



SUNFLOWER (*HELIANTHUS ANNUUS*. L.) YIELD-FORMING ELEMENTS INFLUENCED BY YEAR WEATHER CONDITIONS AND APPLICATIONS OF BIOLOGICAL PREPARATIONS TERRA-SORB AND UNICUM

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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 Agrobiological and Food Resources of the Slovak University of Agriculture (SUA) in Nitra Dolná Malanta in two experimental years 2011 and 2012. In experiment was observed the influence of year weather conditions and applications of biological preparations on selected sunflower yield-forming elements: number of plants per unit area, number of heads per unit area, diameter of head, weight of head, weight of thousand achenes (WTA) and finally achenes yield. The results shown the statistically significant influence of year weather conditions on the number of plants and heads per ha and achenes yield but nonsignificant effects on diameter of head, weight and WTA. Higher averages of monitored parameters were observed in 2011. Higher diameter of head value was observed in 2012. The application of biological preparations influenced statistically high significantly number of plants and heads per unit area and achenes yield, statistically inconclusive effect was observed on diameter of head, weight of head and weight of a thousand achenes. The highest number of plants and heads per unit area and also head weight were observed in treatments with Terra-Sorb application. The largest diameter of head was found in treatments with Unicum application, the weight of thousand achenes, and achenes yield was observed in the control variant.

Keywords: sunflower, year weather conditions, biological preparations, yield forming elements, achenes yield

INTRODUCTION

Year weather conditions are objective factor affecting the yield and quality of crops (Šoltysová, 2005). The course of year weather conditions during each growing phases strongly influence on the production process of sunflower (González et al., 2013).

Distinctive weather changes mainly temperature and precipitation during the growing season is considered by Lobell et al. (2007) as the most important causes of variability of field crops production.

Production process of field crops can be influenced by several technological system factors of field crops cultivation, while one of them can be application of biologically, respectively. Synthetically produced growth stimulus substances (biostimulators) affected mainly physiological and morphogenetic properties of plants (Oosterhuis and Robertson, 2000; Zahradnicek et al., 2007).

Biostimulators as a biologically active substance containing hormones, enzymes, proteins, amino acids, micronutrients and other components activate plant metabolism mainly focused on improving the growth and development of plants (Jankowski, et al., 2008).

Veverková (2012), based on the analysis of sunflower production process, considered as the most important yield-forming elements of the production process number of plants and heads per unit area, the diameter of head, weight of head and the weight of a thousand achenes.

The paper aimed to assess the impact of year weather conditions and applications of biological preparations Terra-Sorb and Unicum on the selected yield-forming elements and sunflower 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. Experiments were realized on brown soil, anthrosols.

The fore crop of sunflower (*Helianthus annuus* L.) was winter wheat (*Triticum aestivum* L.).

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 experiment were used three high oleic sunflower hybrids NK Brio, NK Neoma and NK Ferti.

Basic fertilization was made using the balance method on the base of agrochemical soil analysis (Table 1) for yield 3 t.ha⁻¹.

Table 1 Agrochemical soil analysis

Year	Content (mg kg ⁻¹)					
	P	K	Mg	Na	Mn	Zn
Autumn 2010	62.0	435.0	310.0	33.0	4.0	0.7
Autumn 2011	59.0	380.0	217.0	27.0	9.0	1.0
		N-an (mg/kg)		N-NO ₃ ⁻		N-NH ₄ ⁺
Spring 2011	3.30		1.80		1.50	
Spring 2012	29.0		5.00		24.0	

The experiment was established by split plot design with randomized complete blocks base design in three replications. The experiment results will be statistically analyzed by analysis of variance by standard graphical and statistical methods of statistical package Statistica for Windows.

In the experiment, were used following biological preparations:

Unicum is a plant growth and immunity stimulator in the form of an aqueous emulsion, liquid concentrate designed to increase the yield and quality of crops products. The preparation contains abiestins, stimulating its vitality, strengthen

the defensive functions of plants and create a defense against negative environmental influences. Application was made in two terms (Table 2). Terra – Sorb is a special biostimulator containing pure amino acids of animal origin. Stimulate photosynthesis and transpiration. Application was made in two terms (Table 2).

