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THE INFLUENCE OF ENVIRONMENTAL CONDITIONS AND PLANTING DATE ON SUNFLOWER OIL CONTENT AND FATTY ACIDS COMPOSITION

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Abstract

The sunflower oil is very important in human food because it contains a high percentage of unsaturated fatty acids. This oil ideally combines high nutritional value due to its content in linoleic acid with the high stability resistance during cooking because of oleic acid. This paper aims to show the variation of the main fatty acids in sunflower oil depending on environmental conditions and sowing date. In the studied area, adjusting the planting date and considering climatic factors, we can obtain the desired fatty acid percentage in our inbreed lines, used further for obtaining valuable hybrids. The same set of sunflower inbred lines was planted in two stages: April 10 and the May 27. In this period the environmental factors varied from low temperatures and rainfalls up to very high temperatures and severe drought, year 2012 being marked by extreme phenomen.

Keywords: *fatty acids, linoleic acid, oleic acid, planting date, sunflower.*

INTRODUCTION

Sunflower is a typical oleic plant due to its high content of oil from seeds, which often exceeds 50% of the dry matter. Whole seed oil content used to be determined as the relationship between the percentage of hulls and the percentage of kernel oil. Now, the oil content is expressed as percentage of whole seed weight. In cultivars with low percentage of hulls (20-24%) the oil content exceeds 50% of dry matter. Sunflower oil is considered first-class edible oil due to its content of linoleic acid, followed by oleic acid, together representing approximately 90% of the fatty acids composition.The fats found in food represent a combination in different proportions of saturated, monounsaturated and polyunsaturated fatty acids.

Sunflower oil contains saturated and monounsaturated fats but in much smaller amounts than polyunsaturated fats (Vrânceanu, 2000). The new mutant variety called oleic sunflower has a high content of monounsaturated fats, namely oleic acid and very low proportion of linoleic acid (Soldatov, 1976).

Burr and Burr's demonstrated in their experiences the importance of this specific group of polyunsaturated fatty acids called essential fatty acids, human and animal organisms being unable to synthesize them (Vles and Gottenboss, 1989).

Unlike other vegetable oils, the sunflower oil has a great nutritional value due to its high linoleic acid content and it is very stable due to lack of linolenic acid, so it can be preserved for a long period of time. The linoleic/oleic ratio is not constant and it can be changed by many factors, the most important being temperature during oil accumulation and genotype. (Vrânceanu, 2000).

This paper aims to show how the oil content and the main fatty acids varies depending on sowing date and climatic conditions of the year 2012 in Fundulea area.

MATERIALS AND METHODS

The biological material used for this experience consisted in a set of 5 sunflower lines which was sown on two different dates: on April 10 and May 27. The climatologically data were collected from a meteorological institute nearby

the studied area. The seeds were sown in 2 rows for each sunflower line. The distance between rows was 0.75 m and the length of a row was 4.8 m.

Sunflower seeds were ground with laboratory mill Knifetech Foss, the oil content being determined with Foss 1241 equipment which uses NIR technology. For fatty acids the oil is extracted with diethyl-eter, which is an organic solvent, in Soxleth extractor. The obtained oil is subjected to a transesterification reaction and the fatty acid methyl esters will be determined by gas chromatography.

The materials used for this method are: n-heptane, internal standard methyl heptadecanoat 10 mg/ml, gas chromatograph (Trace GC Ultra) with FID detector and split injector, DBWAX column (30 m-0.25 mm-0.25 µm), analytical balance, vials (with capacity of 10 ml), flask, pipette (5 ml). The chromatographic conditions are: oven temperature 210 ºC, injector temperature 250 ººC, gas pressure 80 kPa, gas flow 1-2 ml/min, injector flow 50 ml/min, analysis time 25 min.

The work procedure consists in weighing of 250 mg of sample in a 10 ml vial then adding 5 ml of methyl heptadecanoate. Homogenized mixture is injected and the chromatogram is obtained. The peaks from C 14 to C 24:1 are integrated.

RESULTS AND DISCUSSIONS

The period Between January and August was marked by extreme phenomena from low to very high temperature and from heavy rain falls in May to severe draught and high temperatures in July.

The ratio of the major fatty acids in sunflower oil is not constant, changing during the oil accumulation. Thus, the concentration of linoleic acid increases until the end of seed maturity, while oleic acid concentration decreases. There exists a negative correlation because oleic acid is a precursor of fatty acids with higher degree of unsaturation. This explains the variation of linoleic and oleic acid between the seeds of the same head (Canvin, 1965; Robertson *et alii*, 1978; Goyne *et alii*, 1979; Unger and Thompson, 1982; Downes and Tonnet, 1982; Simpson and *alii*. 1989; Connor and Sadras, 1992).

