Some aspects of sunflower crop management in Romania

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ABSTRACT

The paper presents some research results regarding the technological management of sunflower, with the following conclusions: (i) sunflower should not be sown in the same field more than once every 6 years, avoiding the alternance with soybeans, due to the potential attack of *Sclerotinia*; (ii) the possibility of reducing soil tillage for fuel saving, without a yield decrease; (iii) the establishment of optimal sowing time in connection with soil temperature; (iv) optimal plant density varying between 40–50 thousands plants/ha. Although sunflower is a tolerant crop to dryness, the association between water deficit and high temperatures during the growing season caused very important yield losses and decreased the seed oil content.

Key words: plant density – Romania – *Sclerotinia* – soil tillage – sowing time – sunflower management.

INTRODUCTION

Sunflower is the main oleaginous crop in Romania, cultivated on an area that doubled in the 1990's, attaining 1 million hectares. The favorable market price sustained by the edible oil demands and by biofuel production, maintains the growth tendency of cultivated area. But this trend is limited by the crop rotation necessity and, also, by an increase in the rapeseed area enlargement.

Aiming to elaborate a crop management adapted to the agrobiological requirements of sunflower, a large number of experiments have been carried out, and their results have contributed to establishing some technological norms.

Research on the previous crop effect, the soil tillage, the sowing time, plant density, fertilizer application, the weeds and diseases control have been made in different countries, as well as in Romania (Blanchet et al., 1987; Sin et Ioniță, 1990; Vannozzi et al., 1990; Vrânceanu, 2000; Bonari et al., 1992; Sarno et al., 1992).

This paper presents some technological aspects resulting from the experiments carried out.

MATERIALS AND METHODS

This research work was carried out in the National Agricultural Research and Development Institute – Fundulea, under rainfed conditions, during a long period, on chernozem soil with a good fertility: organic matter (humus) - 2.5%; N – 0.18%; P_2O_5 – 28 ppm; K – 98 ppm; TON content – 30%; pH – 6.5. The annual mean rainfall is 560 mm, ununiformly distributed during the year and the annual mean temperature is 10.5 °C.

The experiments have included 2 – 6 years rotations and monoculture, soil tillage methods, different sowing treatments with dates and densities (3–6 plants/m^2). The size of an experimental plot varied between 100–500 m^2, and the number of replications between 3–5.

The experiment treatments are presented here, together with the research results.

RESULTS AND DISCUSSION

Crop rotation

The experiments aimed to establish the influence of previous crops and the minimum number of years for sunflower return in the same place, in connection with crop production and disease attacks.

The data presented in Table 1 emphasize the following aspects:

- the highest crop yield was obtained in the 6 years of rotation, demonstrating the necessity of sunflower growing in the same place not for a shorter time than 6 years;
- the 4 - year rotation favored the *Sclerotinia sclerotiorum* attack. Even the soybean in a crop rotation with sunflower increased the attack of *Sclerotinia*;

- the greatest *Sclerotinia* attack and the lowest yields were obtained in the case of sunflower cultivated after soybean and sunflower.

Table 1. Effect of the crop rotation on sunflower yield and *Sclerotinia* attack (4-year average)

Crop rotation	Yield q/ha	Difference q/ha	Difference %	*Sclerotinia* attack - %
Sunflower-Wheat-Sugar beet-Maize-Maize-Wheat (6-years rotation)	32.0	-	-	3.0
Sunflower-Wheat-Sugar beet-Maize (4-years rotation)	30.0	-2.0	7	12.1
Sunflower-Soybean-Wheat-Maize (4-years rotation)	27.9	-4.1	13	16.5
Sunflower-Soybean (2-years rotation)	23.0	-9.0	28	26.0
Sunflower-Sunflower	22.8	-9.2	29	23.4
LSD 5%		1.9		

Soil tillage

The research regarding soil tillage has taken into consideration soil fertility conservation and fuel consumption reduction. The experiment results showed that sunflower reacts weakly to soil tillage methods and to the loosening depth, the crop yield differences being non-significant (Table 2).

The lowest yield was obtained in the case of no-till soil.

The advantage of reduced soil tillage was represented by fuel saving.

Table 2. Relationship between tillage method, fuel consumption and sunflower yield (4-years average)

Soil tillage	Yield q/ha	Difference q/ha	Fuel consumption, %	
			Ground tillage	Total soil tillage+sowing
Plowing 20 cm	22.4	-	100	100
Plowing 30 cm	23.0	+0.6	130	120
Chiseling	21.9	-0,5	57	69
Paraplowing	21.6	-0.8	75	83
Disking	22.0	-0.4	20	41
No-till	20.3	-2.1	-	14
LSD 5%		2.2		

The fuel consumption by soil plowing at 20 cm depth (100%) diminished by 86% in the no-till and by 17–50% using tillage methods with chisel, paraplow and disk, instead of plow, without a yield reduction.

Sowing

This concerns the experiments including different sowing dates and plant densities:

The data presented in Fig. 1 show the yield variation in three different years, depending on planting date, connecting with the soil temperature at sowing depth.

