

ASSESSMENT OF DIFFERENT SUNFLOWER HIBRIDS UNDER AGRO-CLIMATIC CONDITIONS OF ARDS SIMNIC, ROMANIA

Valeriu Lucian RADU¹, Dorina BONEA²

¹Agricultural Research and Development Station Simnic - Craiova, 54 Balcesti Road, Dolj County, Romania

²University of Craiova, Faculty of Agronomy, 19 Libertatii Street, Craiova, Romania

Corresponding author email: dbonea88@gmail.com

Abstract

The present study was conducted with the aim to evaluate sunflower hybrids under the agro - climatic conditions of Agricultural Research and Development Station (ARDS) Simnic - Craiova. A set of six foreign sunflower hybrids was sown in a randomised block design with three replications. Data were recorded on seed yield and associated traits such as plant height, head diameter, thousand seed weight and hectolitre mass. Significant differences were observed among the hybrids for seed yield and all the studied traits. Maximum seed yield was produced by hybrid Sumiko HTS (3576 kg/ha), while hybrids Subaru HTS (2700 kg/ha) and SY Bacardi CLP (2633 kg/ha) showed minimum seed yield. A moderate negative correlation, but non-significant existed between seed yield and hectolitre mass. It is concluded that the hybrid Sumiko HTS showed high productivity and was best adapted to the agro-climatic conditions of ARDS Simnic.

Key words: head diameter, plant height, seed yield, sunflower (*Helianthus annuus* L.).

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important crop for Romania, ranking third in area after maize and wheat. It is grown on an area of 1.098,0 thousand hectares in Romania; with a production of 3.080,0 thousand tons sunflower seed and an average seed yield of 2805 kg/ha (MADR, 2018).

Although sunflower has high yield with good adaptation capacity, the seed yield varies widely depending on many factors such as rainfall distribution during the growing season, temperature, time of sowing, plant density, nitrogen nutrition (Anjum et al., 2012; Barros et al., 2004; Ion et al., 2018; Kaleem et al., 2009; Lawal et al., 2011).

According to Sarwar et al. (2013), seed yield of sunflower is greatly affected by hybrid chosen and that's why we have to choose hybrids with characteristics that best suit our needs and production practices.

In Romania is a highly diversified offer of Romanian and foreign hybrids that is changing from one year to another. According to Ion et al. (2010), it is absolutely necessary that sunflower grower to know the yielding traits of sunflower hybrids, especially the foreign ones

and the new ones that are less known or even unknown.

Sunflower crop is classified as a low to medium drought sensitive (Rauf, 2008).

The understanding of interrelationships between plant characters in optimal and stress conditions is one of the main problems in breeding plant (Razi and Assad, 1999).

Seed yield in sunflower is a quantitative character that dependent on its own component traits (Arshad et al., 2007).

Plant breeders commonly prefer yield components such as plant height and head diameter that indirectly increase seed yield. Therefore, to get higher seed yields, it is important to know the relationships among yield traits in sunflower (Kaya et al., 2009).

Keeping all this in view, present study was designed to investigate comparative yield of different hybrids of sunflower and relationship between seed yield and its components, so as to choose best hybrid for agro-climatically conditions of Craiova.

MATERIALS AND METHODS

Experiment was conducted in a field research under rain fed conditions in the year 2019.

This field research was performed at the Agricultural Research and Development Station (ARDS) Simnic - Craiova (44°19' N, 23°48' E, and 182 m altitude).

Soil of the experimental area is a reddish preluvosol which has the following characteristics for the Ap and Apt surface horizons (0-29 cm; 29-43 cm): the soil reaction is moderately acidic (pH = 5.08-5.33); humus content is low (2.68-2.33%); phosphorus and potassium contents are of 52.2-32.3 mg/kg and 125-104 kg/ha, respectively (Radu et al., 2019). The experiment organized in a randomised block design with three replications.

Sowing was performed on 4 April 2019.

The crop technology was the regular one for sunflower in Southern-Western Romania, with an application of 250 kg of complex fertiliser (7:21:21).

Weeds were controlled by the help of herbicides, respectively Dual Gold 960 EC applied at a dose of 1.5 l/ha (first decade of April). Also, one manual hoeing was performed.

The year 2019 was not very favourable to sunflower because of the drought during July and August when rainfall was below the multiannual average and because of the high temperatures recorded.

