INFLUENCE OF HYBRIDS ON FORMATION OF YIELD-FORMING ELEMENTS OF SUNFLOWER (*HELIANTHUS ANNUUS* L.)

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ABSTRACT

Field polyfactorial trial was carried out on experimental base Center of the Plant Biology and Ecology in Nitra Dolná Malanta in years 2009 – 2010. In the experiment was studied the impact of temperature and precipitation conditions of experimental years 2009 and 2010 on creation of yield – forming elements (number of plants per unit area, number of heads per unit area, average of head, weight of head, WTA – weight of thousand achenes), yield and fat content of sunflower. Within biological material were used hybrids NK Ferti and NK Simfoni. Experimental years 2009 and 2010 were in term of weather conditions very different. From total evaluation of impact of experimental year and biological material on creation and forming of yield - forming elements flows that more favorable was year 2009 for temperatures and precipitation. Higher yields and fat content were found in year 2010. Within the yield – forming creation, quantity and quality was more preferable the hybrid NK Ferti.

Keywords: weather conditions, sunflower hybrids, yield – forming elements

INTRODUCTION

The yield variability and final production of crops are influenced mainly by the weather conditions. The influence of a weather conditions is decisive in the yield creation process of oilseeds and other crops. Their interaction leads to regulation of particular growth phase, due to be forming quantity and quality of yield-forming elements **(Brandt *et al.*, 2003).**

The sunflower as an oilseed crop belongs to broad-line crops with lower compensation ability between the yield – forming elements. As a main indicator for final evaluation of this crop group mentions the oil yield per unit area. To basic yield – forming elements of sunflower belong the number of plants per hectare, oil yield per plant, where is evaluating the weight of one achene and number of achenes per plant and achene oiliness **(Baranyk *et al.* 2010).**

The one of the most important factors, which impacts the sunflower cultivation, is the right hybrid selection. Recently is applied the adapting cultivation technology to individual hybrids. The hybrids influence not only yield and fat content but also individual yield – forming elements **(Karaba, 2005). Černý *et al.* (2010)** emphasize that sunflower cover creates the complicated dynamic system with both soil and climatic factors, where the selected crop is considered as a less adaptive element.

Oil yield is also affected by many characters, among these, the most important are plant number per unit area, number of grains per plant, hectolitre mass, 100-grain weight, husk content, oil content in grain and grain yield **(Joksimović *et al*., 1999). De la Vega** and **Chapman (2001)** describe the differences between the hybrids in yield creation. They found negative effect between number of achenes and WTA. Most productive hybrids had average value of both WTA and number of achenes.

The aim of study was evaluate the impact of weather conditions of year and hybrids on creation of sunflower yield – forming elements, yield and fat content.

MATERIAL AND METHODS

Field polyfactorial trial was carried out on experimental base of the Center of Plant Biology and Ecology in Nitra Dolná Malanta in years 2009 – 2010. The experimental locality is in maize production area characterized as a warm and dry with mild winter and longtime sunshine. The trials were established on brown soil.

Forecrop of sunflower (*Helianthus annuus* L.) was wheat (*Triticum aestivum* L.). Tillage (stubble ploughed under, deep autumn tillage), the way of setting up of sunflower (sowing date II. decade of April, spacing 0.70 x 0.22 m), were made by conventional technology of sunflower cultivation. Basic fertilization was made using the balance method on the base of agrochemical soil analysis for yield level 3 tons per hectare.

SOIL CHARACTERISTICS			
soil type		brown soil	
		2009	2010
content	available N_{an}	8.7 mg.kg^{-1}	11.1 mg.kg^{-1}
	available P	29 mg.kg^{-1}	22 mg.kg^{-1}
	available K	254 mg.kg^{-1}	265 mg.kg^{-1}
	available Ca	850 mg.kg^{-1}	600 mg.kg^{-1}
	available Mg	458 mg.kg^{-1}	463 mg.kg^{-1}
	Humus	1.98 %	1.97 %
pH/KCl		5.65	6.19

In 2009 were applied mineral fertilizer NPK (15:15:15) in dose corresponding to 47 kg N.ha^{-1}, 22.6 kg P.ha^{-1} and 39.3 kg K.ha^{-1}. In 2009 were applied mineral fertilizer NPK (8:24:24) in dose corresponding 38kg N.ha^{-1}, 35.4 kg P.ha^{-1} and 53.8 kg K.ha^{-1}.

