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RESEARCH ARTICLE

Influence of growth stimulants on the elements of sunflower hybrids productivity in the conditions of the Southern Steppe of Ukraine

Yaroslav Hadzalo[1], Rayisa Vozhehova[2], Yaroslav Likar[3], Tetiana Marchenko[4*], Oksana Tonkha[3]

[1] National Academy of Agrarian Sciences of Ukraine, Kyiv, Ukraine
[2] Institute of Climate-Smart Agriculture of the National Academy of Agrarian Sciences of Ukraine, Odesa district, Odesa region, Ukraine
[3] National University of Life and Environmental Sciences of Ukraine, Kyiv, Ukraine
[4] Odesa State Agrarian University, Ukraine, Odesa, Ukraine

***Corresponding author:** Tetiana Marchenko, Odesa State Agrarian University, Ukraine, Odesa, Ukraine
Email: tmarchenko74@ukr.net

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Abstract

This study examines the influence of plant growth stimulants on the yield indicators of sunflower hybrids in the conditions of the Southern Steppe of Ukraine. Research methods included field trials to evaluate sunflower hybrid compositions and the application of plant growth stimulants, alongside statistical processing methods. The genotypic response of sunflower hybrids to growth regulators was established. The highest seed yield, at a level of 3.82 t/ha, was achieved with the hybrid 'Charodiy' using the biopreparation Vympel. The application of the biopreparations STIMPO and Vympel resulted in a significant increase in yield across all hybrids, ranging from 7.9% to 37.2%. The contribution of hybrid composition to seed yield was 68.2%, while the contribution of growth stimulants was 20.5%.

Keywords: Growth stimulants, Hybrid, Sunflower, Plant height, Dry matter accumulation dynamics, Yield

Introduction

Sunflower is one of the most widespread crops in Ukraine and other countries worldwide, due to its significant advantages such as high economic efficiency, consistent demand for seeds domestically and in international markets, and simpler and less costly cultivation technology compared to other crops. Sunflower seeds have a balanced composition of highly valuable fatty acids, high levels of fat-soluble vitamins, and contain low-oxidation and oxidation-stable fats, ensuring prolonged storage of sunflower oil and its high culinary qualities (Kalenska et al., 2020; Yevchuk, 2022; Grechka and Kulinych, 2023; Kalenska et al., 2017). Most natural factors of the Steppe zone (except for low moisture availability) contribute to obtaining high sunflower yields throughout the region, which is another condition for the crop's widespread cultivation in this area. Sunflower seeds contain 47%-52% oil. Sunflower oil accounts for 98% of the total oil production in

Ukraine. It includes highly valuable components for the body, such as phosphatides, stearins, and vitamins (A, D, E, K) (Yurkevich et al., 2022; Fedoryaka et al., 2021; Yeremenko et al., 2017).

Materials and Methods

The research was conducted at the experimental field of the Institute of Irrigated Agriculture of NAAS (National Academy of Agricultural Science), Kherson region. The experiments were carried out using generally accepted agricultural methods and methodological guidelines (Ushkarenko et al., 2019). The study was conducted in a two-factor experiment designed as follows: Factor A – Hybrids ('Yason' (originator: V.Ya. Yuriev Institute of Plant Breeding of National academy of agricultural science early-maturing) 'Zlatson' (originator: V. Ya. Yuriev Institute of Plant Breeding of NAAS, mid-early) 'Charodiy' (originators: V.Ya. Yuriev Institute of Plant Breeding of NAAS, Selection and Genetic Institute, mid-early) Factor B – Plant Growth Stimulants: STIMPO (manufacturer: Agrobiotech, Ukraine), Vympel (manufacturer: Dolina, Ukraine).

Results and Discussion

The research identified differences in sunflower plant height depending on hybrid composition and plant growth stimulants. It was found that the most intensive processes of plant height increase occur in the interphase period from head formation to flowering. While in the interphase period from emergence to head formation, the average plant height across the studied factors was 67 cm, with a daily growth rate of 1.5 cm, in the next period (head formation flowering), the plant height increased by 2.3 times, and the average daily growth rate increased by 2.7 times to 3.8 times (Tab 1).

Table 1. Plant height and average daily growth rate of sunflower plants depending on hybrid composition and plant growth stimulants, cm (average for 2017-2019)

Hybrid (Factor A)	Plant Growth Stimulants (Factor B)	Interphase Period			
		Emergence - Head Formation		Head Formation - Flowering	
		Height	Height Increase	Height	Height Increase
Yason	Control (untreated)	49	1.1	138	3.8
	STIMPO	52	1.2	143	4.6
	Vympel	59	1.4	152	4.7
Zlatson	Control (untreated)	65	1.3	150	4
	STIMPO	72	1.6	163	4.9
	Vympel	79	1.9	170	5.2
Charodiy	Control (untreated)	69	1.5	158	4.1
	STIMPO	74	1.6	168	4.8
	Vympel	85	1.9	175	5.3
Average		67	1.5	157	4.6
$LSD_{05,\ cm}$	A	0,75	0.07	2.9	0.16
	B	0,75	0.07	2.9	0.16

The genotype of the hybrid also affected plant height and daily growth rate. The highest values of these indicators were observed during the flowering phase with the 'Charodiy' hybrid, at 175 cm and 5.3 cm/day, respectively. The lowest

plant height and growth rate were recorded in the 'Yason' hybrid plots 138 cm and 3.8 cm/day, which is 26.8%-39.5% less than the best variant.