Six foreign sunflower hybrids created by the Company Syngenta Romania, namely Sumiko HTS, Subaru HTS, SY Diamantis, SY Bacardi CLP, SY Neostar CLP and SY Onestar CLP, were tested.

At the maturity, ten plants were selected from each replication in order to determine plant height, head diameter, thousand seed weight and hectolitre weight.

Seed yield was adjusted to an 11.0% moisture basis. Seed yield was measured separately from each replication and expressed as kg per hectare.

The collected data were subjected to One-Way Analysis of Variance (ANOVA) and means separated using the Duncan's multiple comparisons tests at 5% level of probability.

To determine the relationships among the analysed traits, were used the regression and the Pearson correlation coefficients.

RESULTS AND DISCUSSIONS

As shown in Table 1, sunflower seed yield and studied traits were significant ($P < 0.05$) or highly significant ($P < 0.01$) affected by sunflower hybrids.

Table 1. Mean squares (MS) for traits of sunflower evaluated at ARDS Simnic during 2019

Source	DF	MS				
		Plant height	Head diameter	Thousand seed Weight	Hectolitre mass	Seed yield
Hybrids	5	246.50**	3.88**	243.20**	18.00*	347129.60**
Error	12	30.00	0.05	13.33	2.90	16095.00

F-test values are shown: * $P < 0.05$; ** $P < 0.01$

Plant height

Analysis of variance showed that the results about the plant height were significant ($p \leq 0.05$) (Table 1).

Multiple comparisons test among means showed that maximum plant height (184 cm) was gained by SY Bacardi CLP which did non-significantly differ from SY Diamantis (179 cm). Minimum plant height was gained by SY Onestar CLP (161 cm) and by SY Neostar CLP

(163 cm) - Table 2. These findings are in accordance with Bakht et al. (2006), Killi and Tekeli (2016) and Sarwar et al. (2013), who also reported significant differences for plant height among sunflower hybrids. They reported that sunflower hybrids significantly differed in plant height and this difference might be due to varietal behaviour and environmental conditions.

Table 2. Mean values for seed yield and studied traits of sunflower hybrids evaluated at ARDS Simnic, Craiova during 2019

Hybrids	Plant height (cm)	Head diameter (cm)	Thousand seed weight (g)	Hectolitre mass (kg/hl)	Seed yield (kg/ha)
Sumiko HTS	174 b	13.8 b	52 cd	43 b	3576 a
Subaro HTS	176 b	14.7 a	72 a	45.8 a	2700 d
SY Diamantis	179 ab	12.4 d	48 d	40.3 c	3002 bc
SY Bacardi CLP	184 a	11.6 e	54 bc	46.2 a	2633 d
SY Neostar CLP	163 c	12.9 c	48 d	45.0 ab	3095 b
SY Onestar CLP	161 c	12.2 d	38 b	46.8 a	2876 c

The linear regression between plant height and seed yield of hybrids was non-significant and negative. It means that at increased level of plant height, the seed yield decreased slightly (Figure 1).

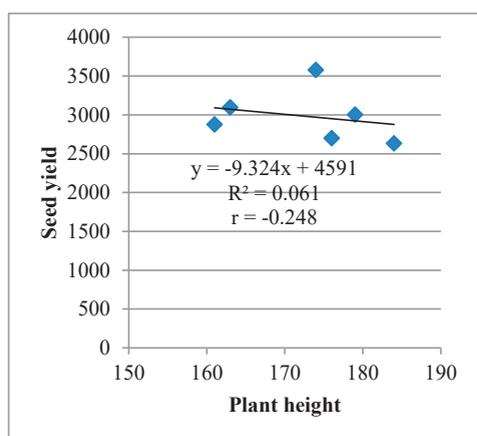


Figure 1. Relationship between plant height and seed yield of sunflower hybrids

Head diameter

Analysis of variance revealed that head diameter showed significant ($p \leq 0.05$) differences among all the hybrids (Table 1). These results are supported by Bakht et al. (2006) and Sarwar et al. (2013), who observed significant differences for head diameter among hybrids.

The largest head diameter (14.7 cm) was recorded in case of Subaro HTS, which was statistically different from all other hybrids, while smallest head diameter was observed in SY Onestar CLP (12.2 cm) and SY Diamantis (12.4 cm) - Table 2.

