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SUNFLOWER PRODUCTION IN RELATION TO MORPHOLOGICAL PARAMETERS AND PLANT DENSITY

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INTRODUCERE: Sunflower (*Helianthus annuus* L.) is a crop of major global importance due to the nutritional value of its seeds and, particularly, as a source of oil (Puttha et al., 2023). Ecological plasticity in sunflower has been analyzed to understand the response of genotypes to climate and soil conditions, to support hybrid zoning, and to adapt agricultural technologies for achieving high yields. Sunflower yield has been evaluated in relation to cultivated genotypes, environmental factors, and technological inputs (Li and Liu, 2025). Plant density is a key factor influencing sunflower yield and has recently been the focus of intensive study, particularly in the context of technological optimization (Olson et al., 2024; Tomasi et al., 2024).
The present study analyzed agronomic parameters and yield variation in three sunflower hybrids under different planting densities. It explored the correlations between yield and agronomic traits and identified yield variation patterns in relation to both planting density and plant morphology.

MATERIAL ŞI METODA DE LUCRU

The study was conducted in ARDS Lovrin, Timis County, Romania. Field experiments, in comparative culture, were carried out in the agricultural year 2023 – 2024, under non-irrigated conditions. Appropriate crop technology for sunflower was applied throughout the experiment. The hybrids ES Celion SU (G1 – experimental code), LID 1046H SU (G2), and LID 5053L SU (G3) were cultivated. Each hybrid was grown at three planting densities: 40,000 plants ha^{-1} (A – experimental code), 60,000 plants ha^{-1} (B), and 80,000 plants ha^{-1} (C). The resulting experimental variants were: G1A, G1B, G1C; G2A, G2B, G2C; and G3A, G3B, G3C. Agronomic parameters were measured for each variant, including stem diameter (SD, cm), plant height (PH, cm), and calatidium diameter (CD, cm). All experimental variants were harvested mechanically at physiological maturity (Meier, 2001). Yield (Y, kg ha^{-1}) was determined for each variant and replicate. Statistical analysis was conducted using the Excel analysis tools and the PAST software package (Hammer et al., 2001).

REZULTATE OBŢINUTE

The values of the agronomic parameters and yield of the sunflower hybrids cultivated at three planting densities are presented in Table 1. The stem diameter (SD) ranged from 7.02 ± 0.32 cm (G3C) to 10.38 ± 0.32 cm (G3A). Plant height (PH) ranged from 116.40 ± 2.72 cm (G3A) to 140.60 ± 2.72 cm (G1C). Calatidium diameter (CD) varied between 13.32 ± 0.77 cm (G3C) and 20.85 ± 0.77 cm (G2A, G2B). Yield (Y) ranged from 1354.29 ± 116.00 kg ha^{-1} (G2A) to 2371.43 ± 116.00 kg ha^{-1} (G1C).

Table 1. Values of agronomic parameters and yield of sunflower hybrids

Sunflower hybrid	Trial	PD	Plant parameters			Y
			SD	PH	CD	
		(no)	(cm)	(cm)	(cm)	(kg ha^{-1})
ES Celion SU	G1A	40000	8.74	133.60	17.00	1954.29
ES Celion SU	G1B	60000	8.98	129.60	16.75	2160.00
ES Celion SU	G1C	80000	8.84	140.60	17.10	2371.43
LID 1046H SU	G2A	40000	9.72	131.20	20.85	1354.29
LID 1046H SU	G2B	60000	9.74	132.20	20.85	2051.43
LID 1046H SU	G2C	80000	8.60	130.20	18.60	2262.86
LID 5053L SU	G3A	40000	10.38	116.40	17.90	1508.57
LID 5053L SU	G3B	60000	9.30	117.20	16.65	1851.43
LID 5053L SU	G3C	80000	7.02	137.20	13.32	2240.00

Table 3. Differences in sunflower yield compared to the average value of the experiment

Trial code	Yield (kg ha^{-1})		Statistical parameters					
	Given mean:	Sample mean:	95% conf. interval:	Difference:	95% conf. interval:	t:	p (same mean):	Significance of differences
G1A	1954.29	1972.7	(1705.2 2240.2)	-18.41	(-249.08 285.9)	0.1587	0.878	ns
G1B	2160.00			187.30	(-80.189 454.79)	-1.6147	0.145	ns
G1C	2371.43			398.73	(131.24 666.22)	-3.4374	0.009	**
G2A	1354.29			-618.41	(350.92 885.9)	5.3312	<0.001	ooo
G2B	2051.43			78.73	(-188.76 346.22)	-0.6787	0.516	ns
G2C	2262.86			290.16	(22.671 557.65)	-2.5014	0.037	*
G3A	1508.57			-464.13	(196.64 731.62)	4.0012	0.004	oo
G3B	1851.43			-121.27	(-146.22 388.76)	1.0454	0.326	ns
G3C	2240.00			267.30	(-0.18924 534.79)	-2.3043	0.050	ns