Seed treatment with plant growth stimulants positively influenced plant height. On average, across the studied hybrids (Factor A), an increase in plant height was observed during the head formation phase by 9.7%-14.9%, and the average daily growth rate by 16.7%-18.9%. The difference between the variants with growth stimulants decreased in the flowering phase to 4.3%-9.5% for height and 2.3%-14.5% for daily growth rate.

In addition to affecting plant height, growth stimulants also significantly increased the dry matter accumulation per unit area in all studied hybrid plots (Tab 2).

Table 2. Dynamics of dry matter accumulation by sunflower hybrids depending on stimulants, t/ha (average for 2017-2019)

Hybrid (Factor A)	Plant Growth Stimulants (Factor B)	Development Phase		
		Head Formation	Flowering	Full Seed Maturity
Yason	Control (untreated)	0.44	0.99	2.31
	STIMPO	0.45	1.19	2.62
	Vympel	0.49	1.29	2.85
Zlatson	Control (untreated)	0.53	1.26	3.34
	STIMPO	0.56	1.54	3.59
	Vympel	0.62	1.7	4.04
Charodiy	Control (untreated)	0.55	1.35	3.7
	STIMPO	0.57	1.58	3.95
	Vympel	0.65	1.73	4.24
Average		0.54	1.4	3.4
LSD_{05}, t/ha	A	0.025	0.08	0.11
	B	0.021	0.09	0.1

It was proven that the greatest increase in dry matter yield was recorded from the head formation phase to the flowering phase. On average, across the field trial, the increase was 2.6 times. Subsequently, from the flowering phase to full seed maturity, the accumulation of dry matter was less intensive but still significant, increasing by 2.4 times. The minimum values of the studied indicator, at the level of 0.44 t/ha–0.49 t/ha, were formed in the head formation phase when growing the 'Yason' hybrid, regardless of the plant growth stimulant variants (Factor B). In all developmental phases, the highest dry matter yield was observed in the 'Charodiy' hybrid variant, especially with the use of the Vympel growth stimulant. On average, for Factor A, this increase compared to the 'Zlatson' hybrid was 3.5%–8.4%, and relative to the 'Yason' hybrid, it was 28.3%–52.9%.

The use of plant growth stimulants also positively influenced the plants' ability to form dry matter. The application of the Vympel growth stimulant increased the dry matter content in the head formation phase by 8.9%–21.2%, in the flowering phase by 9.5%–18.3%, and in the full seed maturity phase by 8.7%–17.9%, respectively. It should be emphasized that the highest dry matter yield was in the 'Charodiy' hybrid variant with the use of the Vympel growth stimulant 4.24 t/ha.

The analysis of the obtained experimental data showed that the hybrid composition and the application of plant growth stimulants significantly affected the sunflower seed yield (Tab 3). The difference in seed yield between hybrids, on average for Factor A, was 0.47 t/ha–0.86 t/ha, or 17.2%–36.8%. The highest average yield was recorded for the 'Charodiy' hybrid 3.20 t/ha. The lowest average seed productivity (2.34 t/ha) was observed for the 'Yason' hybrid.

The application of the STIMPO and Vympel plant growth stimulants resulted in a significant yield increase for all hybrids. For the 'Yason' hybrid, on average for Factor B, the yield in the control variant was 2.10 t/ha, while with the

application of the STIMPO and Vympel growth stimulants, the yield increased by 7.1%–26.7%. For the 'Zlatson' hybrid, this increase was 16.9%–37.2%, and in the variant with the 'Charodiy' hybrid, the increase was 19.1%–33.5%, respectively.

Table 3. Sunflower hybrid yield depending on growth stimulants, t/ha

Hybrid (Factor A)	Plant Growth Stimulants (Factor B)	Yield in the years of study			Average across factors	
		2017	2018	2019	B	A
Yason	Control (untreated)	2.07	2.25	1.98	2.1	2.34
	STIMPO	2.21	2.39	2.14	2.25	
	Vympel	2.55	2.87	2.57	2.66	
Zlatson	Control (untreated)	2.41	2.34	2.19	2.31	2.73
	STIMPO	2.86	2.65	2.58	2.7	
	Vympel	3.21	3.04	3.27	3.17	
Charodiy	Control (untreated)	2.73	2.88	2.55	2.72	3.2
	STIMPO	3.2	3.34	3.19	3.24	
	Vympel	3.53	3.82	3.55	3.63	
Average over the years of study		2.75	2.84	2.67		
LSD_{05}	A	0.09	0.11	0.07		
	B	0,09	0.11	0.07		

Conclusions

The maximum seed yield of 3.82 t/ha was achieved with the 'Charodiy' hybrid and the use of the Vympel growth stimulant. The difference in seed productivity between hybrids was, on average, 0.47 t/ha-0.86 t/ha, or 17.2%-36.8%, in favor of the 'Charodiy' hybrid. The application of the STIMPO and Vympel biostimulants resulted in a significant yield increase for all hybrids by 7.9%-37.2%. The contribution of hybrid composition to seed yield was 68.2%. The contribution of growth stimulants was 20.5%.

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