Previous literature reported head diameter of 9.50-13.30 cm (Alahdadi et al., 2011), 13.1-21.6 cm (Bonea et al., 2010), 14.67-18.87 cm (Fetri et al., 2013) and 13.64-16.29 cm (Iqbal et al., 2017).

The linear regression between head diameter and seed yield of hybrids was positive and non-significantly (Figure 2).

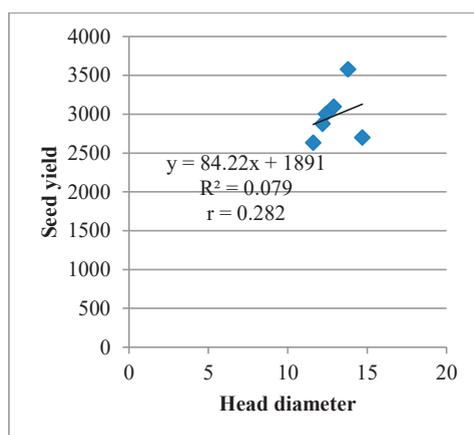


Figure 2. Relationship between head diameter and seed yield of sunflower hybrids

It seems that at increased size of head diameter, the seed yield has increased slightly. Similar results were also reported by Fetri et al. (2013). On the contrary, Iqbal et al. (2017) and Manivannan et al. (2007) reported that the correlation between seed yield and the head diameter was negative and non-significantly. According to Iqbal et al. (2017), decreased the seed yield may be due to less number of fertile florets in large headed plants.

This discordance among results is most likely associated with differences in the environmental conditions and genetic material used in these studies.

Thousand seed weight

Statistical analysis of the data indicated that thousand seed weight was significantly ($p \leq 0.05$) affected by various hybrids of sunflower (Table 1).

The multiple comparisons test among hybrids means showed that maximum thousand seed weight (72 g) was recorded by Subaru HTS, which was statistically different from all other hybrids, whereas minimum thousand seed weight (48 g) were taken by SY Diamantis and SY Neostar CLP (Table 2).

Previous literature reported thousand seed weight of 42-57 g (Bonea et al., 2008), 43.76-52.18 g (Fetri et al., 2013), 50.9-60.5 g (Ion et al., 2015), 48.37-49.11 g (Sarwar et al., 2013). The linear regression between thousand seed weight and seed yield of hybrids was negative and non-significantly (Figure 3). On the contrary, Bonea et al. (2008), Fetri et al. (2013) and Iqbal et al. (2017), found that relationship between thousand seed weight and seed yield of hybrids was positive.

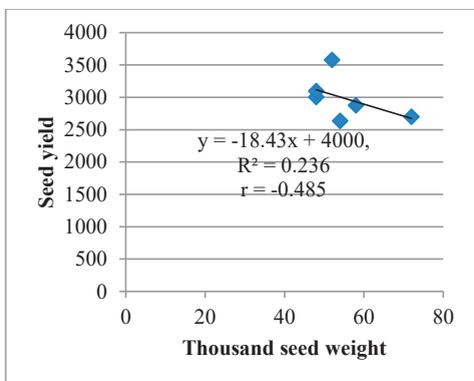


Figure 3. Relationship between thousand seed weight and seed yield of sunflower hybrids

Hectolitre mass

The data regarding hectolitre mass is shown in Tables 1 and 2.

The ANOVA showed that the results about the hectolitre mass were significant ($p \leq 0.05$).

Multiple comparisons test among means showed that maximum hectolitre mass was gained by SY Onestar CLP (46.8 kg/hl), SY Bacardi CLP (46.2 kg/hl) and Subaru HTS (45.8 kg/hl), which were statistically similar with each other.

Minimum hectolitre weight (40.3 kg/hl) was recorded in case of SY Diamantis.

The relationship between hectolitre mass and seed yield of hybrids was moderate negative, but non-significant (Figure 4). On another study carried to ARDS Simnic with ten hybrids of sunflower, Bonea et al. (2008) and Bonea et

al. (2013) reported that the seed yield strongly positive correlated with hectolitre mass ($r = 0.620$ and $r = 0.797$, respectively).