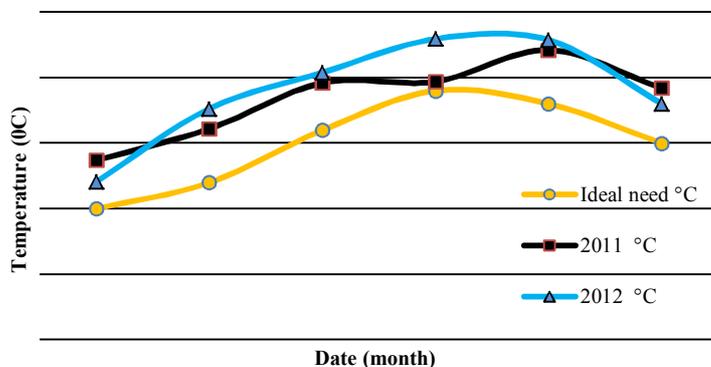
Table 2 Level of preparations applications

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

In the experiments were evaluated following sunflower elements:

- number of plants per unit area (pcs ha⁻¹),
- number of heads per unit area (pcs ha⁻¹),
- diameter of head (mm),
- weight of head (g),
- WTA (g),
- achenes yield (t ha⁻¹)

Basic meteorological data (average monthly temperatures in °C, 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 and 2).



Graph 1 Average monthly temperatures for the years 2011 - 2012 (°C).

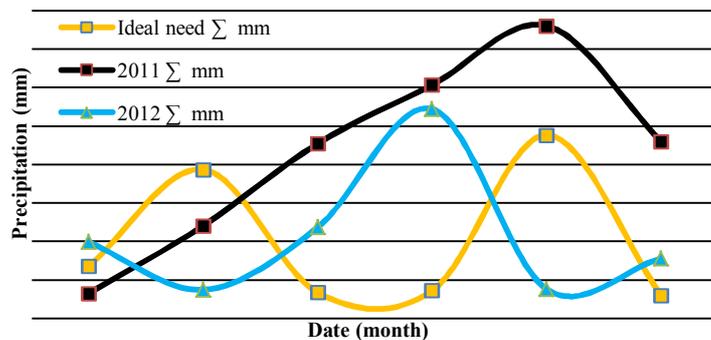


Table 3 Effect of biological preparations on selected sunflower yield forming elements

Year	Variant	Number of plants per ha	Number of heads per ha	Diameter of head (mm)	Weight of head (g)	WTA (g)	Achenes yield (t ha ⁻¹)
2011	Control	52 621	53 185	206	184	63	4.14
	Unicum	54 546	54 603	213	202	61	4.04
	Terra-Sorb	57 437	57 481	206	199	58	3.52
	Average	54 868	55 090	208	195	61	3.9
2012	Control	50 628	51 149	176	199	57	2.77
	Unicum	48 713	48 797	179	187	56	2.64
	Terra-Sorb	59 946	60 113	187	205	61	2.87
	Average	53 096	53 353	181	197	58	2.76

Graph 2 Sum of monthly precipitation for the years 2011 - 2012 (mm).

RESULTS AND DISCUSSION

Achenes yield in sunflower is quantitatively inherited production component and is highly influenced by environmental conditions (Kaya et al., 2009). Production process of sunflower is largely influenced by harmonizing temperature and moisture conditions during the growing season. Therefore, the level of adaptability to specific sunflower agro-ecological environmental conditions with regard to the biological material and the treatment is different (Černý et al., 2011). Experimental year 2011 was characterized by high rainfall recorded in June and July; the temperature conditions were higher than ideal needed (Graph 1 and 2). In 2012, there has been more precipitation in the months of April, June, July and September. As well as the 2011 temperature was higher than the ideal need. Veverková (2011) state statistically high significantly influence of year weather conditions on sunflower yield-forming components and achene yield. This finding partially correlates with our results when the effect of year weather conditions on the number of plants per ha, number of heads per ha and achenes yield was statistically significantly, while diameter of head, weight of head and WTA was nonsignificant (Table 4). During the period between 2011 and 2012 was found the average number of plants per ha 53,982, the number of heads per ha 54,222 ha, 194.5 mm average of head, weight of head 196 g, WTA 59.5 g and achenes yield 3.33 t ha⁻¹ (Table 3). Higher average values of monitored parameters, the number of plants per ha (54 868), the number of heads per ha (55 090), diameter of head (208 mm), WTA (61 g) and achenes yield (3.9 t ha⁻¹) were recorded in 2011. Higher mean value of head diameter (213 mm) was recorded in 2012 (Table 3). Kaya et al. (2009) found that the highest correlation coefficient was between plant height and seed yield. They have shown that sunflower height played an important role for improving both seed yield and other yield components. Other studies suggest the role of head diameter in determine of achenes yield (Amorim et al., 2008)

