

CORRELATION BETWEEN PHYSIOLOGICAL INDEX, SUNFLOWER PLANT HEIGHT AND DRY MATTER IN DIFFERENT PHENOLOGICAL STAGES

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SUMMARY

The interest in cultivating sunflower in Brazil is increasing because of its great capacity of adaptation to different climatic conditions and the possibility of late sowing in autumn. Environmental conditions with late sowing in the Southern region are characterised by lower temperatures and lack of humidity during the growing season. The present research had the objective of evaluating sunflower genotypes behaviour under late sowing. A field trial was set in march, 1998, in the Experimental Station of Agronomic Institute, Campinas, Brazil, in a randomised block design, with 4 replications. The genotypes MG 01 and M 742 (Morgan/Mycogen), Cargill 9602, Cargill 11, AG 910 (Agromania), and SE 04 (Embrapa) were evaluated. Five plants in each block were harvested at 4 phenological stages (V4-6, R3, R5-10, R9). Each plant was measured, weighted, cutted into parts (leaves, stem, capitulum/immature bud) and disc leaves of known area were taken out. The plant parts were dried at 70 ° C until weight became constant. Total leaf area, leaf area index, grain yield, stem, leaves, immature bud and capitulum dry matter were recorded. The results show positive correlation between almost all analysed characteristics. Greater values of total dry matter and LAI were obtained for MG 01 genotype, while M 742 showed the smallest plant height and total dry matter besides the highest grain yield (1722 kg/ha).

Index terms: sunflower, correlation, LAI, dry matter, late sowing.

INTRODUCTION

There is an increasing interest for sunflower in the Brazilian agriculture, especially in the Southern region as a late sowing crop. Late sowing is characterised by lack of humidity and not so high temperatures.

Crop productivity is a complex process that depends on several agronomic characters (Almeida, 1991). Total leaf area (TLA), leaf area index (LAI) and total dry matter (TDM) are some of the most important components for yield determination (Connor & Hall, 1997). According to Merrien et al. (1981b), under reduced water availability, leaf area survival after anthesis is more important than leaf area establishment from emergence to anthesis. Correlations between different characters over the main character (*i.e.* yield)

indicates the variation tendency of the considered variables, being important in the physiological research utilized in selection programs (Costa Neto, 1997; Almeida, 1991). The present research was done to evaluate the behaviour of different sunflower genotypes grown under late sowing, through the dry matter and grain yield, leaf area, leaf area index and plant height.

MATERIAL AND METHODS

A field experiment was set in March, 1998, at the Experimental Station of Agronomic Institute of São Paulo State, in Campinas, Brazil (Latitude: 22° 54' S , Longitude: 47° 05' E; altitude 674 m).. The genotypes SE 4 (EMBRAPA), MG 1 e M 742 (Morgan/Mycogen), AG 910 (Agromania), Cargill 9602, Cargill 11 were evaluated in a randomised block design with 4 replicates. Five competitive plants of each plot, corresponding to 1.12 m² were sampled in the following phenological stage, according to Schneiter & Miller (1981):

- ◆ V₄₋₆ = Vegetative stage; plants with 4 to 6 pairs of leaves
- ◆ R₃ = Reproductive stage; presence of immature bud;
- ◆ R_{5,10} = Reproductive stage; full flowering;
- ◆ R₉ = Physiological maturation; back of the head turns light brown colour.

For the estimates of above-ground biomass accumulation, each plant was measured, weighted, cut into parts (leaves, stem, capitulum/immature bud); disc leaves of known area were taken out. The plant parts were dried under 70 ° C to constant weight. Total leaf area, leaf area index, stem, leaves, immature bud and capitulum dry matter were recorded. After the determination of total leaf area (TLA), stem dry matter (SDM), leaf dry matter (LDM), total dry matter (TDM), plant height (PH) and grain yield (YIELD), the correlation coefficient between the parameters were obtained

RESULTS AND DISCUSSION

The ANOVA showed a significant statistical difference between genotypes in relation to all parameters; the same occurred with the interaction genotype versus phenological stage.