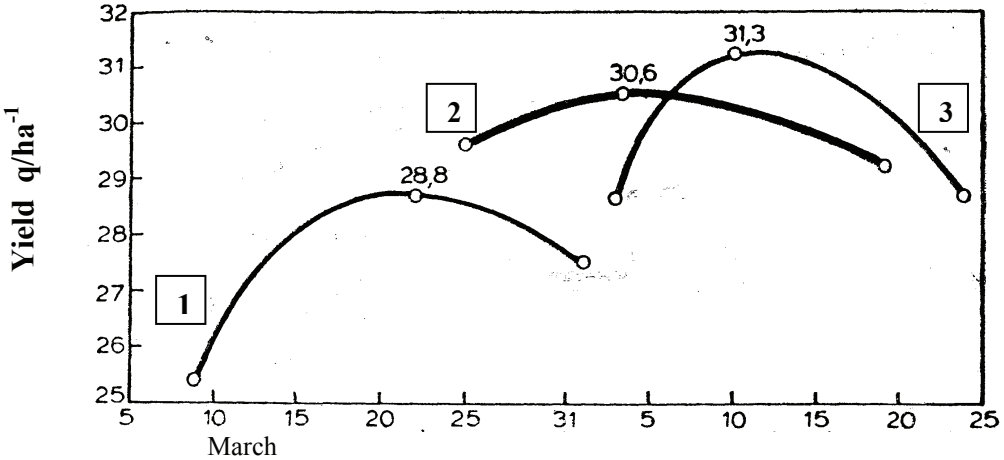
The highest yield was obtained when the soil temperature reached 7 °C. This relation was observed in early spring (1) and, also, in late spring (3), the optimal sowing data being marked by the occurrence of the respective soil temperatures. To sow earlier or later than this moment causes yield losses.

The plant density has been studied taking into account a variation from 30 to 60 thousand plants/ha.

The average results obtained for late hybrids are presented in Table 3.

The data pointed out a relation between the sowing density and the harvested plants, resulting in a decrease of 9.0–12.7%, with a growth tendency as the density increased.

The difference between both densities could be diminished by a better control of diseases and pests and by more careful cultivations, which could reduce the plant number.



1	2.7	6.9	8.1					
2	2.9	3.6	5.3	6.9	8.2	8.5	8.2	
				5.0	7.5	8.2	7.2	3

Soil temperature, in three different years (1, 2, 3)

Fig. 1. The effect of sowing time on sunflower yield.

Table 3. The effect of plant population on sunflower yield (10- year average)

Sowing density, 10^3 seeds/ha	Harvested plants/ha		Yield		Difference q/ha
	10^3	%	q/ha	%	
30	27.3	90.0	27.3	100	-
40	35.4	88.5	29.6	108	2.3
50	43.8	87.6	30.0	109	2.6
60	52.4	87.3	29.0	106	1.7
LSD 5%			2.0		

The sunflower yield varied non-significantly at a population of between 40 and 60 thousand plants/ha. The weak reaction to the variation in plant density is explained by a high capacity for compensation of crop yield components.

Relationship between water supply and sunflower yield

An analysis of rainfall regime during the years 2006 (wet year) and 2007 (with droughts) shows a net differentiation regarding plant growth, yield formation and its quality (Table 4).

Table 4. Relationship between climate conditions (rainfall amount and air temperature), yield level and seed oil in 2006 and 2007

	Wet year 2006	Dry year 2007	Difference
Rainfall, mm			
- Oct.2005-March 2006	301		
- Oct.2006-March 2007		122	179
- April-August	313	190	123
Mean temperature, °C			
- June	20.9	24.1	3.2
- July	22.9	26.9	4.0
- August	23.0	24.1	1.1
Seed yield, kg/ha	2400	550	1850
Seed oil content, %	50.8	42.5	8.3
Oil production, kg/ha	1219	234	985

The rainfall during October – March period and April – August growing period greatly varied with obvious differences between the two years of 179 mm and 123 mm, respectively.

The drought conditions of 2007 were stressed by the association of humidity shortage and high temperature, which was higher by 3 – 4 ^{0}C in 2007, as compared with the previous year.

This phenomenon negatively influenced the plant growth and yield formation, leading to a difference of 1850 kg/ha (77%).

The drought also reduced the seed oil content (8.3%), so that the oil production in 2007 was lower by 985 kg/ha, representing 19% from the oil production obtained in 2006.

CONCLUSIONS

Sunflower must be included in a 6 - year rotation, avoiding its alternance with soybean crop, due to the potential attack of *Sclerotinia*.

The soil tillage method has a weak influence on sunflower yield, offering the possibility to apply a reduced tillage, that ensures a way for fuel saving.

The optimal time for sunflower sowing is indicated by achieving the temperature of 7 °C, at sowing depth.

The optimal plant density for late hybrids is of 40 – 50 thousand plants/ha.

Although the sunflower is a tolerant crop to dryness, the association of water deficit with high temperatures during the growing season caused yield losses of up to 77% and decreased the seed oil content.

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