EVALUATION OF NEW SUNFLOWERHYBRID (HELIANTHUS ANNUUS L.) FOR OIL YIELD UNDER SOUTHERN ROMANIA CONDITIONS

Danil-Marian STANCIU[1], Lizica SZILAGYI[1], Maria OBADĂ[1]

[(1)] University of Agronomic Sciences and Veterinary Medicine Bucharest, 59 Mărăști boulevard, Bucharest, Romania

authors email: danilstanciu18@yahoo.com, lizicasz@yahoo.com, mariaobada18@gmail.com

Corresponding author email: *lizicasz@yahoo.com*

Abstract

Sunflower breeding at the Agricultural Research Company, Fundulea is carried out at an advanced level, yielding impressive results. The working collection comprises a variety of inbred lines, and in recent years, new materials with exceptional combining ability and valuable traits have been developed. The hybrid HS-FSP-1023, currently in the testing phase, is notable for its high production potential and high oil content. Second-year trials conducted in 2023 in the counties of Călărași, Constanța, and Buzău have confirmed its adaptability to various environmental conditions, as well as its drought and disease resistance, ensuring stable yields. The focus is on developing semi-early hybrids with rapid seed drying and high production capacity across diverse environments. The objective of this research is to highlight the performance of hybrid HS-FSP-1023 in comparison with four standard sunflower hybrids, with emphasis on oil yield, making it a promising candidate for expanding the cultivated area in Romania.

Key words**: **sunflower, adaptability, drought resistance, HS-FSP-1023, oil yield

INTRODUCTION

Sunflower *(Helianthus annuus L.)* has been recognized as a significant source of high-quality edible oil for human consumption (Pal et al., 2015). It is an important oil crop in Romania. According to data published by the National Institute of Statistics (INS), sunflowers are currently cultivated on an area of 1,077,867 hectares. In our country, the stability of sunflower production has been adversely affected by climate change, especially due to variations in temperature. In our country, the stability of sunflower production has been adversely affected by climate change, especially due to variations in temperature, rainfall, and other environmental factors. Therefore, to enhance stability, it is essential to develop and select genotypes with strong tolerance to climate-related stresses (Mihaela Sima et al., 2015). Also, the development of improved cultivars has played a crucial role in enhancing plant productivity and quality. Selecting the right cultivar is a critical decision for farmers, as it determines the highest achievable performance within a specific agricultural area. Breeders aim to develop cultivars tailored to the unique needs of each region while aligning with market demands. Emphasis is placed on inbred lines with strong combining ability, yielding hybrids with high ecological adaptability and resilience to cold, drought, lodging, diseases, and pests, while achieving targeted quality standards (Škorić, 2015). Additionally, due to the increased demand for sunflower production, the breeding focus is on intensifying the development of highly productive oilseed hybrids to meet the needs of the edible oil industry (Cvejić et all., 2023) This study aimed to assess the hybrid resulting from the inbreeding of selected inbred lines, with a focus on evaluating its oil yield in comparison to reference hybrids suited for the analyzed regions. The research was conducted within the breeding division of the Agricultural Research Company Fundulea.

MATERIALS AND METHODS

Experimental site and set up

The trials were conducted at three locations with different pedoclimatic conditions in Southern Romania: Fundulea (Călărași county), Mircea Vodă (Constanța county), and Râmnicu Sărat (Buzău county), on farms belonging to project partners. These trials aimed to evaluate the hybrids based on their productivity and adaptability to each specific environment during the 2013 growing season. The experimental design was a randomized block, in three replications at each site.

Climatic conditions in the 2023 growing season across the tested areas were generally favorable for seedbed preparation, planting, germination, and the growth of sunflower crops

Materials

Five sunflower hybrids were tested: HS-FSP-1023, PARAISO 102 CL, PUNTASOL CL, FD15E27 and P64LL125. Among these 5 hybrids, two are adapted to Clearfield technology (Syngenta), two to Expres technology (ARC and NARDI Fundulea), and one to conventional technology (Corteva).

Table 1. Sunflower hybrids tested, their origin and maturity

Hybrid	Origin	Maturity
HS-FSP-1023	ARC Fundulea*	Semi-early
PARAISO 102 CL	Saaten Union	Semi-late
PUNTASOL CL	Syngenta Agro	Semi-early
FD15E27	NARDI Fundulea*	Semi-late
P64LL125	Corteva Agriscience	Semi-early

Agricultural Research Company;National Agricultural Research and Development Institute

During the growing season, all technological sequences were applied optimally under non-irrigated conditions. Sowing was done with a row distance of 70 cm and a plant spacing of 22 cm, at a seed rate of 8 kg·ha−1. Potassium and phosphorus were applied at sowing, while nitrogen was applied in three splits and as a foliar application before the reproductive stage.