From sowing to emergence the cultivars received 29.8 mm of rain and a total rain of 281.4 mm. According to Robinson (1978), water requirement varies among years and locations. In Colorado, USA, the water requirement for sunflower is 577 mm while in Saskatchewan is 386 mm and in Hungary, 600 mm; all of those results are far from the obtained for the present research. From emergence to the beginning of flowering, SE 04, AG 910 and M 742 received 152.7 mm while the others had 174.9 mm of rain.

The leaf area development show different patterns in different genotypes (Table 1). MG 01 and M 742 did not present a leaf area reduction observed in the remaining genotypes, but a slightly increase up to physiological maturity, similarly to the “stay green” character. Although Cargill 9602 showed a marked decrease in total leaf area and a not expressive grain yield, the total dry matter kept rising as a consequence of the total stem dry matter increase (Figure 2).

Genotype MG 01 presented the larger leaf area and higher TDM (Figure 3) at physiological maturation (Table 1); decrease in SDM, observed in Figure 2, can be a consequence of sampling problems.

Cultivar	Yield (kg ha ⁻¹)	Leaf area (m ² ha ⁻¹)				Plant height (cm)			
		V4-6	R3	R5.10	R9	V4-6	R3	R5.10	R9
MG 01	1453 bc	120.8 c	757.8 a	11865 a	13258 a	5.9 b	78.6 ab	156.3 b	155.4 b
M 742	1722 ab	227.3 ab	471.8 a	5722 c	6094 bc	9.1 ab	67.0 b	124.0 c	133.6 c
C 9602	1231 c	189.5 b	1079.2 a	11426 ab	8000 bc	6.9 cd	93.2 a	189.1 a	189.2 a
C 11	1056 c	275.9 a	478.4 a	8798 b	5771 c	8.9 ab	64.5 b	152.5 b	158.0 b
AG 910	1909 a	220.9 ab	521.6 a	10687 ab	9019 b	8.0 bc	87.4 a	144.8 b	150.2 b
SE 04	1427 bc	196.9 b	389.3 a	8653 b	7577 bc	10.1 a	70.7 b	152.3 b	163.3 b

Table 1- Grain yield, leaf area and plant height in different phenological phases of 6 sunflower genotypes

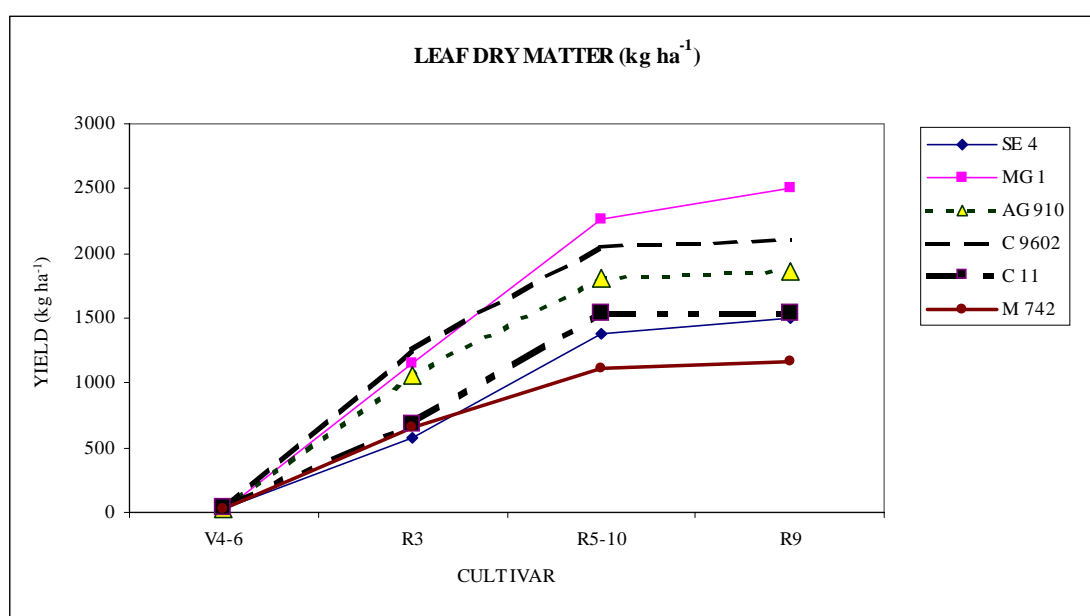


Figure 1- Leaf dry matter accumulation in the six studied genotypes.