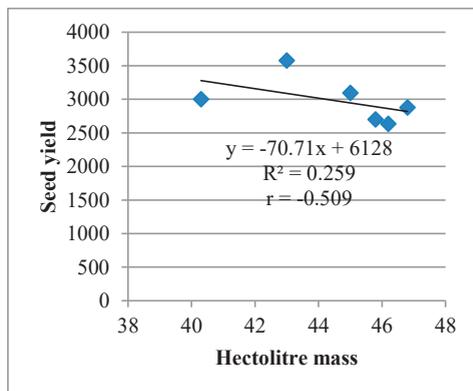


Figure 4. Relationship between hectolitre mass and seed yield of sunflower hybrids

Seed yield

Analysis of variance showed significant ($p \leq 0.05$) differences for seed yield among the hybrids (Table 1).

Comparison of hybrids means shown that the statistically highest seed yield (3576 kg/ha) was obtained in Sumiko HTS, whereas SY Bacardi CLP and Subaru HTS provided least seed yield of 2633 kg/ha and 2700 kg/ha, respectively (Table 2).

According to Hladni et al. (2011), a high seed yield and a high crude protein yield are the two most important criteria for introducing new hybrids into production.

In our study, seed yield level was similar to those obtained previously in Romania and the other countries (Ion et al., 2010; Killi and Tekeli, 2016; Ozturk et al., 2017), but lower or higher than those reported by some other studies (Bonea et al., 2010; Bonea et al., 2012; Bonea et al., 2013; Ion et al., 2015; Ion et al., 2018).

These differences in seed yield values could be explain by their different genetic potential, the agronomic practices used or environment conditions.

CONCLUSIONS

Although all the hybrids included in the experiment performed well under the agro-climatic conditions of ARDS Simnic, but

hybrid Sumiko HTS (3576 kg/ha) proved to be the best regarded the seed yield.

The regression results illustrated in the figures confirmed the importance of these components in determining seed yield.

Seed yield was weakly to moderately positively or negatively associate with studied traits.

A moderate negative correlation, but non-significant existed between seed yield and hectolitre mass.

The significant variation in seed yield values and other traits among hybrids under experiment can be due to the genetic potential of the tested hybrids or to climatic conditions and adaptability.

According to the results of this study, sunflower hybrid Sumiko HTS can be recommended for the similar ecological condition of our study region.