The experiment was established by split plot design with randomized complete blocks base design in three replications.

Used biological material:

- NK Ferti: two-line hybrid, medium early, moderately high,
- NK Simfoni: two-line hybrid, medium late, moderately high.

Monitored yield-forming elements:

- plant number per unit area (member per hectare),
- head number per unit area (member per hectare),
- average of head (mm),
- weight of head (g),
- WTA – weight of thousand achenes (g),
- achene yield (t ha^{-1}),
- fat content (%).

In the trial were monitored temperature and precipitation conditions of experimental years 2009 – 2010, which are given in the tables 1, 2. These values were achieved from

agrometeorological station of the Department of Biometeorology and Hydrology, Faculty of Horticulture and Landscape Engineering of SUA in Nitra.

The results of trials were evaluated by programs of Microsoft Excel and in statistical program Statistica 7 (polyfactorial analysis of variance).

Table 1 Average temperatures of years 2009 - 2010

Month	Climatic Normal (°C)	2009			2010		
		Temperatures (°C)	Δ t	Characteristic of month	Temperatures (°C)	Δ t	Characteristic of month
IV	10.4	11.0	0.6	normal	10.6	-0.5	normal
V	15.1	16.0	0.9	normal	15.2	-0.4	normal
VI	18.0	19.9	1.9	warm	20.1	-1.8	very cold
VII	19.8	20.4	0.6	normal	23.0	-3.3	extremely cold
VIII	19.3	20.5	1.2	warm	19.5	-0.3	normal
IX	15.6	15.4	-0.2	normal	14.0	1.4	warm

Table 2 Average precipitation in years 2009 - 2010

Month	Climatic Normal (mm)	2009			2010		
		Precipitation (mm)	% of Climatic Normal	Characteristic of month	Precipitation (mm)	% of Climatic Normal	Characteristic of month
IV	39.0	36.4	93.3	normal	95.3	244.4	extremely dry
V	58.0	55.4	95.5	normal	156.3	269.5	extremely dry
VI	66.0	86.2	130.6	Wet	158.3	239.8	extremely dry
VII	52.0	90.0	173.1	very wet	51.9	99.8	normal
VIII	61.0	9.8	16.1	extremely dry	103.3	169.3	very wet
IX	40.0	51.5	128.8	wet	73.7	184.3	very wet

RESULTS AND DISCUSSION

In sunflower production process and other crops as well, the impact of weather conditions is decisive. By their interaction goes to the regulation of growth phases, it manifests in the formation of quantity and quality of created yield – forming elements **(Brandt *et al.*, 2003; Šrojtová 2006).** Experimental years 2009 – 2010 were in term of weather conditions very different (tab 1, 2). The experimental year high significantly influenced the creation of whole yield – forming elements and achene fat content. The achene

yield was affected statistically non-significant (tab 4). In term of creation yield – forming elements was more favorable year 2009. High amount of precipitation negatively reflected the plant number per hectare, but were recorded higher values of other monitored yield elements. This fact is attributed to the ability of sunflower cover mutually compensate and regulate the real state (parameters) of individual morphological organs. Marked higher values were found at indicator of head weight in 2010. Higher yields (2.4 t.ha^{-1}, 2.6 t.ha^{-1} respectively) and higher fat content (42.3 %, 43.0 % respectively) were recorded on monitored sunflower hybrids (table 3) in 2010.

