

SUNFLOWER YIELD FORMATION INFLUENCED BY YEAR WEATHER CONDITIONS, GENETIC MATERIAL AND FOLIAR NUTRITION

Černý I.¹, Mátyás M.¹, Kovár M.²

¹Department of Crop Production, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic

²Department of Plant Physiology, Faculty of Agrobiology and Food Resources, Slovak University of Agriculture in Nitra, Tr. A. Hlinku 2, 949 76 Nitra, Slovak Republic

E-mail: xmatyas@is.uniag.sk

ABSTRACT

In 3-years polyfactorial experiments realized in field conditions with different sunflower hybrids were studied the impact of foliar preparations Unicum and Terra-Sorb on achenes yield and fat content. The observed results confirmed the statistically significant influence of year weather conditions, genetic material and foliar preparations on sunflower achenes yield. Fat content in achenes was statistically highly significantly influenced by year weather conditions and used genetic material. The effect of both foliar preparations on fat content in achenes was statistically nonsignificant. The highest average yield of achenes (3.90 t ha⁻¹) was reached in 2011. The highest average content of fat in achenes (52.79 %) was detected in 2011. As the most adaptable was observed hybrid NK Neoma, in which was observed the highest average yield (3.26 t ha⁻¹) and fat content (51.15 %) for the whole period. For sunflower cultivation were more appropriate environmental conditions of experimental year 2011. The hybrid NK Neoma achieved the highest achenes yield (4.19 t ha⁻¹) and fat content in achenes (56.3%) in 2011. In the range of applications, the highest achenes yield (4.33 t ha⁻¹) and the highest fat content in achenes were achieved after application of preparation Unicum (53.75%).

Key words: year conditions, genetic material, foliar nutrition, sunflower, achenes yield, fat content

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INTRODUCTION

The process of field crops yield formation in a field is influenced by the presence of many factors. The agro-ecological factors still have the dominant role (Brandt *et al.*, 2003). Field production process and the final production of sunflower are significantly affected by extreme weather events. Temperature and precipitation changes during vegetation period can be considered as the most important causes of yield variability. Effect of extreme climatic conditions depends on the crop growth phase (Banayan, 2010; Lobell *et al.* 2007) Sunflower hybrid selection is crucial for maximal expression of genetic potential under soil and environmental conditions (Černý and Töröková, 2008). Selection of sunflower hybrid and most quality seed are important activities influences the quantity and quality of final achenes production, especially in intensive cultivation (Mojiri *et al.*; 2003 Ferreras *et al.*; 2000).

With this state agree Gallikova (2007) too, who in terms of the complexity of the conditions to maximize the yield potential of crops, under adequate soil - climatic conditions, highlights the complexity of macro and micro-nutrients nutrition factor.

We can ensure optimal nutrition for plants with proper foliar fertilizers application. Their application can supply plants not only with basic biogenic elements and microelements but also with various stimulants (Varga, 2011). Among such stimulants includes biologically active substances, thus substances which affect physiological and morphogenetic properties of plants. They are mostly substances assigned to plant hormones, their chemical analogues, or a simple metabolic regulators that influence the course of biochemical reactions, respective (Oosterhuis and Robertson, 2000).

The aim of field experiments were to evaluate the effects of year weather conditions and foliar application of biologically active substances on the production performance and achenes yield quality of different sunflower hybrids.

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, characterized by the warm and moderately dry environmental conditions, with mild winters and long sunshine, with brown soil, anthrosols.

The fore crop of sunflower (*Helianthus annuus* L.) hybrids in individual experimental years was winter wheat (*Triticum aestivum* L.). Basic fertilization was made on the base of agrochemical soil analysis for yield 3 t.ha⁻¹ using the balance method. Tillage (stubble ploughed under, deep autumn plowing), the way of setting up of sunflower (interline and row distance 0.70 and 0.22 m, respectively), were made by conventional technology of sunflower cultivation.

In the range of genetic material were used hybrids: a) NK Brio (double line hybrid, with a normal type of oil), b) NK Neoma (double line late hybrid with a normal type of oil) and c) NK Ferti (double line medium early hybrid, with a higher proportion of oleic acid).

In the experiment were used two biological preparations: a) Unicum (plant growth and immunity stimulator in the form of an aqueous emulsion, liquid concentrate designed to increase the yield and quality of vegetable products. The preparation contains abiestins) and Terra-Sorb (special biostimulator containing pure amino acids of animal origin).

Levels of dose and time of foliar application of both preparations are shown in table 1.

