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Short Communication

Interrelationships among the oil and fatty acids in maize

Gül Ebru Orhun* and Kayihan Z. Korkut

Çanakale Onsekiz Mart University, Bayramiç Vocational College 17700, Çanakkale / Turkey.

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In this study, 28 F_1 maize hybrids obtained by 8x8 half diallel crossing were used, in order for the interrelationships among the oil content and fatty acids to be determined by correlation analyses. The range values for oil content of hybrids varied between 3.34 to 4.95%. The results showed positive correlation meaningfully between most traits, and it showed that oleic acid has the most possitive correlation (r = 0.655) with oil content.**

Key words: Oil, corn, fatty acids, interrelationships, correlation coefficient.

INTRODUCTION

Maize is one of the most common cereals. In 2010, maize production was 704 million tons; while in 2007, it was estimated to reach 800 million tons. Maize, with a remarkable productive potential among the cereals, is the third most important grain crop after wheat and rice (Saleem et al., 2008). The grain of modern maize hybrid contains about 4% oil (Laurie et al., 2004). Refined corn oil contains 99% triglcerides, 59% of these polyunsaturated fatty acids, 24% fatty acids and saturated, 13% monounsaturated fatty acids and saturated fatty acids. Corn oil is composed of saturated and unsaturated fatty acids with carbon chain lengths ranging from 12 to 24. Approximately 95% or more of the total oil is composed of palmitic (16:0), stearic (18:0), oleic (18:1) and linoleic (18:2). Linolenic acid(18:3) may vary from less than 0.5% to more than 2.0% (Jellum, 1970). Corn oil is considered to be a high – quality plant oil. Corn oil can help lower blood cholesterol levels and prevents hardening of the arteries.

Reduces the risk of heart disease. The international demand for quality parameters of corn hybrids such as oil, protein, carbonhydrates and starch is increasing because of technological and nutritional reasons (Bilgin et al., 2010). The presence of unsaturated fatty acids in corn oil, increases the quality of the oil. Corn breeders have long recognized the potential for higher oil and oil fatty acids concentrations between fat and fatty acids examined. The studies related to correlation has recently been studied in some crop by Barbaro et al. (2006) and Asghari-Zakaria et al. (2007). Estimation of simple correlation between various agronomic characters may provide good information necessary for maize breeders, when, selection is based on two or more traits simultaneously (Khayatnezhad et al., 2010).

Plant breeders have to study the degree of characters association (Ahmad and Saleem, 2003). Present studies were conducted with a view to finding out the nature and extent of character association at genotypic level and the criterion for indirect selection for oil and oil acids content in maize. Therefore, to investigate the reletionships of corn grain oil, fatty acids concentration correlation analyses was aimed at in this study. Correlations obtained for studied character could also be useful as indicators of the more important ones under consideration.

MATERIALS AND METHODS

In this study, 28 F_1 hybrids obtained by 8x8 half diallel crossing and 8 inbred dent corn were used as the material. Experiments were conducted in randomized block design with 4 replicates. This study was carried out in Edirne ecological conditions 2007 to 2008 growing season. Hand sowing was done in 4-rowed plots having 5 m length. Fertilization was applied as on the base of 10 kg pure nitrogen (N), 8 kg pure phosphorus (P_20_5) and 8 kg potassium (K_20) before sowing. The weeds were controlled by hand hoeing. During the vegetation, 4 times irrigation was made. Ears of plants were harvested at the time of maturation by hand. Then the grains were

*Corresponding author. E-mail: eborhun@gmail.com, ebruorhun@comu.edu.tr.

Table 1. Results of analysis of variance for studied traits.

Source	Df	Oil content	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid
Replication	3	0.173	0.001	0.740	0.001	0.001	0.001
Genotypes	35	2.310**	3.002*	1.799*	3.686*	3.818*	2.795*

**:0.01, *0.05.

Table 2. The range values of twenty-eight maize hybrids.

	Oil content (%)	Palmitic acid (%)	Stearic acid (%)	Oleic acid (%)	Linoleic acid (%)	Linolenic acid (%)
Range (min)	3.34	9.63	1.96	23.26	42.23	0.722
Range (max)	4.95	12.06	2.76	43.41	60.97	1.281

Table 3. Correlation coefficients between traits.