Table 3 Yield – forming elements, achene yield and fat content of sunflower in 2009 - 2010

Year	Hybrid	plant number	head number	average of head	weight of head	WTA	yield	fat content
2009	NK Ferti	58026.9	58700.6	207.4	260.2	79.4	2.0	41.1
2010	NK Ferti	57808.1	58705.8	266.0	629.9	86.0	2.6	42.3
2009-2010	**average**	**57917.5**	**58703.2**	**236.7**	**445.1**	**82.7**	**2.3**	**41.7**
2009	NK Simfoni	57618.6	57862.5	198.2	232.4	80.2	2.2	39.9
2010	NK Simfoni	56686.9	58840.5	234.0	528.1	85.2	2.4	43.0
2009-2010	**average**	**57152.8**	**58351.2**	**216.1**	**380.2**	**82.7**	**2.3**	**41.5**

The hybrids affected not only achene yield but also fat content **(Karaba 2005)**. The impact of hybrids statistically high significantly reflected on the plant number, average of heads and achene yield. The hybrids influenced statistically non-significant (tab 4) the fat conten, weight of head and WTA. In comparison of hybrids, the highest average plant number achieved hybrid NK Ferti 57 917.47 member per hectare with average highest head number 58 703.2 member per hectare, what witnesses the multi-heads of hybrid, what is undesirable for industrial using of sunflower **(Baničová et al., 2003)** (tab 3). Higher values of head average were found in 2010, in which the sunflower was influenced by unfavorable year conditions. The highest average value of average head was achieved on hybrid NK Ferti 236.71 mm in comparison with hybrid NK Simfoni (tab 3). Again the highest value of head weight (445.1 g) was found on hybrid NK Ferti, average values WTA (82.7 g) achieved both hybrids consistently (tab 3).

Kováčik (2004) attaches considerable importance to impact of hybrid in term of yield forming. His results confirm the differences among the hybrids in both fat content and composition in warm and dry area of cultivation. In biological material evaluation of both

quantity and quality was achieved the average achene yield 2.3 t.ha^{-1} and average fat content 41.5 %, 41.7 % respectively.

From total impact evaluation of both year and biological material on creation and forming yield – forming elements flows, more favorable was year 2009 for temperature and precipitation conditions and hybrid NK Ferti was more adaptable on concrete weather conditions.

Table 4 Analysis of variance sunflower yield – forming elements, yield and fat content

	SS	d.f.	MS	F - ratio	Sig. level
Plant number					
year	1.852637	1	1.852637	46.8	0.000000
hybrid	1.345593	4	3.363983	8.5	0.000007
year*hybrid	7.611677	4	1.902919	4.8	0.001419
Head number					
year	9.279520E+07	1	9.279520E+07	17.92	0.000053
hybrid	1.009232E+08	4	2.523081E+07	4.87	0.001277
year*hybrid	5.281606E+07	4	1.320401E+07	2.55	0.044080
Average of head					
year	112460	1	112460	120.683	0.000000
hybrid	15664	4	3916	4.202	0.003529
year*hybrid	10128	4	2532	2.717	0.034174
Weight of head					
year	3719297	1	3719297	146.9492	0.000000
hybrid	103318	4	25829	1.0205	0.400758
year*hybrid	53103	4	13276	0.5245	0.717931
WTA					
year	1953.4	1	1953.4	15.052	0.000192
hybrid	1016.0	4	254.0	1.957	0.107237
year*hybrid	100.3	4	25.1	0.193	0.941402
Achene yield					
year	2228600	1	2228600	0.998990	0.320066
hybrid	8910430	4	2227608	0.998548	0.412301
year*hybrid	8922462	4	2230615	0.999896	0.411580
Fat content					
year	53.4	1	53.4	47.5	0.000000
hybrid	284.0	4	71.0	63.3	0.000000
year*hybrid	74.1	4	18.5	16.5	0.000000

Legend: SS – sum of squares, d.f. – degrees of freedom, MS – mean of squares.

CONCLUSION

From field trials established on experimental base of Dolná Malanta in year 2009 – 2010 flow statistically high significant influence of year on all monitored yield – forming elements and fat content in sunflower achenes. For sunflower cultivation was more favorable year 2009 in term of weather conditions, a greater compensation ability of sunflower was showed in 2010. The higher yields and fat content were found in 2010.

The hybrids influenced plant number per unit area, head number, averae of head and fat content in achenes. The impact of hybrids on achene yield, weight of head and WTA were statistically non-significant. More adaptable was hybrid NK Ferti in term of concrete weather conditions of experimental years, yield elements, quantity and quality.

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