CONTENT AND OIL PRODUCTIVITY IN SUNFLOWER GENOTYPES PRODUCED IN CAMPO NOVO DO PARECIS – MT, BRAZIL

Andréia Fernanda Silva IOCCA[1], Flávio Carlos DALCHIAVON[1], Bruno João MALACARNE[1], Claudio Guilherme Portela Carvalho de CARVALHO[2]

[1]Instituto Federal de Educação Ciência e Tecnologia de Mato Grosso-Campus Campo Novo do Parecis, curso de Bacharelado em Agronomia, MT 235, km 12, Zona Rural, CEP 78360-000 Campo Novo do Parecis, MT, Brazil
.[2]Embrapa Clima Temperado, Caixa Postal 403, 96010-971, Pelotas, RS, Brazil

* andreia.iocca@cnp.ifmt.edu.br

ABSTRACT

This study aimed to evaluate genotypes of sunflower seeded second harvest in the year 2014 in Campus Campo Novo do Parecis, in the experimental field of the Instituto Federal de Educação Ciência e Tecnologia de Mato Grosso. The experimental design was a randomized block design with treatments 16 (16 genotypes) and four replications. The experimental plots consisted of four rows 6.5 m long with row spacing of 0.45 m, containing area of 11.7 m², totaling an area of 748 m². The population of 45000 plants per hectare is used. Data were subjected to analysis of variance and the Scott - Knott test at 5 % probability. The genotypes that stood out in relation to achenes productivity were the MG 360, AGUARÁ 06, MG 305, AGUARÁ 04, CF 101, SYN 045, GNZ NEON, HELIO 251 and SYN 3950HO. For the achenes oil content and productivity, the MG 360 genotype was the highest value and stands in relation to other genotypes.

Keywords: spectroscopy, *Helianthus annuus* L., lipids, oilseeds, achenes productivity.

INTRODUCTION

Among oilseeds grown in the world, the sunflower stands out among the main, both in production and in planted area. Sunflower (*Helianthus annuus* L.) is an annual cycle plant and its rapid growth characteristics, resistance to drought, cold and heat, more than most species of economic cultivation in Brazil and can be used for various purposes (Leite et al., 2005) as high quality oil extraction for human consumption or as raw material for biodiesel production, among others.

In general, sunflower seed it has about 45 to 65% oil in its composition (Grunvald et al., 2014A). Sunflower oil essentially consists of triglycerides (98 to 99%). It has a high content of unsaturated fatty acids (about 83%) and Vitamin E (alpha-tocopherol), but a reduced content of linolenic acid (≤ 0.2%). Sunflower oil is essentially rich in essential fatty acid (EFA) linoleic acid, about 60% that helps in reducing serum cholesterol and LDL. Thus contributing to the prevention of arteriosclerosis and cardiovascular problems (Turatti et al., 2002).

Changes in oleic are the result not only of the genotype, but also of climatic differences during their cultivation. Thus, among the various technologies developed for sunflower production, the appropriate choice of the genotype that has high yield and / or oil is important to ensure the success of the culture as a component of the production system (Porto et al., 2007).

In the region of Campo Novo do Parecis, sunflower is grown second summer harvest from February/March, due to the occurrence of rainfall conditions and temperatures suitable for its cultivation (Castro and Farias, 2005). However, despite being the main growing region in the country, little information is available on the agronomic characteristics of genotypes as content and productivity of oil, to facilitate the cultivation practices, reducing risk and increasing profitability.

MATERIAL AND METHODS

The work was carried out at the experimental fields and facilities of the Instituto Federal de Educação Ciência e Tecnologia de Mato Grosso - Campo Novo do Parecis in second-crop system in succession to soybeans in the agricultural year 2013/2014. The soil, according to the American System of Soil Classification (USDA, 1960) is the Typic Tropudox. The initial characterization of fertility, for the first layer of 0-0.20 m, presented the following values: pH ($CaCl_2$) = 5,7; MO = 26 g dm^{-3}; P (resina) = 5,9 mg dm^{-3}; K, Ca, Mg e H+Al = 1,5; 32; 11 e 40 $mmol_c$ dm^{-3}, respectively; with V = 54,8%.

Average temperatures occurred during the experimental period were: 30.3; 23.2 and 18.9 °C for maximum temperature, medium and minimum, respectively, and 570 mm rainfall, meeting the water demands required by sunflower between 500 and 700 mm distributed along its growing cycle (Castro and Farias, 2005).

