International Journal of Agriculture, Environment and Bioresearch

Vol. 06, No. 01; 2021

ISSN: 2456-8643

THE EVALUATION OF CONFECTIONERY SUNFLOWER (*Helianthus Annuus* L.) CULTIVARS AND POPULATIONS FOR YIELD AND YIELD COMPONENTS

Ismail Demir

Kırşehir Ahi Evran University, Faculty Of Agriculture,department Of Field Crops, Kırşehir, Turkey

https://doi.org/10.35410/IJAEB.2021.5612

ABSTRACT

This study was performed to determine yield and some quality components of confectionary sunflower (*Helianthus annuus* L.) populations and cultivars in 2015-2016 under rainfed condition of semi-arid climate zone. Experiments were carried out in the Randomized Complete Blocks Design with three replications. Plant height, head diameter, hull ratio, seed yield per plant, thousand seed weight, seed yield and crude oil content were investigated. The highest seed yield and head diameter were 3791.39 kg ha-1and 20.35 cm from Çigdem-1 cultivar, seed yield per plant was 127.51g from Hamit population, thousand seed weight was 125.93 g from Elbistan population, seed hull ratio was 54.37% from Elbistan population, oil content was 34.24% from ÇRZ 13-7 variety and plant height 161.33 cm from Inegöl population. Rainfed agriculture condition especially in semi-arid climate zone, rainfall and temperature in growing period have important role on seed yield. It has been observed that local populations of confectionary sunflower generally retain their yield capabilities better when stress conditions increase.

Keywords: Confectionery Sunflower, Population, Seed Yield, Rainfed Condition.

1. INTRODUCTION

Sunflower is an important oilseed plant to meet the vegetable oil need. In addition to the production of sunflower for oil, sunflower varieties for confectionary are also included in production. Confectionery Non-oil seed sunflower generally has a relatively thick hull that remains loosely attached to the kernel, permitting more complete dehulling[1]. Seed of the confectionary sunflower generally is larger than that of the oilseed types and has a lower oil percentage and dehulled kernel ratio. The use of confectionary sunflower seeds has a long and rich tradition in Russia, Turkey and Ukraine. The favoured seed colour of confectionary hybrids in Turkey is white with grey stripes, while in Balkan countries such as Serbia, Bulgaria, Moldova, and Romania, as well as Russia black seeds are preferred[2-4]. Confectionary non-oil sunflower seed types can be black, white, black with white stripes, or colourful and significantly larger than the oil-type sunflower seeds. Day by day, depending on the consumption, the cultivation of confectionary sunflower also increases. Confectionary sunflower production in Turkey is mostly done with genotypes referred to by name if the local population. Some of them are in the form of village populations named Alaca, Kırıkkale, Denizli, Cyprus, Maraş, Haymana ala, Aksaray. After 2008, the varieties named Çiğdem 1 and Palancı 1 were also developed, but they could not find a place in production widely. In Turkey, the most common types of Inegöl

Vol. 06, No. 01; 2021

ISSN: 2456-8643

Alain (registered in 2013) production are performed[5]. Additionally, confectionary sunflower data both for production and consumption cannot be found in most national or international organization statistics in the world. Oil seed and confectionary sunflower cultivation areas and production statistical data in Turkey are collected separately. In 2019, the sunflower cultivation area for confectionary was 76.5 thousand ha, while the cultivation area for oil seed sunflower was 675 thousand ha. Production is approximately 2 million tons for oil seed sunflower and 150 thousand tons for confectionary sunflower. In some cities of Turkey (Kayseri, Kahramanmaraş, Denizli) only confectionary sunflower is cultivated. However, confectionary sunflower production is not enough for Turkey consumption and domestic needs are supplied by importing similar type[4, 5].

This study was performed to determine yield and some quality components of confectionary sunflower (*Helianthus annuus* L.) populations which was collecting from different regions of Turkey and to compare all genotypes performance in semi-arid climate zone under rainfed condition. The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper.

2. MATERIAL AND METHODS

This study was conducted in Research Farm of Agricultural Faculty of Kırşehir Ahi Evran University in 2015 and 2016. This experimental field in Kırşehir province is located at 39.15° Northern latitude and 34.11° Eastern longitude at 1014 meters above sea level. Experimental soil of field has clayed loam texture, alkaline character, calcareous, non-saline, has certain amount of available phosphorus concentration, rich in potassium content, poor in organic matter and nitrogen classes as described by Kacar [6] (Table 1).