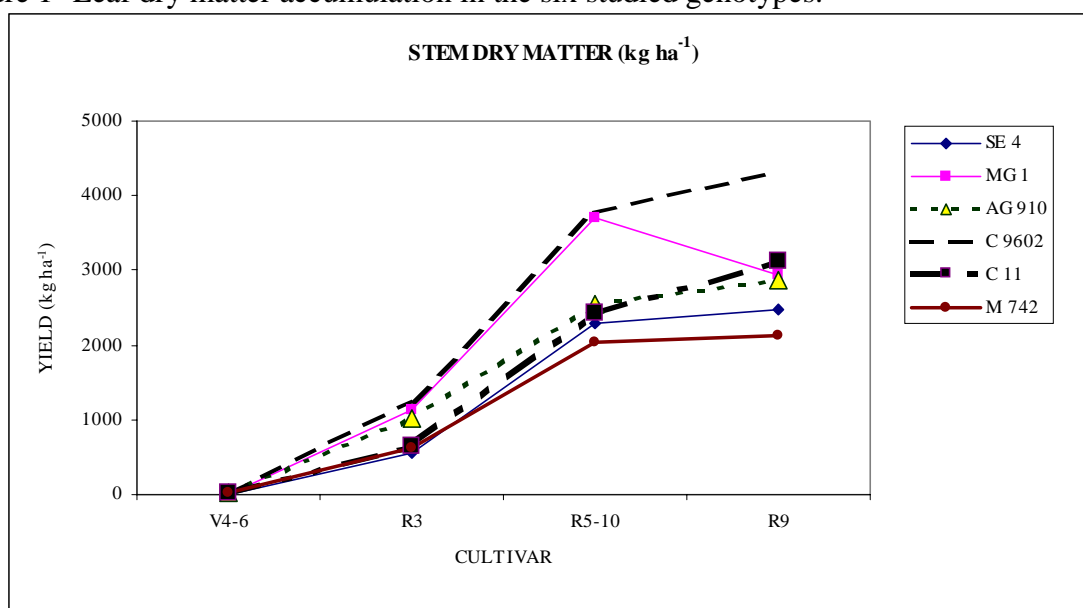


Figure 2- Stem dry matter accumulation in the six studied genotypes

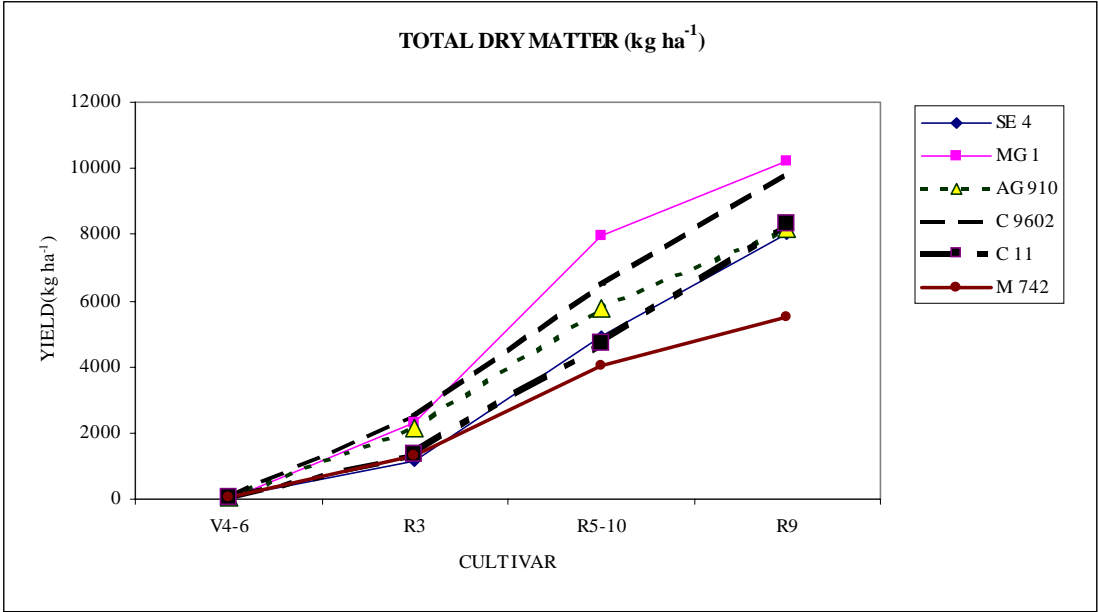


Figure 3- Total matter (TDM) accumulation in the six studied genotypes.