The experimental design was a randomized complete block design with 16 treatments (genotypes) and four replications, as follows: ADV 5504, AGUARÁ 04, AGUARÁ 06, BRS 323, BRS G42, CF 101, GNZ NEON, HELIO 250, HELIO 251, HLA 2012, M734, MG 305, MG 360, PARAISO 20, SYN 045 and SYN 3950HO. The experimental plots consisted of 4 rows with 6.5 m long, with row spacing of 0.45 m, containing area of 11.7 m² (1.8 x 6.5 m). Only the two 5 meters central rows of each genotype were considered for data collection. The plotted area comprises 4.5 m².

The plot of the rows, was done on March 7, 2014, and the previous application of fertilizers was carried out with the aid of a sowing machine and was distributed at a depth of 0.10 m, 45 kg ha^{-1} Potassium Chloride + 267 kg ha^{-1} NPK 10-30-20, totalizing: 26.7 kg ha^{-1} N; 80 kg ha^{-1} P2O5; 80 kg ha^{-1} K_2O, according to the results of soil analysis and recommendation (EMBRAPA, 2004). Further, beside the row fertilization at 0.04 m deep, three seeds were placed in each hole, each 0.495 m, by manual planter.

The desiccation and the application of boron was performed on March 07, using trawl trailed sprayer with an application volume of 150 L ha^{-1} using glyphosate (648 g a.i. L^{-1}) at a dosage of 2 L ha^{-1} + Prometryn dosage 2 L ha^{-1} + mineral oil (0.5 L ha^{-1}) + boric acid dosage of 3 kg ha^{-1} (600 g ha^{-1} Boron).

Thinning was done 10 days after emergence (DAE) with a scissor, leaving only one plant per hole, reaching a population of 45,000 plants ha^{-1}.

The following coverage fertilizations were made: 1) 32 DAE with a dosage of 50 kg ha^{-1} N (urea); 2) foliar application of boron, with knapsack sprayer at 35 DAE using a dosage of 3 kg ha^{-1} (600 g ha^{-1} Boron), and 43 DAE with a dosage of 11 kg ha^{-1} (1.1 kg ha^{-1} of Boron). The source of Boron used was boric acid 150 L ha^{-1} according to the requirement of sunflower of 2 kg ha-1 B, Control of weed, pests and diseases have been carried out according to the recommendations of EMBRAPA (2004).

To avoid birds attacks, the plotted sections of the central rows were protected (stage R6) by using polypropylene based bags (30 x 30 cm) and fixed with clips.

The following agronomic characteristics were evaluated: productivity achenes (**PR**; kg ha-1), determined based on two central lines 5 meters, which is corrected for moisture condition of 11% (wet basis) obtained by reading the humidity value of the achenes; oil content (**OC**; %), predicted by near infrared spectroscopy (NIR) according to the methodology described by Grunvald et al. (2014b); and oil yield (**OY**, kg ha-1), calculated by multiplying the achenes oil content (%) and productivity achenes (kg ha-1) / 100.

The harvest of the capitulums was performed manually in the two of 5 meter central rows in R_9 with pruning shears aid. Later the capitulum inflorescence were the natural dryied, cleaned and weighed. The results were submitted to analysis of variance followed by the average test Scott-Knott, both 5% probability, with the statistical program SISVAR (Ferreira, 2011).

RESULTS AND DISCUSSION

All variables showed significant differences ($p < 0.05$) in the analysis of variance (Table 1). The data from the achenes productivity variables, oil content and oil yield are shown in Table 2. For the achenes productivity, genotypes were stood SYN 3950HO (2205.5 kg ha^{-1}) and HELIO 251 (2204.1 kg ha^{-1}), but not statistically different genotypes GNZ NEON, SYN 045, CF 101, AGUARÁ 04, MG 305, AGUARÁ 06 and MG 360, which had average productivity ranging from 1836.8 e 2132.5 kg ha^{-1}. However, it appears that even the lowest yields were found in genotype HLA 2012 e BRS G42, with average 40% lower than those observed in the most productive genotypes.

Table 1. ABSTRACT of the analysis of variance for the sunflower productivitiy parameters (Campo Novo do Parecis, MT, 2014).

Parameters[1]	F[2]	CV (%)[3]	GA[4]
PR (kg ha^{-1})	6.4*	12.4	1846.9
OC (%)	27744.6*	0.1	43.2
OY (kg ha^{-1})	6.8*	12.4	796.5

[1] PR = achenes productivity, OC = oil content, OY = oil yield; 2 * significant at 5%; 3 CV = Coefficient of variation; 4 GA = General average.

