Journal of Microbiology, Biotechnology and Food Sciences

Černý et al. 2013 : 2 (Special issue 1) 1739-1747

REGULAR ARTICLE

EVALUATION OF YEAR WEATHER CONDITIONS AND HYBRIDS IMPACT ON THE SUNFLOWER (*HELIANTHUS ANNUUS* L.) ACHENE YIELD AND FAT CONTENT

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ABSTRACT

The field polyfactorial trials were carried out on experimental fields of the Plant Biology and Ecology Centre, the Faculty of Agrobiology and Food Resources of the Slovak University of Agriculture (SUA) in Nitra Dolná Malanta in two experimental years 2010 and 2011. Experimental locality is situated in the corn production area (climatic region: warm; climatic sub-region dry; climatic zone: warm, dry with mild winter and long sunshine), in altitude 250 m above sea level, with brown soil. On the trials was observed the influence of both temperature and moisture conditions of experimental area on sunflower yield of achenes and fat content. Fore crop of sunflower was spring barley (*Hordeum vulgare* L). Technological system of sunflower cultivation was realized in accordance with conventional technology of cultivation. The basic fertilization was made by balance method on the base of agrochemical analysis of soil for expected yield 3 t ha^{-1}. The meteorological data were got out from agro-meteorological station the Faculty of Horticulture and Land Engineering SUA in Nitra. The results show statistically high significant impact of the year weather conditions on

the both achenes yield and fat content. In the range of weather conditions, year 2011 have better impact on the values of both indicators than year 2010. The effect of hybrids on monitored production parameters was statistically high significant. In the year 2010 and 2011, in terms of yield quantity but also fat content had hybrid NK Kondi the most stable production. In 2010 and 2011 were reported negative correlations of fat content from achenes yield except of hybrid NK Tristan, which reach positive addiction in 2010.

Key words: sunflower, year weather conditions, hybrid, yield, fat content

INTRODUCTION

The formation of crop production is very complex process conditioned by function and multiplicity factors that create the complex dynamic structure of growth, physiological and biochemical processes in the interactions. The sunflower growth fully reflected the developmental processes of the organism and processes of metabolites. Althought dependence of the each element of this chain on environmental conditions is different. Impact of the year weather conditions considered **Bajči *et al.*, (1997), Brandt *et al.*, (2003), Szabó (2008) and Černý *et al.*, (2011)** as decisive. Their collaboration is responsible for regulating the length of individual growth phases in which is formed the quantity and quality of the final production.

Sunflower is considered as market and environmentally attractive crop. Sunflower seeds are a rich source of oil and protein. Oil, due to its high content of polyunsaturated fatty acids and high levels of fat-soluble vitamins, is evaluated positively in dietary terms **(Kovacik, 1995)**.

Kováčik (2004), considered as an important factor in the successful sunflower cultivation suitable choice of hybrids. For maximum effect of sunflower hybrid genetic potential is required "his" powerful agro-ecological environment in which yield is given by complex and the complexity of the relationship between the genetic potential of hybrid and soil – weather conditions of cultivation site. The results show that in areas with warmer and drier climate differences between hybrids in oil content and composition are greater than in cooler and humid areas. **Cole *et al.* (1998)** found the fact that the impact of the cultivation sites with different weather conditions is minimal at high oil hybrids.

The paper was aimed to assess the impact of the experimental base weather conditions and hybrids on the sunflower achene yield and fat content. Find intensity of fat content dependence on sunflower hybrids achene yield.

MATERIAL AND METHODS

The field polyfactorial experiments were carried out on the Experimental base of the Centre of Plant Biology and Ecology, FAFR SUA in Nitra Dolná Malanta. Experimental base is localized in the warm corn production area (climatic region: warm; climatic sub-region dry; climatic zone: warm, dry with mild winter and long sunshine, with brown soil, anthrosols).
The fore crop of sunflower (*Helianthus annuus* L.) was spring barley (*Hordeum vulgare* L.). Basic fertilization was made using the balance method on the base of agrochemical soil analysis for yield 3 $t.ha^{-1}$. In 2010 was applied urea (46 % N) in dose 120 kg N ha^{-1}. Amount of phosphorus and potassium in soil was good to high (Tab. 1).