Parameters estimated

a) number of achenes per head.

b) weight of achenes per head.

c) oil yield.

For the analysis of the first two parameters, ten plants were randomly selected from each replication. The oil content was determined using Magnetic Resonance Imaging (MRI) technology, with the sample weighing 5 grams of seeds.

Statistical analysis

The collected data underwent statistical processing using analysis of variance (ANOVA). Correlation analysis was conducted to evaluate the relationships between the number of achenes, the weight of achenes per head, and oil yield. Using the Data Analysis Toolpak in Excel, I applied ANOVA analysis, which resulted in the correlation coefficients.

RESULTS AND DISCUSSIONS

Results on the number of achene and their weight per head

The comparative analysis of achene production (both number and weight per head) among various sunflower hybrids, assessed under three different climatic conditions, is presented in Table 2. At Fundulea, the hybrid HS-FSP-1023 demonstrated superior performance in terms of achene number, yielding a total of 1,364 achenes per plant. In contrast, the hybrid FD15E27 exhibited the lowest achene number, with a total of 1,285 achenes. Additionally, the HS-FSP-1023 hybrid recorded the highest mean achene weight per head, at 98 grams. Conversely, the FD15E27 and PARAISO 102 CL hybrids had the lowest achene weight, each measuring 83 grams.

In the experimental study conducted at Mircea Vodă, the hybrid PARAISO 102 CL exhibited the highest achene production, yielding a total of 1,280 achenes per head. Conversely, the hybrid FD15E27 demonstrated the lowest achene number, recording a total of 1,050

achenes. Additionally, when assessing the weight of achenes per head, the HS-FSP-1023 hybrid showed the highest average weight, measuring 102 grams, whereas the FD15E27 hybrid recorded the lowest average weight at 59 grams.

At Râmnicu Sărat, a comparative analysis of achene production among various sunflower hybrids revealed that the P64LL125 hybrid exhibited the highest average number of achenes per head, totaling 1280 achenes. In contrast, the PARAISO 102 CL hybrid demonstrated the lowest average, recording only 1100 achenes. Additionally, the evaluation of achene weight per capitulum highlighted that the HS-FSP-1023 hybrid achieved the highest mean weight, measuring 86 grams, while the FD15E27 hybrid presented the lowest mean weight at 67 grams. These findings underscore significant variability in both achene number and weight across the examined sunflower hybrids, which may have implications for agronomic performance and yield potential.

Table 2. The number of achene and their weight per head, mean and CV

Hybrid	No. achenes / head	Achene weight/head (g)
Fundulea		
HS-FSP-1023	1364	98
FD15E27	1285	83
P64LL125	1350	97
PUNTASOL CL	1310	95
PARAISO102 CL	1300	83
Mean	1321.8	91.2
CV (%)	2.28	7.41
Mircea Vodă		
HS-FSP-1023	1264	102
FD15E27	1050	59
P64LL125	1220	74
PUNTASOL CL	1250	96
PARAISO102 CL	1280	82
Mean	1212.8	82.6
CV (%)	6.9	18.64
Râmnicu Sărat		
HS-FSP-1023	1206	86
FD15E27	1230	67
P64LL125	1280	81
PUNTASOL CL	1190	76
PARAISO102 CL	1100	68
Mean	1201.2	75.6
CV (%)	4.91	9.69

The relatively low CV% values for achene number suggest a high degree of stability in this trait, indicating stable production across the studied sites, particularly at Fundulea. In contrast, the higher CV% values for weight of achenes per head indicate greater variability and lower stability in this trait, especially notable at Mircea Vodă (Table 2). These results illustrate the need for further investigation into the environmental and genetic factors influencing achene weight, as well as their potential implications for agricultural practices aimed at optimizing both traits for improved yield stability.

Results on oil yield

Table 3. Mean oil yield and relative oil yield

Hybrid	Oil yield (kg/ha)	Relative oil yield (kg/ha)
Fundulea		
HS-FSP-1023	2316	109%
FD15E27	1992	94%
P64LL125	2130	100%
PUNTASOL CL	2140	101%
PARAISO 102 CL	2052	97%
Average	2126	100%
Mircea Vodă		
HS-FSP-1023	2187	126%
FD15E27	1338	77%
P64LL125	1341	77%
PUNTASOL CL	1967	113%
PARAISO 102 CL	1857	107%
Average	1738	100%
Râmnicu Sărat		
HS-FSP-1023	1892	110%
FD15E27	1524	89%
P64LL125	1941	113%
PUNTASOL CL	1648	96%
PARAISO 102 CL	1569	91%
Average	1714,8	100%

The analysis of oil production data, as depicted in Table 3, reveals that at the Fundulea location, the average oil yield for the hybrids under investigation was 2,126 kilograms per hectare. Notably, the hybrid HS-FSP-1023 achieved the highest oil yield, measuring 2,316 kilograms per hectare, which corresponds to a statistically significant increase of 9% relative to the mean oil yield for the experiment. In contrast, the hybrid FD15E27 recorded the lowest yield at 1,992 kilograms per hectare, reflecting a decrease of 6% compared to the experimental average.