Values higher than this study were found by Backes et al. (2008) for HELIO 250 genotypes (1849.0 kg ha^{-1}), M734 (2052.0 kg ha^{-1}), AGUARÁ 04 (2252.0 kg ha^{-1}) and below to HELIO 251 (1882.0 kg ha^{-1}) in second-crop cultivation in northern Santa Catarina. Additionally, Vogt et al. (2010), in sunflower crop sown in November in northern Santa Catarina, reported higher yields for genotypes AGUARÁ 04 (1916.0 kg ha^{-1}) e M734 (1962.0 kg ha^{-1}) and means inferior to HELIO 250 (1450.0 kg ha^{-1}). Already Capone et al. (2012) evaluated the performance of cultivars in southern Tocantins state reported productivities 2834.1 e 2997.6 kg ha^{-1} para os genótipos HELIO 250 e HELIO 251, respectively. Poletine et al. (2013) reported an assay developed in the northwestern region of the state of Paraná, for genotypes BRS G42, SYN 3950HO, M734 and MG 305, with productivities 715.5 kg ha^{-1}, 1215.0 kg ha^{-1}, 1225.0 kg ha^{-1} e 1592.0 kg ha^{-1}, respectively. These variations in productivity reveal the importance of evaluation of genotypes in different producing regions to verify the feasibility of its use.

Analyzing the oil content of genotypes, the MG 360 genotype had the highest oil content, 47.8% (Table 2), differing from the other investigated genotypes.

Table 2. Mean values for productivity achenes (PR), oil content (OC) and oil yield (OY) from different sunflower genotypes.

Genotypes	PR (kg ha^{-1})	OC (%)	OY (kg ha^{-1})
ADV 5504	1446.9 c	47.1 b	681.5 b
AGUARÁ 04	2084.1 a	45.9 d	956.6 a
AGUARÁ 06	1859.5 a	41.6 n	773.7 b
BRS 323	1782.0 b	42.1 l	750.2 b
BRS G42	1425.9 c	42.0 m	598.9 b
CF 101	2104.4 a	45.1 f	949.1 a
GNZ NEON	2132.5 a	37.8 p	806.1 a
HELIO 250	1694.7 b	43.5 h	737.2 b
HELIO 251	2204.1 a	39.1 o	861.8 a
HLA 2012	1313.0 c	46.7 c	613.2 b
M734	1673.7 b	37.6 q	629.3 b
MG 305	1993.8 a	43.3 i	863.3 a
MG 360	1836.8 a	47.8 a	878.0 a
PARAISO 20	1685.3 b	43.2 j	728.5 b
SYN 045	2108.5 a	43.6 g	919.3 a
SYN 3950HO	2205.5 a	45.2 e	996.9 a

Different letters differ by Scott-Knott test at 5% probability.

However, the ADV 5504 genotypes (47.1%) and HLA 2012 (46.7%) also showed considerable oil content. In contrast, the M734 genotype was presented the lower oil content, with the representative average 37.6%. Some industries have been remunerating the sunflower producers from the oil content contained in achenes and no longer by simple mass achenes, since not always the genotype with the highest productivity of achenes per area results in greater productivity of oil in the same area , and the oil product of greater interest at the end of the manufacturing process and currently the main commercial sunflower crop product.

Watching the oil yield data, the averages of the genotypes SYN 3950HO, AGUARA 04 CF 101, SYN 045, MG 360, MG 305, HELIO 251 and GNZ NEON were the ones that showed the highest values (Table 2), getting between 806.1 (GNZ NEON) and 996.9 kg ha^{-1} (SYN 3950HO), but all belonging to the same statistical group. Thomas et al. (2012), testing different planting dates mentioned lower oil yield for AGUARA 04 genotypes, with 928.0 kg ha^{-1}, and HELIO 250, with 717.0 kg ha^{-1}. For the M734 genotype, the value was 864.0 kg ha^{-1}.

CONCLUSIONS

For achene productivity variable stood out the AGUARA 04 and 06 genotypes, CF 101, GNZ NEON, HELIO 251, MG 305 and 360 and 045 and SYN 3950HO, whose values were ranging between 1836.8 and 2205.5 kg ha^{-1}. However, for the oil content of the MG 360 was the one with the highest percentage, especially also in the group of genotypes with the highest oil productivity values, confirming its high potential for use in production systems Brazilian savannah.

ACKNOWLEDGEMENTS

The authors would like to thank the Instituto Federal de Mato Grosso (Campo Novo do Parecis), the Research Group Phytotechnicity, the Centro Nacional de Desenvolvimento Científico e Tecnológico (CNPq - Process 402022 / 2014-9) for supporting the current research and Embrapa Soja, the supply of seeds, materials and information necessary for the development work.

