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Seed Yield And Oil Content In Flax (*Linum usitatissimum* L.), Cropped In Southern Environments

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Introduction

The fat acid groups, ω -3 (mainly α -linoleic acid) and ω -6 (mainly linolenic acid), have an important role in the human cardiovascular and tumoral illnesses prevention (Vecchini *et al.*, 2004; Thompson *et al.*, 2004). The ω -6 reduces the amount of blood cholesterol, even if this reduction concerns the "good" cholesterol; besides, it has a low ability to reduce the plasmatic levels of triglycerides. The ω -3 reduces the plasmatic levels of triglycerides, but it has a low ability in the bad cholesterol reduction. For this reasons, the optimal ω -3/ ω -6 ratio must range between 2 and 4, to maximize the positive effects on human health.

The aim of this work is to evaluate the adaptability and therefore the productivity of flax (*Linum usitatissimum* L.), in two different Mediterranean environments, with the purpose to identify crop management and location that can ensure elevated oil yield and quality for animal food preparation.

Methodology

In two Mediterranean locations, Foggia (Apulia region) and Cammarata (Sicily region), field experiments were carried out in two years, 2006 and 2007, with a spring sowing in the first year, autumnal and spring sowing times in the second year. Seed yield and oil seed composition were recorded. The soil of Foggia is a Vertic Calcixercept, the soil of Cammarata is a Chromic Haploxerert, both with xeric conditions. The climate is "accentuated thermomediterranean", with temperatures below 0 °C in the winter and above 40 °C in the summer. Rainfall (500-600 mm) is mostly concentrated during the winter months.

In 2006 the sowing dates were April 6th in Foggia and 24th March in Cammarata, while the crop was harvested at the end of July in Foggia and 28th June in Cammarata. In Foggia, for the delay in sowing time and for the drought conditions, two irrigations in April and May were applied (total of 60 mm).

In the second year in Foggia the autumnal flax was sown on 17th November, the spring sowing on 19th March, and harvested on 21st June and 17th July, respectively. In Cammarata the autumnal sowing date was 8th December 2007, while for the spring sowing, the date was 20th January. The crop was harvested on 12th June and 2nd July for the autumnal and for the spring sowing crop, respectively.

Results

In the first year no difference was observed between the two locations for seed yield, while Cammarata gave the best results in the second year for both sowing dates (Tab.1), with values slightly lower than those reported in Northern Italy (Casa *et al.*, 1999). The seed productivity was, in general, higher in the autumnal sowing times than spring one, for the longer crop cycle and for the temperature closer to the optimal values for reproductive phase. The amount of oil yield is function of seed yield and oil content, with these variables inversely correlated. The oil yield resulted higher in autumnal than spring sowing time and in Cammarata than in Foggia (Tab.1).

The oil of seed flax cropped in Foggia had a different fat acid composition, with an ω -3 average content 5% greater than the seed oil obtained in Cammarata, but an ω -6 average content lower of 8%. Consequently, the ratio ω -3/ ω -6 resulted higher in Foggia, and this is a positive result from a qualitative point of view.

The pedoclimatic conditions of Cammarata were more favourable for flax cultivation, both for yield and quality, than Foggia, but the results need to be confirmed. The table 2 shows a strong correlation between the rain (and irrigation) felled down during crop cycles and the seed yield; in fact, the greater difference between the two locations is due to the cumulated rain felled down during the cropping cycles of autumnal and spring flax sowing times (on average, 644 mm in Cammarata and 490 mm in Foggia). This positive correlation has been compensated for the negative correlations with the average air temperature, probably because the higher is the rain, the lower is the air temperature. The percentage of ω -3 and ω -6 seem to not be influenced by climatic conditions.

Table 1. Seed yield, oil content and acidic composition of flax, cropped in Foggia and Cammarata in two years and sowing times. Different letters indicate significant difference at $P > 0.05$ (LSD test).

Seasons	Seed yield $t\ ha^{-1}$	Seed oil content %	Seed oil yield $kg\ ha^{-1}$	ω -6 content %	ω -3 content %	ω -3/ ω -6	ω -6 yield $kg\ ha^{-1}$	ω -3 yield $kg\ ha^{-1}$
Spring 2006								
Foggia	0.55	33.1 b	183.1	15 b	46.8 a	3.2 a	27.8	85.3
Cammarata	0.44	35.9 a	160.0	19.1 a	43.1 b	2.3 b	29.2	70.7
Mean	0.50	34.4	171.6	17.1	44.9	2.8	28.5	78.0
Autumn 2007								
Foggia	0.80 b	31.3 b	249.5 b	17.5	46.9 a	2.7	43.3 b	116.2 b
Cammarata	1.02 a	32.2 a	325.1 a	16.8	44.5 b	2.7	55.3 a	144.5 a
Mean	0.91	31.7	285.3	17.2	45.7	2.7	49.3	130.4
Spring 2007								
Foggia	0.38 b	31.9	120.8 b	16.4	45.1	2.8	19.8 b	54.6 b
Cammarata	0.77 a	32.1	246.7 a	16.8	44.4	2.7	41.5 a	109.7 a
Mean	0.58	32.0	186.7	16.6	44.8	2.8	30.7	82.2
Foggia	0.58 b	32.1 b	184.4 b	16.3 b	46.3 b	2.9 a	30.3 b	85.4 b
Cammarata	0.74 a	33.4 a	243.9 a	17.6 a	44.0 a	2.6 b	42.0 a	108.3 a

Table 2. Pearson correlation coefficients between rainfall and average temperature observed during crop cycle in both years, sowing dates and locations.

	Seed yield $t\ ha^{-1}$	Seed oil content %	Seed oil yield $kg\ ha^{-1}$	ω -6 content %	ω -3 content %	ω -3/ ω -6	ω -6 yield $kg\ ha^{-1}$	ω -3 yield $kg\ ha^{-1}$
Rainfall	0.91	-0.72	0.87	n.s.	n.s.	n.s.	0.85	0.88
AverageTemp	-0.75	0.56	-0.72	n.s.	n.s.	n.s.	-0.77	-0.71

Conclusions

Despite the brevity of the experiment, encouraging results emerged on the flax oil yield and quality. The autumnal better than spring sowing time and Cammarata better than Foggia location, seem to be the first indications for the seed yield, oil content and ω -3 and ω -6 composition and yield.

References

- Casa R., Russell G., Lo Cascio B., F. Rossigni, 1996. Environmental effects on linseed (*Linum usitatissimum* L.) yield and growth of flax at different stand densities. *European Journal of Agronomy*, 11:267-278.
- Thompson L. U., J. Chen E. Hui, J. Mann, 2004. Interactive effects of flaxseed and tamoxifen on human breast cancer. *Proc. 60th Flax Institute*, March 17-19, 2004, Fargo, N.D., 86-90.
- Vecchini A, et al., 2004. Dietary alpha-linolenic acid reduces COX-2 expression and induces apoptosis of hepatoma cells. *J Lipid Res.* 45:308-316.