At the Mircea Vodă location, the mean oil yield for the evaluated hybrids was found to be 1,738 kilograms per hectare. Among the hybrids tested, HS-FSP-1023 exhibited the highest yield, recording 2,187 kilograms per hectare, which corresponds to a significant 26% increase relative to the overall average yield of the experiment. Conversely, the hybrid FD15E27 yielded the lowest output at 1,338 kilograms per hectare, representing a notable 23% deficiency compared to the experimental average.

In the study conducted at Râmnicu Sărat, the mean oil yield for the assessed hybrids was determined to be 1,714.8 kilograms per hectare. Among the hybrids evaluated, P64LL125 exhibited the highest yield, achieving 1,941 kilograms per hectare, which signifies a noteworthy 13% enhancement over the overall mean yield for the experiment. Conversely, the hybrid FD15E27 recorded the lowest yield at 1,524 kilograms per hectare, corresponding to an 11% deficit relative to the mean yield established for all hybrids in the study.

Correlation between the number of achenes, achene weight per head, and oil yield

The results of this study indicate a negative correlation between the number of achenes and the weight of achenes per head with oil yield. This suggests that as the number of achenes and their weight per head increase, the overall oil yield decreases. This insight highlights a potential balance between achene production and oil content, implying that strategies aimed at enhancing oil yield could involve managing the number of achenes or their weight. Future research could explore the underlying biological mechanisms responsible for this negative correlation and investigate optimal cultivation practices to balance achene production and oil yield.

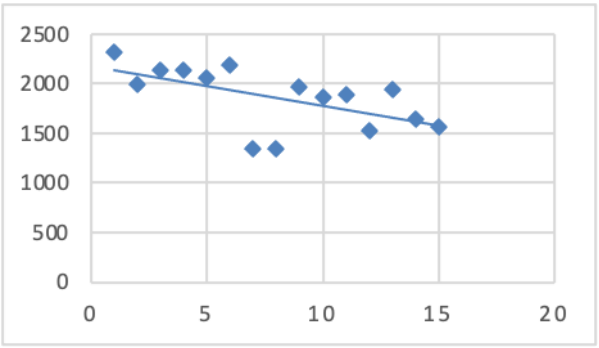

Figure 1. Correlation between the number of achenes, achene weight per head and oil yield

CONCLUSIONS

The findings indicate that the evaluated hybrids are well-suited for the distinct pedoclimatic conditions of each studied region. Notably, the HS-FSP-1023 hybrid performed exceptionally in Călărași and Constanța, yielding high seed and oil outputs that highlight its adaptability and effectiveness in these environments. Although its performance in Buzău was less favorable, the high yields in other regions demonstrate its potential as a valuable option for farmers aiming to maximize productivity. This variability in performance across locations underscores the importance of careful hybrid selection to enhance agricultural outcomes tailored to the specific agronomic conditions of each area.

ACKNOWLEDGEMENTS

We received logistical, technical, and administrative support from the Agricultural Research Company Fundulea, including materials for experiments, writing assistance, and language review.

There was no external funding for this study

REFERENCES

Dragan Škorić. Sunflower Breeding for Resistance to Abiotic and Biotic Stresses. *IntechOpen* 2015. https://www.intechopen.com/chapters/49800 (in English)

Mihaela Sima, Elena-Ana Popovici, Dan Bălteanu, Dana Magdalena Micu, Gheorghe Kucsicsa, Carmen Dragotă & Ines Grigorescu. A farmer-based analysis of climate change adaptation options of

agriculture in the Bărăgan Plain, Romania. *Earth Perspectives* 2015, *2* (1), Article 31. https://doi.org/10.1186/s40322-015-0031-6 (in Romanian)

Pal, U., Patra, R., Sahoo, N., Bakhara, C. & Panda, M. Effect of refining on quality and composition of sunflower oil. J. Food Sci. Technol. 52(7), 4613–4618. https://doi.org/10.1007/s13197-014-1461-0 (2015).

Sandra Cvejić, Olivera Hrnjaković, Milan Jocković, Aleksandar Kupusinac, Ksenija Doroslovački, SonjaGvozdenac, Siniša Jocić & Dragana Miladinović, 2023. Oil yield prediction for sunfower hybrid selection using diferent machine learning algorithms. www.nature.com/scientificreport