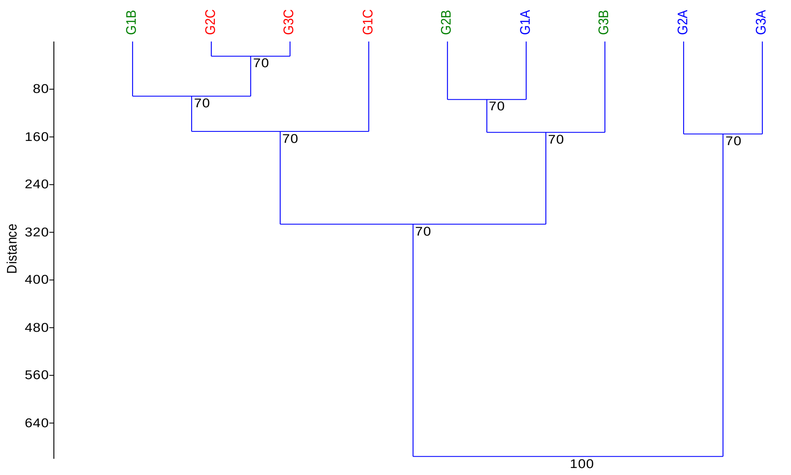
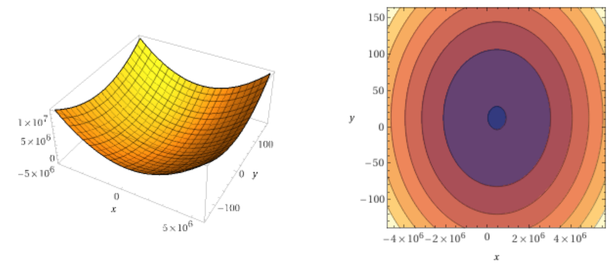
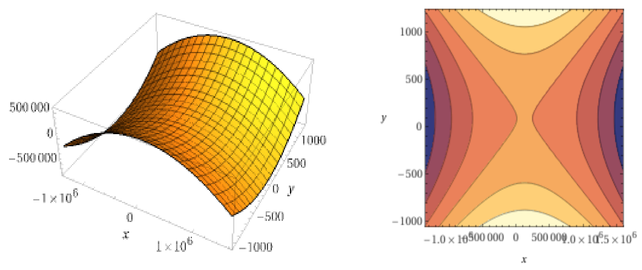


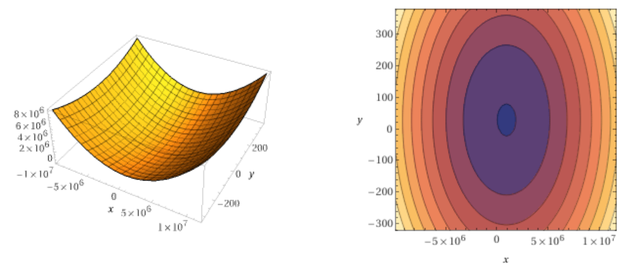
Figure 5. Cluster diagram of experimental variants in sunflower, based on Euclidean distances



Yield variation in relation to PD (*x*-axis), and SD (*y*-axis) parameters



Yield variation in relation to PD (*x*-axis), and PH (*y*-axis) parameters



Yield variation in relation to PD (*x*-axis), and CD (*y*-axis) parameters

CONCLUZII

Plant density influenced the yield of the tested sunflower hybrids. The density of 40,000 plants ha^{-1} led to yields below the average of the experiment, except for the G1A variant which presented close values. The density of 60,000 plants ha^{-1} led to yields above the average for the G1B and G2B variants (without statistical certainty). The density of 80,000 plants ha^{-1} led to yields above the average for all three tested hybrids, with statistical certainty for the G1C ($p<0.01$, **) and G2C variants ($p<0.05$, *).
Mathematical and graphical models described the variation of yield in relation to agronomic parameters and plant density. Plant density (PD) and stem diameter (SD) facilitated the estimation of yield with the highest level of certainty (RMSEP = 94.025 kg ha^{-1}).

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