WINTER SOWING AND HIGHER POPULATIONS AS DRY-FARMING STRATEGIES ON SUNFLOWER CROP (HELIANTHUS ANNUUS L.)

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Sunflower is sown in early spring (March-April) under Mediterranean dryland conditions. Plant development is coincidental with increasing air temperature and crop ET and usually reproduction occurs under water and temperature stresses, resulting in severe yield limitations (Downes 1975, Carvalho et al 1990, 1991). As a strategy of stress avoidance during the reproductive stages winter sowing (late December and January) has been successfully tested (Vesperinas et al 1991, Ordóñez 1990). This experiment tested the potential advantage in anticipating sowing date to late December or January, and in increasing plant population in order to use soil water more efficiently.

Methods: The experiment was conducted over two years (1991/92 and 1992/93) at the Experimental Farm of the ISA. Climate is a sub-humid mediterranean with 650mm average annual rainfall and the soil is a Clay Vertisol.

Table 1. Experimental design.

Cultivar: Cargill hybrid SC-010	Plot size: 10m2 (3.25 x 3.1m)
Factorial: 4 planting densities; 4 planting dates; 4 replications	
Planting densities: 4,6,8 and 10 plants m-2	
Planting dates: late December, January, February and March	

Treatment effects were observed during emergency and harvest, by measuring germination percentage (%), duration (d), seed yield (g dm m-2), seed weight (g dm per 1000 seeds), grains per head and head diameter (cm). Seed weight, grains per head and head diameter were estimated by the average of 12 observations. An ANOVA was performed on these variables. Differences among means were estimated using Scheffe's test at a 5% error tolerance.

Results: Soil temperature did not affect germination since the lowest temperature, 8.4°C on January, is within the germination tolerance range (Ordóñez 1990). Although germination duration increased with sowing anticipation, germination percentage was not affected (table 2). There was no combined effect of sowing date and population on yield, for the two year period. Yet, on the first year, higher yields corresponded to higher populations on early sowing dates and vice versa. Early sowing had positive consequences on seed yield and yield components, with no differences between December, January and February sowing dates (table 3). Although sowing anticipation benefits seed weight, December and January sowing dates strongly affected the number of seeds per head, when compared to February. Apparently, this effect was determined by the period of water stress during the "visible bud" phenological stage (figure 1). Population had no effect on seed yield or yield components above the 6 plants/m2 level. Above this level there is an important decrease on seed weight and seeds per head, that is not compensated by the increase in plant density. The decrease in seed weight and seeds per head with increasing density, was also mentioned by Miller et al 1984 and Zaffaroni et al 1991.

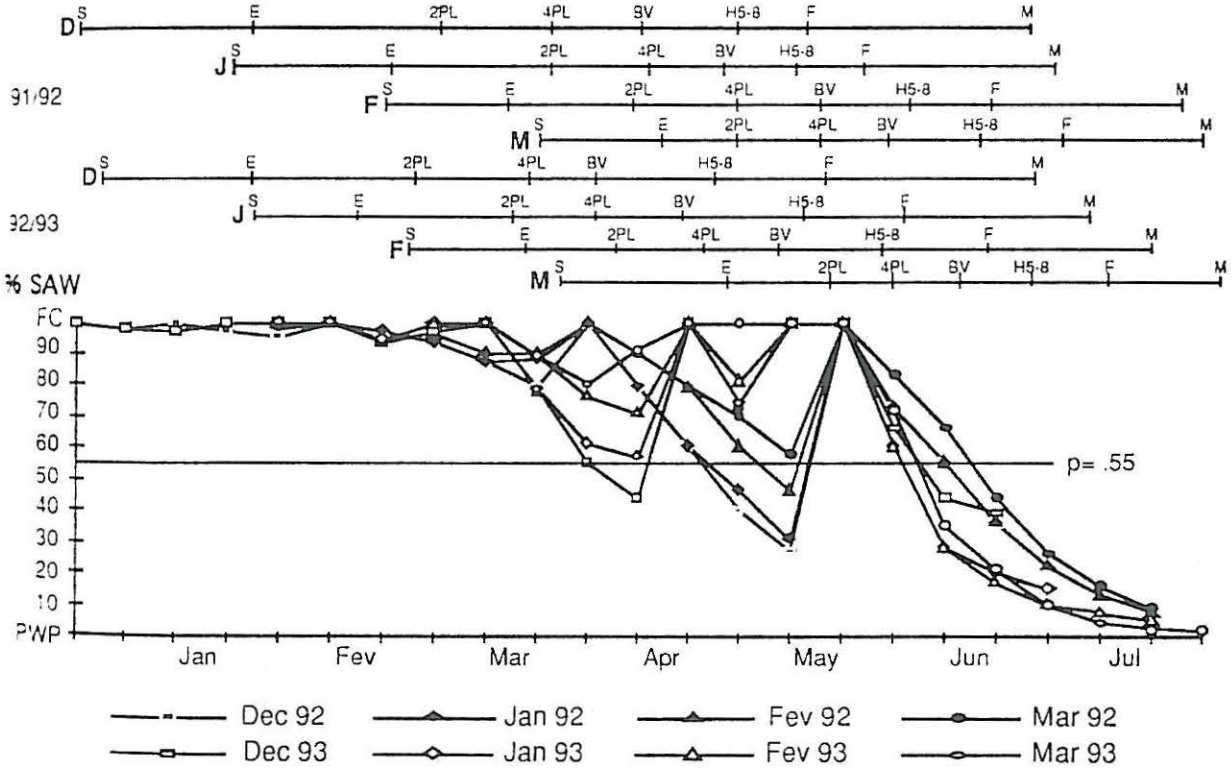
Table 2. Means and standard errors of germination percentage and duration.