Tillage (stubble ploughed under, deep autumn plowing), the way of setting up of sunflower (interline distance 0.70 m, distance in row 0.22 m), were made by conventional technology of sunflower cultivation.

In this experiment were used hybrids NK Dolbi (double line, mid-late, mid-high hybrid), NK Kondi (double line, early , lower to medium high hybrid) and NK Tristan (double line, early , lower to medium high hybrid).

The yield of achenes was calculated as yield per hectare in the range of each experimental variant. The fat content was determined by extraction method on Soxhlet in labs of Centre of Plant Biology and Ecology Dolná Malanta.

Basic meteorological data (average monthly temperatures in °C, monthly precipitation in mm) for each experimental year were obtained from meteorological station the Faculty of Horticulture and Land Engineering, SUA in Nitra (Tab. 2). Experiments were carried out by the split plot design with randomize complete blocks base design **(Ehrenbergerová, 1995)** in three replications. Statistical evaluation of the experimental factors was processed by the multifactor analysis of variance and correlation analysis by STATISTICA 8 software.

Table 1 Climatic and soil conditions of experimental locality

Characteristics		Value	
altitude		250 m above sea	
production area		corn	
climatic region		warm	
climatic subregion		very dry	
climatic district		warm, dry with mild winter and long sunshine	
CLIMATIC CHARACTERISTIC			
		2010	2011
average air temperature	per year	10.3 °C	9.9 °C
	per vegetation periode	18.4 °C	17.05 °C
sum of precipitation	per year	581.2 mm	409.9 mm
	per vegetation periode	385.8 mm	299.4 mm
SOIL CHARACTERISTIC			
soil type		brown soil	
		2010 spring	2011 spring
content	available N_{an} (by Kjeldahl method)	4.4 mg kg^{-1}	3.3 mg kg^{-1}
		2009 autumn	2010 autumn
	available P (by Mehlich III method)	38 mg kg^{-1}	62 mg kg^{-1}
	available K (by Mehlich III method)	395 mg kg^{-1}	435 mg kg^{-1}
	humus (by Ťjurin method)	2.17 %	2.18 %
pH/KCl		6.34	6.25

Table 2 Temperature and precipitation conditions of experimental locality

Month	Ideal demand for sunflower (i)		2010		2011	
	∑ mm	X_{td} °C	∑ mm	X_{td} °C	∑ mm	X_{td} °C
IV.	27.5	10	83.8	11.1	13.2	13. 7
V.	77.6	12	182.2	15.6	48.4	16.1
VI.	13.6	16	147.5	19.4	91.1	19.6
VII.	14.6	19	72.4	22.8	121.6	19.7
VIII.	95.4	18	54.2	19.6	152.3	22.1
IX.	12.2	15	70.1	14	92.1	19.2

X_{td} – average monthly temperatures

RESULTS AND DISCUSSION

Pulkrábek *et al.* (2007), **Veverková (2012)** state that the year weather conditions are an important factor participating in the yields formation of all crops. In terms of experimentally defined goals should be noted that the year weather conditions were very erratic. This means that the real temperature and rainfall balance during the individual years were differentiated, which resulted in a mismatch between the real state and the physiological requirements of the crops to temperature and humidity security**.**

The obtained results suggest that weather during years influenced both achenes yield and fat content statistically high significantly (Table 4). Weather conditions in 2010, in comparison with an ideal demand for sunflower **(Černý *et al.*, 2011)** were characterized by above-average rainfall mainly in the months of May, June, July and September. Average monthly temperatures were at an appropriate level (Table 2). In 2011, more precipitation was recorded only in the months of June and July, the course of temperatures during the growing season was higher than ideal need (Table 2). The experimental results confirmed the fact that the year 2011 was statistically significantly better for sunflower cultivation, the results show also statistically high significantly influence of biological material whether in the achieved achenes yields or the fat content in achenes (Table 3, 4). The tendency from results obtained by us confirmed experiments og **Simić *et al.* (2008)**, which in the year with excessive precipitation in average reached lower achene yield.

