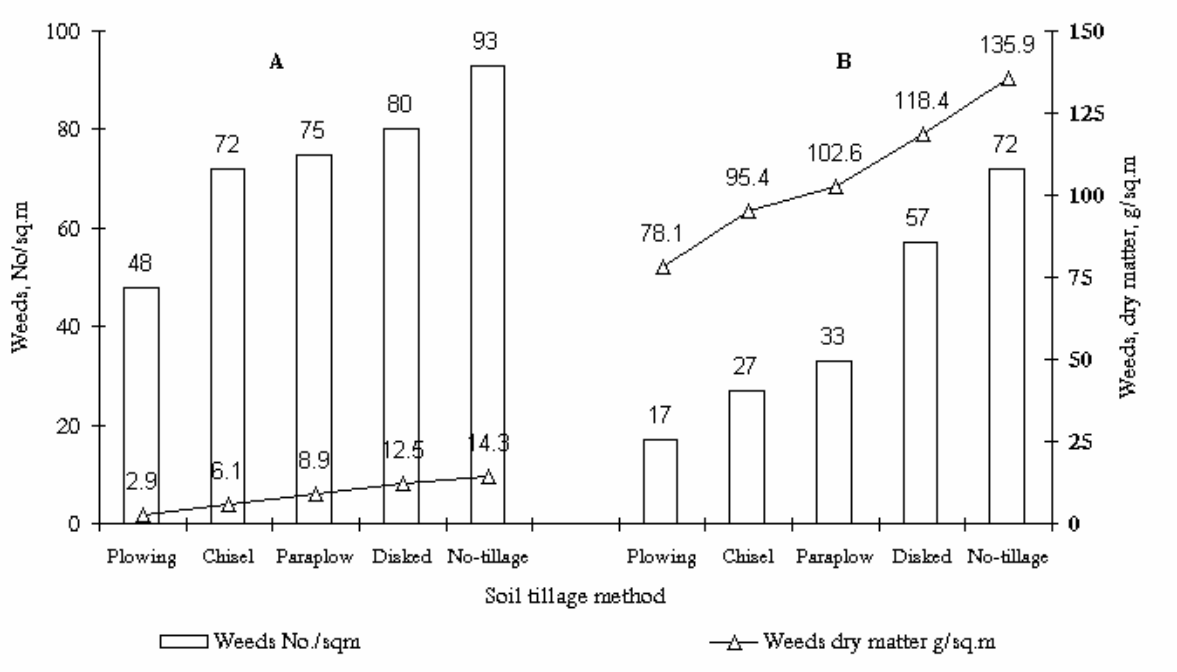

Figure 1. Effect of soil tillage method on weed infestation in sunflower crop. Before first weeding (A) and at harvesting time (B)

Table 3. Effect of soil tillage methods on sunflower yield and their quality indicators. Fundulea, 1990-1999

Soil tillage methods	Seed yield q/ha	Oil content %	Oil yield/ha kg	Quality indicators	
				weight of 1000 seeds, g	weight of hl, kg/100 l
Plowing (Control)	22.6	49.45	1115.3	48.7	40.7
Chisel	21.1 a*	50.70	1068.0 a	48.2 a	39.5 a
Paraplow	22.9 a	50.70	1165.8 b	48.5 a	38.8 b
Disking	21.6 a	50.48	1092.0 a	47.6 a	39.3 a
No-tillage	18.8 b	50.18	941.5 d	47.4 a	39.2 a
LSD (P=0.05)	3.5		44.6	1.7	1.6

*) The values followed by the same latter are not significantly different at the P=0.05 confidence level according to Duncan's new multiple range test.

Regarding the data for sowing time, the trial was carried out in three variants: sowing in April 10-15, sowing in May 1-5, and sowing in May 20-25 period.

In the case of the first sowing time, in April 10-15, higher seed yield was registered for the whole experimentation period (1990-1999).

Delay of sowing gave a significant yield decreasing up to 1.2 q/ha for sowing in May 1-5 and up to 2.4 q/ha for sowing in May 20-25, respectively. Relationships between yield of seeds in the case of sowing under optimal conditions and delay of sowing show a direct correlation having the coefficients of correlation of r=0.882***, respectively r=0.816** (very significantly and distinct significantly) (Figure 2).

Sunflower production was also influenced by density at sowing (Zaffaroni and Schneiter, 1991). Our experiment confirmed an optimum sowing density by using a number of 45,000 seeds/ha. Using a low density, till 25,000 seeds/ha a decreasing of yield production, by 4.5 q/ha was recorded. A little increasing of yield production was possible if a higher sowing density, of over 45,000 seed/ha, or 65,000 seeds/ha was applied.

Studies regarding the relationships between different levels of plant density showed a good plant arrangement if a density of about 45,000-55,000 seeds/ha was used at sowing.