Jankowski and Dubis (2008) notes that the application of biologically active substances, like nutrition and fertilization are an important factor influencing the production process of field crops. During the experimental years 2011 and 2012 was found statistically high significantly effect of the biological preparations on the number of plants per ha and number of heads per ha and achenes yield. Černý (2012) describes statistically non-significantly influence of foliar application on achenes yield, what is contrary to our results. Effect of the preparations on diameter of head, weight of head and the weight of a thousand achenes was statistically inconclusive (Table 4). During the experimental period was found the highest number of plants per ha (59 946), number of heads per ha (60 113) weight of head (205 g) at variant with Terra-Sorb application in 2012. The largest diameter of head (213 mm) was observed in treatments with Unicum application in 2011, the highest weight of a thousand achenes (63 g) and achenes yield (4.14 t ha⁻¹) were detected at the control variant in 2011 (Table 3).

Table 4 Analysis of variance sunflower yield forming elements and achenes yield.

Analysis of variance for number of plants per ha					
	Degr. of freedom	SS	MS	F- ratio	Sig. level
Intercept	1	4.963652E+10	4.963652E+10	118750.9	0.000000
year	1	9.987843E+07	9.987843E+07	239.0	0.000102
treatment	2	8.975616E+07	4.487808E+07	107.4	0.000334
Analysis of variance for number of heads per ha					
	Degr. of freedom	SS	MS	F- ratio	Sig. level
Intercept	1	4.971880E+10	4.971880E+10	41810.17	0.000000
year	1	9.619830E+07	9.619830E+07	80.90	0.000846
treatment	2	7.057042E+07	3.528521E+07	29.67	0.003987
Analysis of variance for head diameter					
	Degr. of freedom	SS	MS	F- ratio	Sig. level
Intercept	1	693492.6	693492.6	5151.372	0.000000
year	1	2523.1	2523.1	18.742	0.012357
treatment	2	140.7	70.3	0.522	0.628654
Analysis of variance for weight of head					
	Degr. of freedom	SS	MS	F- ratio	Sig. level
Intercept	1	782963.4	782963.4	466.7478	0.000027
year	1	4549.0	4549.0	2.7118	0.174955
treatment	2	1785.1	892.5	0.5321	0.623894
Analysis of variance for WTA					
	Degr. of freedom	SS	MS	F- ratio	Sig. level
Intercept	1	68438.90	68438.90	60298.59	0.000000
year	1	8.45	8.45	7.44	0.052556
treatment	2	4.66	2.33	2.05	0.243711
Analysis of variance for sunflower achenes yield					
	Degr. of freedom	SS	MS	F- ratio	Sig. level
Intercept	1	198.7353	198.7353	38238.76	0.000000
year	1	6.0436	6.0436	1162.85	0.000004
treatment	2	0.2281	0.1140	21.94	0.006978

Legend: SS – sum of squares, MS – mean of squares.

CONCLUSION

The aim of field polyfactorial experiments, conducted in the years 2011 and 2012 on experimental fields in Dolná Malanta was to evaluate the influence of year weather conditions and application of biological preparations Terra-Sorb and Unicum on the selected yield-forming elements and achenes yield.

The experimental results show a statistically high significant influence of year weather conditions on number of plants and heads per ha and achenes yield. The effect of weather conditions on head diameter, weight of head and WTA was statistically inconclusive. Higher average values of monitored parameters were recorded in 2011. Higher value of diameter of head was recorded in 2012.

The application of biological preparations influenced statistically high significantly number of plants and heads per unit area and achenes yield, statistically inconclusive effect was observed on head diameter, weight of head and WTA. The highest number of plants and heads per unit area and also weight of head were observed in treatments with Terra-Sorb application in 2012. The largest head diameter was found in treatments with Unicum application in 2011, the highest WTA and achenes yield was observed in the control variant in 2011.

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