The correct selection of the hybrid is one of the most important factors influencing the success of growing sunflower **(Karaba 2005)**, in which must be taken into account focus of final production, hybrid maturity, potential yield with corresponding quality indicators and tolerance to economically important diseases **(Baranyk *et al.*, 2010)**. Our results (Table 3, 4) confirmed statistically highly significant different reaction of sunflower on final production. In 2010, the highest achenes yield (+0.51 t ha^{-1}) reached NK Kondi compared with hybrid NK Dolbi, which reached lowest yield. In 2011, the highes achenes yield (+0.75 t ha^{-1}) was recorded again with NK Kondi, compared with hybrid NK Tristan, which reached lowest yield (Tab. 3). The same tendency was also found in the assessment of fat content in achenes, where in 2010 the highest fat content (+1.47 %) was recorded with hybrid NK Kondi in comparison with hybrid NK Dolby, which recorded the lowest fat content. In 2011 the highest fat content (+13.11 %) was recorded with hybrid NK Kondi in comparison with hybrid NK Tristan, in which was recorded the lowest fat content (Tab. 3).

Table 3 The average achene yield and fat content of the hybrids

Indicator	Hybrid	2010	2011
Achene yield ($t\ ha^{-1}$)	NK Dolbi	2.38	4.07
	NK Kondi	2.89	4.19
	NK Tristan	2.58	3.44
Fat content (%)	NK Dolbi	40.75	52.04
	NK Kondi	42.22	56.30
	NK Tristan	41.95	43.19

Table 4 Analysis of Variance for sunflower achene yield and fat content

	Degrees	SČ	PČ	F	p
		Achene yield			
Abs. member	1	570.3100	570.3100	9788.951	0.000000
year	1	24.3076	24.3076	417.223	0.000000
hybrid	2	3.0145	1,5072	25.870	0.000000
		Fat content			
Abs. member	1	114659.0	114659.0	34778.19	0.000000
year	1	1064.3	1064.3	322.81	0.000000
hybrid	2	403.3	201.7	61.17	0.000000

Correlation analysis has investigated dependence of the fat content from achene yield. The results in 2010 reported negative correlation with NK Dolby and NK Kondi hybrid, but a positive correlation with the hybrid NK Tristan (Fig. 1, 5). In 2011 were recorded negative correlations for all three hybrids (Fig. 2, 4, 6). It follows the fact that despite diametrally different growing year dependence of the fat content from achenes yield is negative, which means that with increasing achenes yield dropped fat content in achenes. The results obtained in 2011 confirmed the findings of **Bagiu (2007)**, who concluded that the amount of fat content in achenes is positively correlated with achenes yield. The reaction of biological material was confirmed in the year 2010 with adverse weather conditions, where a positive correlation was found only in NK Tristan.

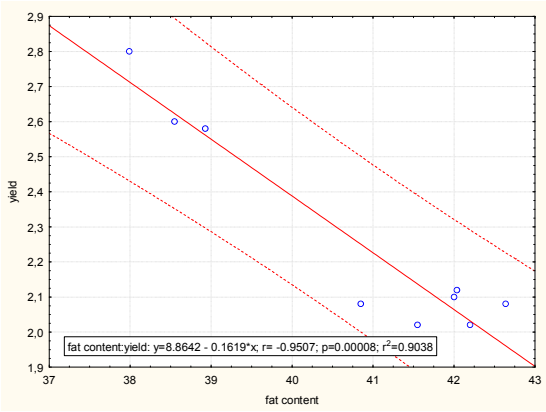

Figure1 Dependence between fat content and achene yield of hybrid NK Dolbi in 2010

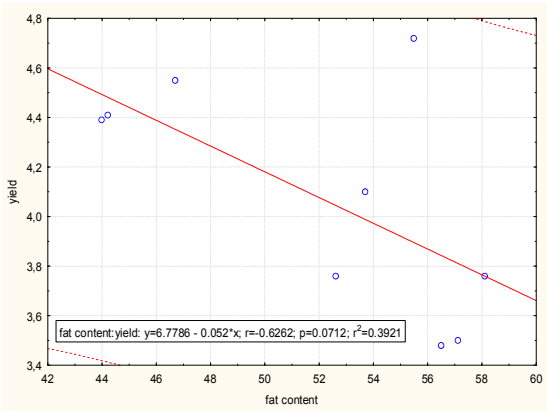

Figure 2 Dependence between fat content and achene yield of hybrid NK Dolbi in 2011