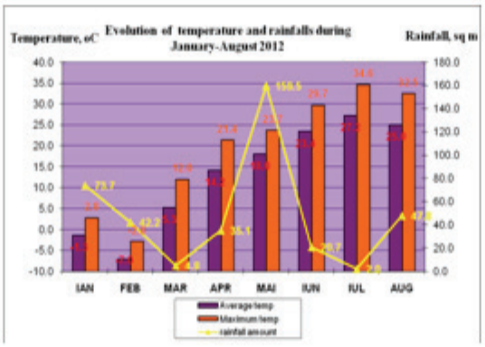

Figure 1. Evolution of temperatures and rainfalls during January-August 2012

The linoleic and palmitic acid contents increase, while the oleic acid content decreases in seed from the perimeter towards the centre of the head (Fick and Zimmerman, 1973; Zimmerman and Fick, 1973).

Regarding the two main fatty acid of sunflower oil, it is well known that they closely depend on the environmental conditions. Temperature, especially day/night temperature differences are the most important environmental factors driving seed oil percentage and oil chemical composition (Izquierdo et al., 2002; Rondanini et al., 2003, 2006; Qadir et al., 2006; Echarte et al., 2010).

Data obtained after processing the samples are presented in table 1 and table 2.

Table 1. Oil and fatty acid composition for sunflower lines sown on April 10, 2012

Line	Oil	Humidity	Palmitic	Stearic	Oleic	Linoleic
V1	42.0	8.5	6.1	2.5	36.4	53.1
V2	46.8	7.9	5.8	4.4	33.0	55.3
V3	47.6	8.0	5.8	2.6	28.7	61.7
V4	48.0	8.4	5.6	3.6	32.0	57.4
V5	47.7	8.2	5.8	4.1	30.5	58.0

Table 2. Oil and fatty acid composition for sunflower lines sown on May 27, 2012

Line	Oil	Humidity	Palmitic	Stearic	Oleic	Linoleic
V1	38.2	7.9	6.1	3.2	31.7	57.1
V2	46.5	8.5	5.9	4.2	33.7	54.4
V3	41.8	8.6	5.4	2.5	33.6	57.2
V4	48.4	7.5	6.3	4.5	29.1	57.6
V5	42.5	8.6	6.1	4.4	28.7	58.1

Different planting dates and water regimes cause different environmental conditions during seed-filling and oil synthesis of

sunflower seed and therefore a possible alteration in oil content and fatty acid composition of the seed (Flagella *et al*., 2002). Thus, in our results we can observe that the concentration of oleic acid decreased for 4 of 5 lines until the end of seed maturity (figure 2), while for 4 of 5 lines the linoleic acid concentration increased for plants sown later (figure 3).

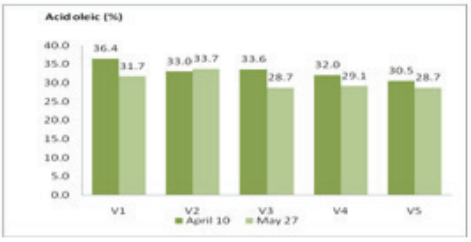

Figure 2. Variation of oleic acid depending on sowing date

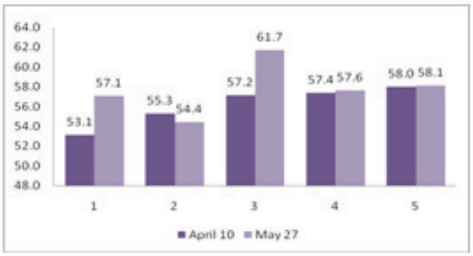

Figure 3. Variation of linoleic acid depending on sowing date

It is known that the oil content varies very much, depending on genotype and environmental factors. The main factor in oil accumulation is water, thus in southern regions, that are more draughty, the oil content is lower than in humid regions.

The rain fallen during seed formation have favorable effects on oil accumulation not only by improving the water supply but also because decrease temperature and increase atmospheric humidity. Even if it is a year with heavy rainfalls, but with high temperatures, the oil content decrease. In case of heavy rainfalls during the second half of summer they will lead to stimulate the secondary growth, which will also have negative effects on oil content (Vrânceanu et al., 1969).

As can be seen in figure 2, the oil content varied very much, thus sunflower lines sown on May 27 showed a significant decrease in oil content, even *with 5% less than in the first set.*

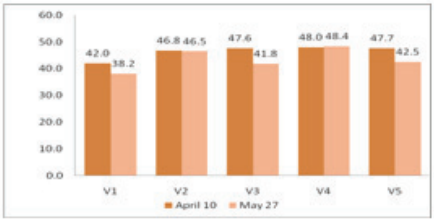

Figure 4. Oil content depending on sowing dat

CONCLUSIONS

It was noted from results obtained for the five sunflower lines that the oil concentration varied up to 5% from one set to another, this trait being very strong affected by draught. Regarding fatty acids, there are also differences between the two set of sunflower lines; the linoleic acid increased in the second set sown later, while the oleic acid concentration was affected by late planting.

In order to obtain optimal results, it is recommended to adjust sowing date according to the objectives pursued.

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