LITERATURE

Backes, R.L.; Souza, A.M.; Junior, A.A.; Gallotı, G.J.M. E Bavaresco, A. Desempenho Em Cultivares De Girassol Em Duas Épocas De Plantio De Safrinha No Planalto Norte Catarinense "Performance İn Sunflower Crop İn Two Off-Season Planting Seasons İn Northern Santa Catarina Plateau". Scientia Agraria, V.9, P.41-48, 2008.

Capone, A.; Santos, E.R Dos.; Ferraz, E.C.; Santos A.F. Dos.; Oliveıra, J.L. De. E Barros, H.B. Desempenho Agronômico De Cultivares De Girassol No Sul Do Estado Tocantins "Agronomic Performance Of Sunflower Cultivars İn Southern Tocantins State". Journal Of Biotechnology And Biodiversity, V.3, P.13-23, 2012.

Castro, C. E Farias, J.R.B. Ecofisiologia Do Girassol "Sunflower Ecophysiology". In: Leıte, R.M.V.B., Righenti, A.M. E Castro, C. Girassol No Brasil "Sunflower in Brazil". Londrina: Empresa Brasileira De Pesquisa Agropecuária - Cnpso. P.163-210, 2005.

Ferreira, D.F. Sisvar: A Computer Statistical Analysis System. Ciência E Agrotecnologia, V.35, P.1039-1042, 2011.

Grunvald, A.K., Carvalho, C.P.G. De, Oliveira, A.C.B, Pıres, J.L.F., Carvalho, H.W.L., Oliveira, I.R. 2014a. Adaptabilidade E Estabilidade De Híbridos De Girassol Convencional E Alto Oleico Na Região Sul Do Brasil "Adaptability And Stability Of Conventional Sunflower Hybrids And High Oleic İn Southern Brazil". Revista De Ciências Agrárias. V.57, P.217-223,

Grunvald, A.K.; Carvalho, C.P.G. De; Leıte, R.S.; Mandarıno, J.M.G.; Andrade, C.A. De B. E Scapım, C.A. Predicting The Oil Contents İn Sunflower Genotype Seeds Using Near-İnfrared Reflectance (Nır) Spectroscopy. Acta Scientiarum Agronomy, V.36, P.233-237, 2014b.

Leıte, R.M.V.B.; Brıghentı, A.M. E Castro, C. Girassol No Brasil "Sunflower İn Brazil". Londrina: Empresa Brasileira De Pesquisa Agropecuária - Cnpso. 641p, 2005.

Poletıne, J.P; Mendes, M.A.; Sapıa, J.G. E Macıel, C.D.G. Avaliações Morfoagronômicas E Teor Óleo Em Genótipos De Girassol Nas Condições Do Arenito Caiuá "Reviews Agronomic And Oil Content Sunflower Genotypes İn The Sandstone Caiuá Conditions". Journal Of Agronomic Sciences, V.2, P.105-117, 2013.

Porto, W.S.; Carvalho, C.G.P. E Pınto, R.J.B. Adaptabilidade E Estabilidade Como Critérios Para Seleção De Genótipos De Girassol "Adaptability And Stability As Criteria For Selection Of Sunflower Genotypes". Pesquisa Agropecuária Brasileira, V.42, P.491-499, 2007.

Thomaz, G.L.; Zagonel, J.; Colasante, L.O. E Nogueıra, R.R. Produção Do Girassol E Teor De Óleo Nas Sementes Em Diferentes Épocas De Semeadura No Centro-Sul Do Paraná "Sunflower Production And Oil Content İn Seeds İn Different Sowing Times İn The Center-South Of Paraná". Ciência Rural, V.42, P.203-208, 2012.

Turattı, J. M.; Gomes, R. A. R.; Athıé, I. Lipídeos: Aspectos Funcionais E Novas Tendências "Lipids:...". Campinas: Ital, 2002. 78p.

Vıanello, R.L. E Alves, A.R. Meteorologia Básica E Aplicações "Basic Meteorology And Applications". Viçosa: Ufv. 449p, 2004.

Vogt, G.A.; Balbınot Junıor, A.A. E Souza, A.M. Divergência Genética Entre Cultivares De Girassol No Planalto Norte Catarinense "Genetic Divergence İn Sunflower Crop İn The Northern Highlands Of Santa Catarina". Scientia Agraria, V.11, P.307-315, 2010.