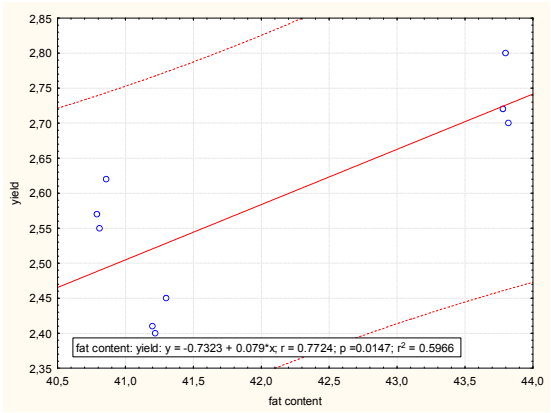

Figure 3 Dependence between fat content and achene yield of hybrid NK Tristan in 2010

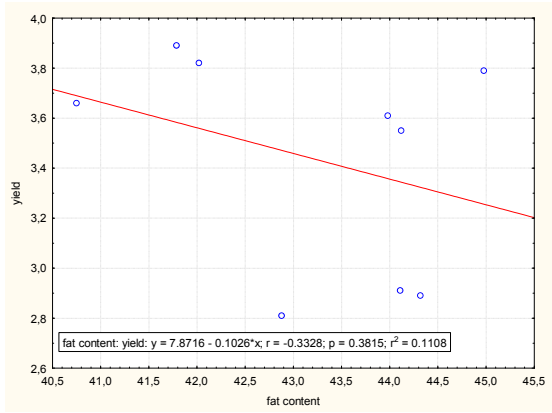

Figure 4 Dependence between fat content and achene yield of hybrid NK Tristan in 2011

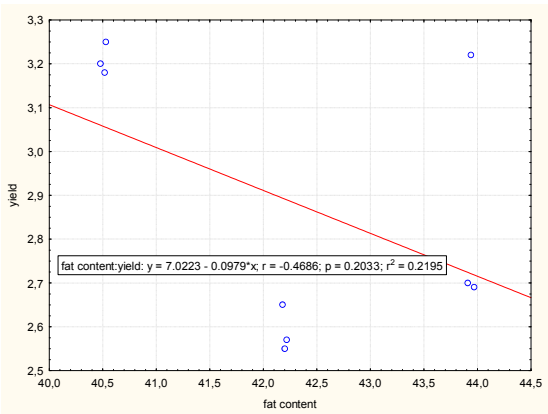

Figure 5 Dependence between fat content and achene yield of hybrid NK Kondi in 2010

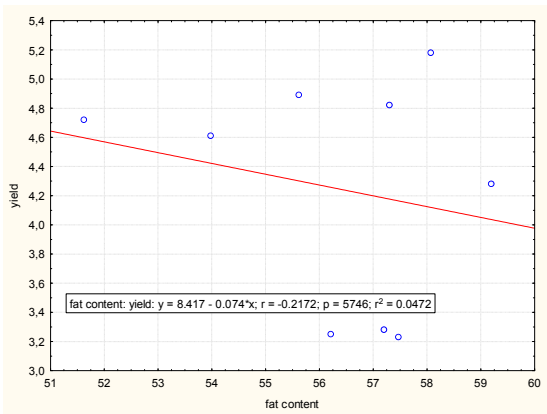

Figure 6 Dependence between fat content and achene yield of hybrid NK Kondi in 2011

CONCLUSION

In two year field polyfactorial experiment, carried out in 2010 and 2011, was determined the impact of weather conditions of locality and sunflower hybrids NK Dolbi, NK Kondi and NK Tristan on the sunflower achenes yield and fat content. As well determine dependence of fat content from sunflower hybrids achene yield. The results show that for sunflower growing were statistically high significantly better year 2011 and its weather conditions, for both production parameters achene yields and fat content. Hybrids reaction was statistically high significantly different, where in the year 2010 and 2011 in terms of quantity and quality was more productive hybrid NK Kondi. In the years 2010 and 2011 were reported negative correlation of fat content from achene yield, except of hybrid NK Tristan, which made a positive addiction in 2010.

Acknowledgments: This work was supported by Scientific Grant Agency of Ministry of Education in Slovak Republik, number of project VEGA 1/0388/09/8 Rationalization of cultivation system of Sunflower (*Helianthus annuus L.*) in the conditions of climatic change.

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