	Germination (%)		Germination duration (days)	
	Mean	SE	Mean	SE
Dec	72.0 a	3.7	47.0 c	1.7
Jan	75.4 a	4.9	36.0 b	2.0
Feb	77.6 a	5.9	28.6 a	0.8
Mar	86.0 a	3.0	33.4 ab	1.2

Table 3. Means and standard errors of seed yield, number of seeds per head, seed weight and head diameter

	Seed yield (g m-2)		Nº seed per head		Seed weight (g/1000 seeds)		Head diameter (cm)	
Seedling date	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Dec	271 a	16.4	678 a	36.2	67.5 a	1.59	14.4 a	0.45
Jan	216 b	12.1	770 ab	31.9	52.1 c	1.52	12.9 b	0.45
Fev	212 b	11.3	858 a	37.3	44.1 c	1.73	11.9 bc	0.44
Mar	176 c	17.0	770 ab	35.2	34.3 d	3.00	11.1 c	0.43
Pop. plants m-2	Mean	SE	Mean	SE	Mean	SE	Mean	SE
4	199. a	11.7	922 a	35.8	56.6 a	3.34	14.5 a	0.49
6	241 ab	16.5	831 ab	36.4	53.5 a	2.93	13.2 a	0.35
8	239 ab	17.0	708 bc	30.6	46.1 b	2.66	11.6 b	0.47
10	256 b	14.6	624 c	23.3	44.2 b	2.62	11.2 b	0.40

Results indicate that sowing date anticipation associated to higher plant density is not a favorable strategy in dryland sunflower cropping. The benefits obtained with sowing anticipation disappear when, simultaneously, plant density increases. Even so, there is no advantage on anticipating sowing earlier than February. Soil water status, during the growth cycle, is not significantly better on December or January sowing dates (figure 1). This conclusion does not fully agree with information collected by other authors (Vesperinas et al 1991, Ordõnez 1990), that related seed yield increase with the anticipation of sowing date to early-mid winter.



Legend: S- seedling; E- emergence; 2PL- two pairs of leaves; 4PL- four pairs of leaves; BV- visible bud (star); H5-8- head diameter of 5 to 8 cm; F- flowering; M- maturation.

Figure 1. Phenological stages and evolution of soil available water (SAW) per treatment.

Carvalho M et al 1991 Rev Ci Agr 14, 3-15
Gomes R 1975 Com Agr 5, 11-17
Hall B et al 1984 Agr J 76, 511-515
Ordõez A 1990 Agric 59, 774-775
Vesperinas E et al 1991 Agric 703, 156-163
Zaffaroni et al 1991 Agr J 83, 113-118