Characters	Oil content	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid
Oil	1					
Palmitic	-0.219	1				
Stearic	0.031	0.416**	1			
Oleic	0.655**	-0.455**	-0.001	1		
Linoleic	-0.674**	0.317**	-0.127	-0.980**	1	
Linolenic	-0.436**	0.530**	0.097	-0.557**	0.514**	1

separated from the cobs and dried to 15% moisture content. The grains were threshed by hand.

% oil content of grains was determined according to the method (TSE-973 EN ISO- 659 February 2000). The oil was extracted from each sample with hexane as a solvent by using Gerdhardt soxhlet. Faty acid compositions were determined by using the UPAC model Gas- Liquid Chromatography (Anonymous, 2000). Saturated fatty acids and unsaturated fatty acids content were calculated fom the chromatographic results. The statistical analysis was carried out by the Steel and Torrie (1960) method, using the computer packaged program. Correlation coefficients were calculated using the Tarpopgen packaged program.

RESULTS AND DISCUSSION

The components of maize oil are of importance for the quality of grain, so oil and oil acid content and their relationships are an important role, in its nutritional and industrial value. Results of analysis of variance (Table 1) indicated that, there were significant differences among the genotypes in the studied traits. All F genotype values are significant. This conditions the high potential of the geneotypes so that they can be used as the genetical source for breeding aims. The range values for oil content, palmitic acid, stearic acid, oleic acid, linoleic acid and linolenic acid of 28 F_1 hybrids are shown in Table 2. The range values for oil content of hybrids varied between 3.34 to 4.95%. Such results are reported by Mittelman et al. (2003), Wassom et al. (2008), and Jellum and Widstrom (1970, 1983) stated the range values for stearic acid varied between 1 to 3%.

Dağlioğlu et al. (2006), reported the range values for oleic acid to vary between 19.79 to 38.58%, for linoleic acid 38.97 to 64.43%, for linolenic acid 0.78 to 1.84%, for palmitic acid 9 to 18.70%, for stearic acid 1.51 to 3.46%. Wassom et al. (2008), reported the maximum values for oleic acid 51%, for linoleic acid 59.6%, for palmitic acid 15.4% and for stearic acid 41.6% discovered. Goffman and Böhme (2001), reported that the major fatty acids were palmitic, oleic, and linoleic acids, whose contents were in the ranges 9.2 to 12.1%, 19.5 to 30.5%, and 53.0 to 65.3%, respectively. These results are similar to our results (Table 2). Correlation values between traits are illustrated in Table 3. Results showed that oleic acid has the most positive correlation (r = 0.655**) with oil content. The results of Bilgin et al. (2010), Wassom et al. (2008) and Pamin et al. (1986), stated that oil content was positively correlated with oleic acid; but linoleic acid and linolenic acid showed negative correlation with oil content (r = -0.674** and r = -0.436). A highly significant positive correlation between oil content and oleic acid content indicated the possibility of simultaneous improvement in oil quality and quantity. Lofland et al. (1954), in their study, showed that the percentage of linoleic acid in the oils ranged from 15.7 to 67.6% and varied inversely with oil content (r = –0.691) and oleic acid ranged from 16.5 to 75.9% for corn. In addition, there was a low negative correlation between linoleic acid content and oil content (Patel, 1990). As it can be seen from Table 3, oleic acid

showed the most negative correlation with linoleic acid (r = -0.980**) and a negative correlation with linolenic acid (r = -0.557**). Similar results were reported by Fick and Miller (1997) for sunflower, and Bilgin et al. (2010) for maize.

In Table 3, palmitic and stearic acids showed non-significant correlation with oil content for maize. Similar results were determined by Bilgin et al. (2010). In their study, palmitic and stearic acids were correlated with oil content negatively and non-significantly (Bilgin et al., 2010). Secondly, linolenic and stearic acids showed the most positive correlation with palmitic acid (r = 0.530** and r = 0.416**) and linolenic acid showed positive correlation with linoleic acid (r = 0.514**). Linoleic and linolenic acids showed negative correlation with oil content (r = -0.674** and r = -0.436). Such results are reported by Bilgin et al. (2010), Wassom et al. (2008) and Pamin et al. (1986).

Conclusion

In summary, unsaturated fatty acids (oleic, linoleic and linolenic) have showed significant correlations with oil content, but saturated fatty acids (palmitic, stearic) have showed non-significant correlations with oil content. That is a direct relationship between oil content and fatty acids have been observed for maize.

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