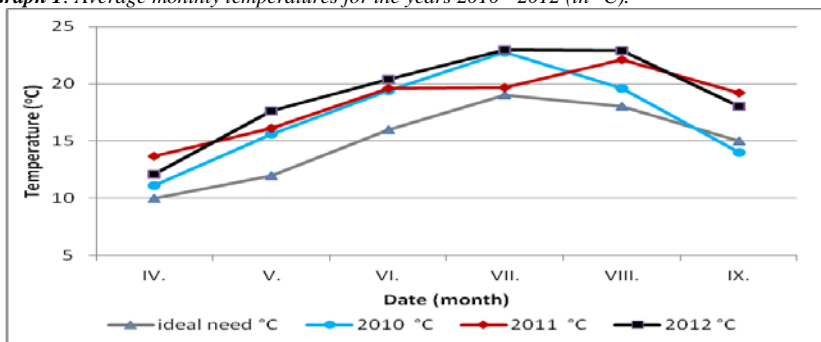
Tab. 1 The doses and time applications of biologically active preparations.

Variant	Term of treatment	Dose
Control	-	-
Terra-Sorb	2 – 4 true leaves 20 days after 1 st application	1.5 l ha ⁻¹ 1.5 l ha ⁻¹
Unicum	2 – 4 true leaves Beginning of flowering	200 ml ha ⁻¹ 200 ml ha ⁻¹

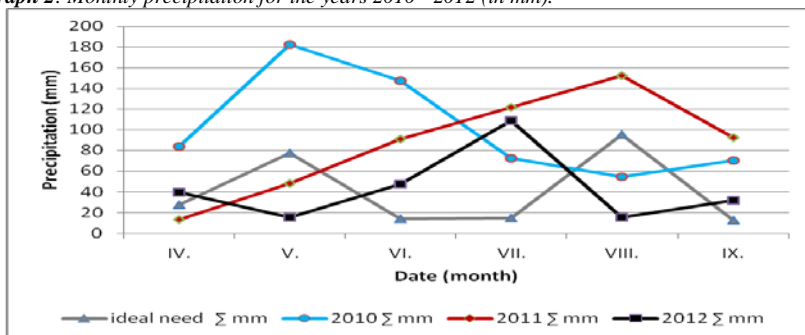
Basic meteorological data (average monthly temperatures in °C and sum of monthly precipitation in mm) for each experimental year were obtained from meteorological station the Faculty of Horticulture and Land Engineering, SUA in Nitra (Graph 1, 2).

The experiments were established by split plot design with randomized complete blocks base with three replications. The results of the experiment were statistically analyzed by ANOVA, through standard graphical and statistical methods statistical package Statistica for Windows.

Graph 1: Average monthly temperatures for the years 2010 - 2012 (in °C).



Graph 2: Monthly precipitation for the years 2010 - 2012 (in mm).



RESULT AND DISCUSSION

The production process of sunflower is significantly influenced by year weather conditions (Šrojtová, 2006). Weather conditions during the different experimental years were significantly misaligned. Year 2010 was characterized by excessive precipitation in the first half of the growing

season. Year 2012 had less precipitations amount in compared with 2010 and 2011 (Graph 1 and 2).

Effect of environmental conditions during year on achenes yield was statistically high significant (Table 4 and 8). The average achenes yield for the period was 3.07 t ha^{-1} . The highest achenes yield (4.19 t ha^{-1}) was reached in 2011 (Tab 2) which was more precipitation in the second half of the growing season. The fat content was statistically high significantly affected by weather conditions too (Table 5 and 8). The average fat content in sunflower achenes for the year was 48.35%. The highest fat content (56.3%) was found in 2011 (Table 2).

An important factor in the sunflower growing technological system is selection of both performance and stable seed, respectively the genetic origin of hybrids (Kováčik, 2004). Our results confirmed this fact that achenes yield was significantly influenced by the hybrid selection (Tab. 8). However, this dependence is typical for the evaluation of fat content. The best adaptability to both soil and ecological conditions expressed hybrid NK Neoma, where was observed the average yield of achenes 3.26 t ha^{-1} . Hybrid NK Neoma reached the highest achenes yield (4.19 t ha^{-1}) in 2011. The lowest yield of achenes (2.38 t ha^{-1}) was observed in NK Brio in 2010 (Tab 2). In terms of fat content, the most powerful was hybrid NK Neoma (51.15 %). The highest fat content in achenes reached hybrid NK Neoma (56.3 %) in 2011 and the lowest NK Brio (41.08 %) in 2010 (Tab 2).