M 742 showed the smallest plants (Table 1) and lower LDM (Figure 1), SDM (Figure 2) and TDM (Figure 3), but a high grain yield (Table 1).

According to Merrien et al.(1981a), the first response to crop water limitations affect leaf area rather than photosynthesis. LAI appears to be well correlated with water availability. The greater LAI (Figure 4) of MG 01 was due to its greater leaf area (Figure 1).

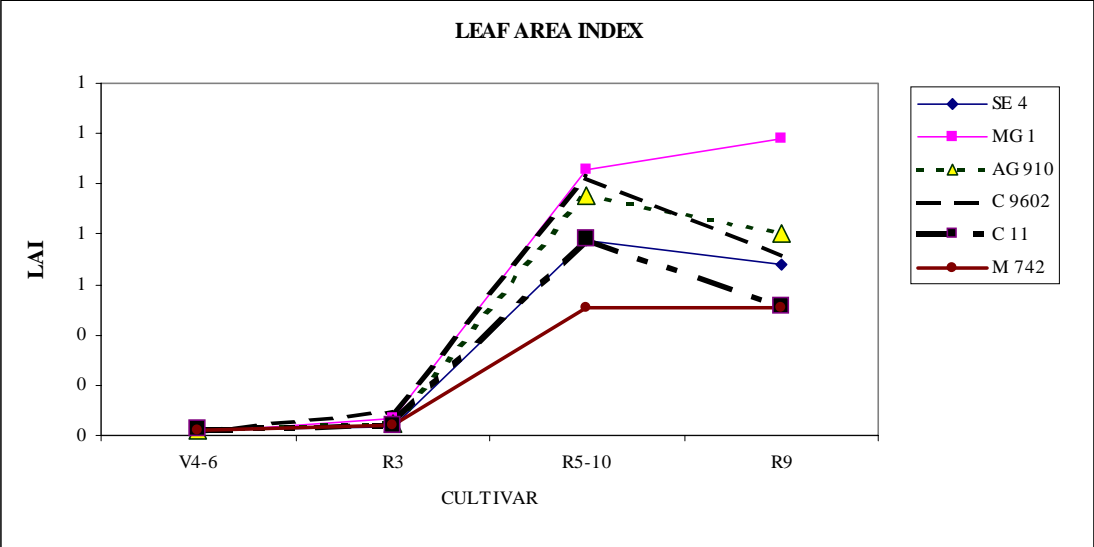


Figure 4- Leaf area index (LAI) evolution in the six studied genotypes.

Total leaf area (TLA) shows a positive correlation with plant height (PH) and total dry matter (TDM) but no significant correlation with grain yield. PH shows negative correlation with grain yield and positive with LAI and TDM (Table 2).

Correlated Parameters	Phenological Stages			
	V ₄₋₆	R ₃	R ₅₋₁₀	R ₉
TLA X PH	0.66	0.76	0.74	-
TLA X TDM	0.98	0.86	0.90	0.68
PH X YIELD	-	-	-0.59	-0.60
PH X LAI	0.66	0.76	0.74	-
PH X TDM	0.63	0.89	0.57	0.72

Table 2- Correlation coefficients statistically significant at 1%, at different phenological phases in the six studied genotypes.

Vannozzi et al. (1996), working with drought resistance, found a correlation of -0,41% for PH x LAI, which was substantially different from the value found in this research, that was positive and higher.

CONCLUSIONS

- The genotype MG 01 produces the highest total dry matter yield in the late sowing;
- AG 910 and M 742 presents the highest grain yield in the late sowing;
- Total leaf area shows a positive correlation with plant height and total dry matter.

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