REFERENCES

- Alahdadi, I., Oraki, H., Khajani, F.P. (2011). Effect of water stress on yield and yield components of sunflower hybrids. *African Journal of Biotechnology*, 10(34), 6504–6509.
- Anjum, A.S., Muhammad, S., Imran, M., Arshadullah, M. (2012). Performance of early and late sown sunflower hybrids under organic farming system in rainfed area. *Science Technology and Development*, 31(1), 26–28.
- Arshad, M., Ilyas, M., Khan, M. (2007). Genetic divergence and path coefficient analysis for seed yield traits in sunflower *Helianthus annuus* L. hybrids. *Pakistan Journal of Botany*, 39(6), 2009–2015.
- Bakht, J., Ahmad, S., Tariq, M., Akbar, H., Shafi, M. (2006). Performance of various hybrids of sunflower in Peshawar valley. *Journal of Agricultural and Biological Science*, 1(3), 25–29.
- Barros, J.F., de Carvalho, M., Basch, G. (2004). Response of sunflower (*Helianthus annuus* L.) to sowing date and plant density under Mediterranean conditions. *European Journal of Agronomy*, 21(3), 347–356.
- Bonea, D., Urechean, V., Constantinescu, E., Pandia, O. (2008). The interrelations between the capacity of production and the component elements at the sunflower. *Bulletin UASVM, Agriculture*, 65(1), 355.
- Bonea, D., Borleanu, C.I., Urechean, V., Constantinescu, E. (2010). Agronomic value of some sunflower hybrids cultivated in Oltenia area. *Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series*, XL(2), 46–51.
- Bonea, D., Urechean, V., Constantinescu, E., Iancu, D. (2012). The behaviour of some sunflower (*Helianthus annuus*) hybrids from abroad under water and heat stress at ARDS Simnic. *Scientific Papers. Series A. Agronomy*, LV, 129–132.
- Bonea, D., Urechean, V., Mîndrilă, G., Iancu, D. (2013). Results on the yield and correlations between characters in some sunflower (*Helianthus annuus* L.) hybrids grown in Oltenia. *Annals of the University of Craiova – Agriculture, Montanology, Cadastre Series*, XLIII(1), 73–77.
- Fetri, M., Ghobadi, M.E., Asadian, G., Rajabi, M. (2013). Effect of sowing date on yield and yield components of sunflower (*Helianthus annuus* L.). *Annals of Biological Research*, 4(2), 90–93.
- Hladni, N., Jocić, S., Miklič, V., Saftićpanković, D., Kraljević-Balalić, M. (2011). Interdependence of yield and yield components of confectionary sunflower hybrids. *Genetika*, 43(3), 583–594.
- Iqbal, Q., Ali, S., Shafique, O., Tahir, M.N., Khan, B.A., Ahmad, I., Khan, I. (2017). Assessment of different exotic sunflower hybrids for their agro-ecological adaptability. *Pakistan Journal of Agricultural Research*, 31(2), 122–132.
- Ion, V., Stefan, V., Dumbrava, M., Ion, N., Basa, A.Gh. (2010). Yield results obtained from an assortment of sunflower hybrids cultivated at Moara Domneasca Research Farm in the period 2006-2008. *Scientific Papers, Series A, LVIII*, 364–370.
- Ion, V., Dicu, G., Basa, A.G., Dumbrava, M., Temocico, G., Epure, L.I., State, D. (2015). Sunflower yield and yield components under different sowing conditions. *Agriculture and Agricultural Science Procedia*, 6, 44–51.
- Ion, V., Bășa A.Gh., Dumbravă, M., Epure, L.I. (2018). Results regarding yield components and grain yield at sunflower under different row spacing and nitrogen fertilisation conditions. *Scientific Papers. Series A. Agronomy*, LXI(1), 247–254.
- Kaleem, S., Hassan, F.U., Saleem, A. (2009). Influence of environmental variations on physiological attributes of sunflower. *African Journal of Biotechnology*, 8(15), 3531–3539.
- Kaya, Y., Evci, G., Durak, S., Pekcan, V., Gucer, T. (2009). Yield components affecting seed yield and their relationships in sunflower (*Helianthus annuus* L.). *Pakistan Journal of Botany*, 41(5), 2261–2269.
- Killi, F., Tekeli, F. (2016). Seed yield and some yield components of sunflower (*Helianthus annuus* L.) genotypes in Kahramanmaraş (Turkey) conditions. *Journal of Scientific and Engineering Research*, 3(4), 346–349.
- Lawal, B.A., Obigbesan, G.O., Akanbi, W.B., Kolawole, G.O. (2011). Effect of planting time on sunflower (*Helianthus annuus* L.) productivity in Ibadan, Nigeria. *African Journal of Agricultural Research*, 6(13), 3049–3054.
- MADR, (2018). Date privind evoluția suprafețelor și a producției în România. <https://www.madr.ro/culturi-de-camp/plante-tehnice/floarea-soarelui.html> Retrieved February 6, 2020.
- Manivannan, N., Karthika, R., Punitha, B., Vindhiyavarman, P., Muralidharan, V. (2007). Association pattern among the yield attributes in varieties and hybrids of sunflower (*Helianthus annuus* L.). *Madras Agricultural Journal*, 94(1-6), 84–88.

- Ozturk, E., Polat, T., Sezek, M. (2017). The effect of sowing date and nitrogen fertilizer form on growth, yield and yield components in sunflower. *Turkish Journal Field Crops*, 22(1), 143–151.
- Radu, V., Popa, I., Dodocioiu, A.M., Buzatu, G.D. (2019). The quality status of the reddish preluvosol from ARDS Simnic. *Analele Universității din Craiova, seria Biologie, Horticultură, Tehnologia Prelucrării Produselor Agricole, Ingineria Mediului*, 24, 213–217.
- Razi, H., Assad, M. (1999). Comparison of selection criteria in normal and limited irrigation in sunflower. *Euphytica*, 105(2), 83–90.
- Rauf, S. (2008). Breeding sunflower (*Helianthus annuus* L.) for drought tolerance. *Communications in Biometry and Crop Science*, 3(1), 29–44.
- Sarwar, M.A., Khalil-UR-Rehman, M.N., Javeed, H.M.R., Ahmad, W., Shehzad, M.A., Iqbal, S., Abbas, H.T. (2013). Comparative performance of various sunflower hybrids for yield and its related attributes. *Cercetări Agronomice în Moldova*, XLVI, 4(156), 57–64.