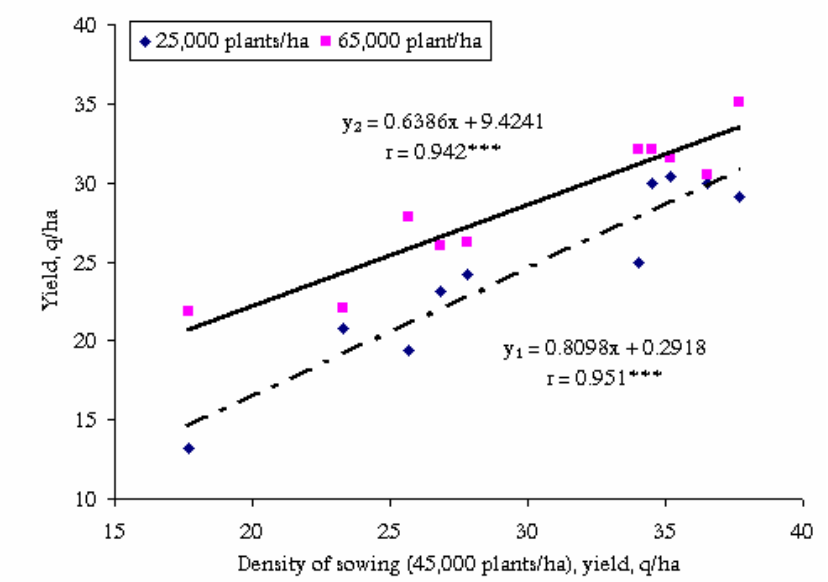

Figure 2. Relationships between sowing time and delay of sowing on sunflower yield. Fundulea, 1990-1999

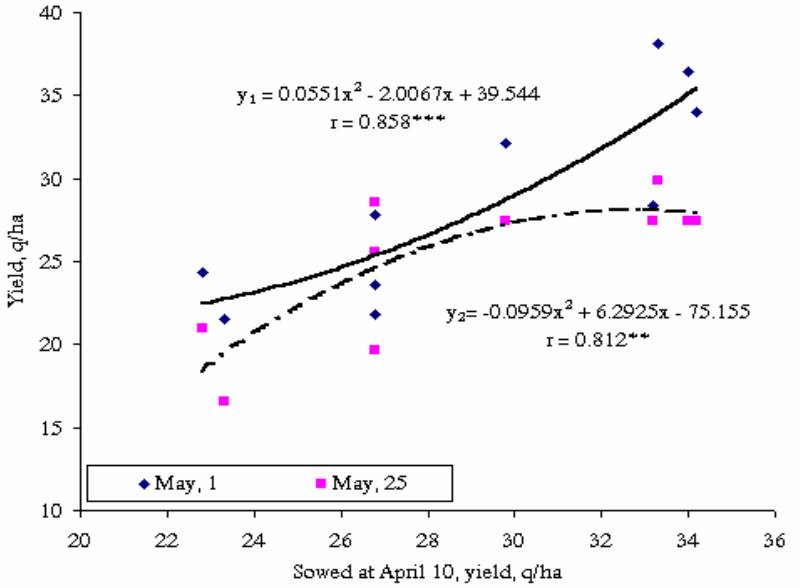

Figure 3. Relationships between optimum density at sowing and different variants of density on sunflower yield. Fundulea, 1990-1999

Data from figure 3 confirm the existence of direct relations between yield and density at sowing, indicated by the two coefficients of correlation r=0.953*** and r=0.990***, with their respective statistical significance.

CONCLUSIONS

Reduced tillage worsened soil drainage capacity, reduced the available water, increased soil compaction and weed infestation, and didn't, however, guarantee good conditions for crop growth.

Information on soil tillage system is necessary in sunflower cropping for maximize and improve the quality and the level of yield.

Time of sowing and plant density had a great influence on yield in sunflower cropping. Delayed sowing and low density couldn't assure economical yields.

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	zero-tillage	1.51 b	1.53 c	1.49 a	1.48 a	1.50 b
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	Disking	15.6 a	7.5 a	6.5 a	6.7 a	9.1 a
	zero-tillage	9.5 c	9.3 a	7.4 a	5.6 a	7.9 b
	LSD (P=0.05)	*6.8*	*5.4*	*4.2*	*2.7*	*4.3*

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Fig. 1.

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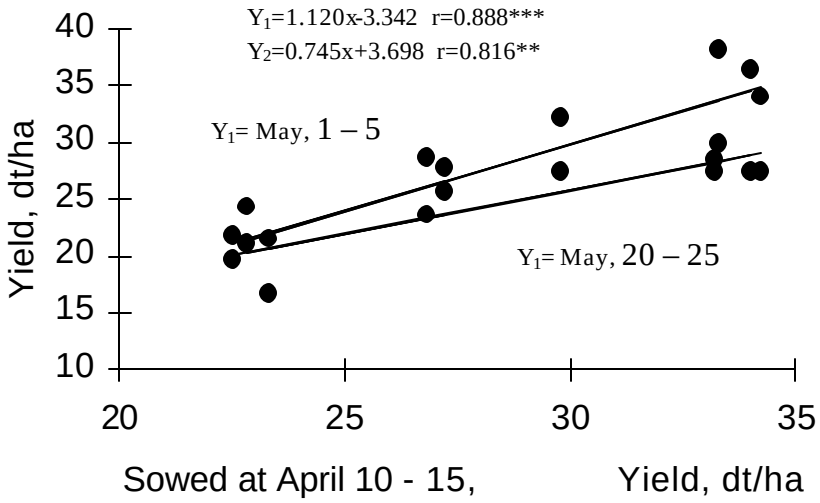

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