Černý *et al.* (2011) and Tahsin (2005) concluded the significant effect of leaf preparations on both the achenes yield and fat content, respectively. In the experimental conditions of years 2010 to 2012 was found statistically high significant influence of the leaf preparations on the achenes yield of sunflower. Statistically significant difference in achenes yields was found between control variant and variants after foliar application of Terra-Sorb and Unicum (Table 6, 8). The average achenes yield during the reporting period, due to the level of treatment was 3.06 t ha^{-1} . The highest achenes yield (4.33 t ha^{-1}) for the reporting period 2010 - 2012 was observed at the variant with Unicum application in 2011, while the lowest (2.37 t ha^{-1}) was observed at the variant with Terra-Sorb application in 2010 (Table 3). The influence of leaf preparations on the fat content was statistically inconclusive (Table 7, 8). The average fat content for the period was 48.35%. The highest fat content (53.75%) was observed at variant with Unicum application in 2012 and the lowest (40.98%) at variant with Unicum application in 2010 (Table 2).

Table 2 Average achenes yield and fat content of the hybrids.

Indicator	Hybrid	2010	2011	2012	Average
Achenes yield (t ha^{-1})	NK Brio	2.38	4.07	2.73	3.06
	NK Neoma	2.89	4.19	2.7	3.26
	NK Ferti	2.58	3.44	2.62	2.88
	Average	2.62	3.90	2.68	3.07
Fat content (%)	NK Brio	41.08	52.04	51.95	48.35
	NK Neoma	42.22	56.30	54.93	51.15
	NK Ferti	41.95	43.19	51.52	45.55
	Average	41.75	50.51	52.79	48.35

Table 3 Average achenes yield and fat content at variants with leaf preparations.

Indicator	Variant	2010	2011	2012	Average
Achenes yield (t ha ⁻¹)	Terra-Sorb	2.37	3.23	2.87	2.82
	Control	2.66	4.14	2.43	3.07
	Unicum	2.82	4.33	2.75	3.30
	Average	2.62	3.9	2.68	3.06
Fat content (%)	Terra-Sorb	40.99	52.32	53.53	48.95
	Control	43.29	50.65	51.09	48.34
	Unicum	40.98	48.56	53.75	47.76
	Average	41.75	50.51	52.79	48.35

Table 4 The effect of weather conditions on achenes yield of sunflower (LSD test).

Year	Achenes yield (t ha ⁻¹)	1	2
2010	2.62	****	
2011	3.90		****
2012	2.68	****	

Table 5 The effect of weather conditions on fat content in achenes of sunflower (LSD test).

Year	Fat content (%)	1	2	3
2010	41.75	****		
2011	50.51		****	
2012	52.79			****

Table 6 The effect of treatments by foliar preparations on achenes yield of sunflower (LSD test).

Treatment	Achenes yield (t ha ⁻¹)	1	2	3
Terra-Sorb	2.82	****		
Control	3.07		****	
Unicum	3.30			****

Table 7 The effect of treatments by foliar preparations on fat content in achenes (LSD test).

Treatment	Fat content (%)	1
Terra-Sorb	48.95	****
Control	48.34	****
Unicum	47.76	****

Table 8 Analysis of Variance

	DF	SS	MS	F	P
Achenes yield					
Intercept	1	761.6987	761.6987	17022.20	0.000000
Year	2	28.2697	14.1349	315.88	0.000000
Hybrid	2	1.9928	0.9964	22.27	0.000000
Variant	2	3.0696	1.5348	34.30	0.000000
Replications	2	761.6987	0.0892	1.99	0.147279
Fat content					
Intercept	1	189360.4	189360.4	33156.36	0.000000
Year	2	1834.1	917.1	160.58	0.000000
Hybrid	2	422.6	211.3	37.00	0.000000
Variant	2	18.9	9.5	1.66	0.201775
Replications	2	5.3	2.6	0.46	0.634104

Legend: DF – degree of freedom, SS – sum of squares, MS – mean of squares

CONCLUSIONS

The aim of the field experiments conducted in cultivation periods of years 2010 - 2012 on experimental base of Center of Plant Biology and Ecology FAFR Slovak University of Agriculture was to assess the impact of year weather conditions, hybrids and foliar fertilizer Unicum and biostimulator Terra-Sorb on sunflower achenes yield and fat content. The results showed statistically significant influence of year weather conditions, genetic material and the application of preparations on sunflower achenes yield. In terms of achieved yield were the appropriate conditions for sunflower cultivation in the year 2011, hybrid NK Neoma and application of foliar fertilizer Unicum.

Fat content was statistically high significantly affected by year weather conditions and used hybrid. The impact of foliar preparations on fat content in achenes was statistically nonsignificant. In the range of experimental years 2010 - 2012 was achieved the highest fat content in the year 2011. The most powerful, in terms of fat content, was hybrid NK Neoma and application of biostimulator Terra-Sorb.

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