Table 1. Soil properties of the experimental field at 0-30 cm depth

Saturation%	pH	EC (mmhos/cm)	Tuz (%)	Absorbable P (%)	CaCO3 (%)	Absorbable K (ppm)	Organic matter (%)
55	7,59	0,58	0,021	0,19	21,8	63,78	1,39

The meteorological data for the research period of the two years were collected from Kırşehir Meteorology Station located about 1.5 km away from the Research Farm. The experimental site was located in semi-arid climate zone with continental climate characteristics and limited rainfall distribution having peaks usually in period of December to June. Dry period often referred to as after June to November. Weather data of experimentation in 2015 and 2016 are presented in Tables 2. The months of June (161.4 mm) in 2015 and May (95.8 mm) in 2016 were the wettest months during the research periods. Total rainfall of growing period of research years were 260.80 mm and 183.50 mm in 2015 and 2016 respectively. Both 2015 and 2016 were warmer than long term monthly average temperature and after May to September in 2016 were hottest months based on mean atmospheric temperature. Relative humidity values, however, ranged

Vol. 06, No. 01; 2021

ISSN: 2456-8643

between 42.5% (July 2016) and 66.8% (June 2015) and 2016 growing period was dryer then 2015 as shown in Table 2.

Table 2. Meteorological data of the study area

Months	Mean Temperature (°C)			Relative Humidity (%)			Precipitation (mm)		
	1970-2020	2015	2016	1970-2018	2015	2016	1970-2018	2015	2016
April	10.85	8.80	13.80	63.29	66.2	47.4	42.44	26.80	23.80
May	15.39	16.0	14.90	60.80	58.1	63.7	44.30	39.20	95.80
June	19.74	18.4	21.00	54.00	66.8	53.0	36.80	161.4	16.10
July	23.34	23.0	24.20	48.10	47.0	42.5	6.80	20.60	5.80
August	23.43	24.8	25.70	48.40	47.5	43.8	4.90	11.80	
Septembe	19.10	23.0	18.40	53.10	40.8	48.2	11.60	1.00	42.00
Mean	18.60	19.0	19.70	54.60	54.4	49.8			
Total							146.84	260.8	183.5

The experimental sites were ploughed twice and harrowed once before marking out the plots. Ten confectionary sunflower genotypes and population (Palancı-1, TTAE-ÇRZ-13-4, TTAE-ÇRZ-13-6, TTAE-ÇRZ-13-7, TTAE-ÇRZ-13-9, TTAE-ÇRZ-13-10, Çiğdem 1, Elbistan, Hamit and Inegöl) were evaluated regarding their yield and yield parameters. At each sowing date, seeds of the test varieties were sown at as pacing of 70 cmx 40 cm which corresponded to 35,000 plants ha−1 in the second week of April (10 April 2016 and 12 April 2017). Three seeds of the test varieties were sown per hole and later thinned to one plant per stand at stage of 4- 6 true leaf. Each experimental plot consisted of six rows 4 m in length and measured 4.2 mx4 m (16.8 m2). No agro-chemicals were used during both experiments in order to simulate the usual practice of the farmers and less environmental damage. The crop was grown under rain-fed conditions which is the usual practice of the semi-arid climate condition's farmers. There were no incidences of pests and diseases during the research but to protect the bird damage mesh bags were used.

The following parameters were evaluated within the scope of the study: plant height (cm), head diameter (cm), thousand seeds weight (g), seed yield per plant (g), hull-kernel ratio (%), seed yield (kg/ha) and crude oil rate (%). Variance analysis was performed on the obtained data according to the random blocks method [7]. The Duncan test was employed to determine the significance of the differences between the trials. All statistical calculations and the variance of data was analysed by MSTATC software [8].

3. RESULT AND DISCUSSION

The data regarding plant height of 10 confectionary sunflower genotypes and population were significantly ($P<0.01$) different both research years, as shown in Table 3. The genotypes Inegöl (161.33 cm) and ÇRZ-13-7 (160.03 cm) produced the maximum plant height in first year and

Vol. 06, No. 01; 2021

ISSN: 2456-8643

ÇRZ-13-6 (154.27 cm) was higher in second year. The differences in plant height may also be attributed to the genetic potential of genotypes and the other prevailing environmental conditions. Mean plant height of 2015 (150.28 cm) was higher than the plant height of 2016 (144.79 cm) (Table 3). This kind of differences may be resulted from climate, environmental conditions, and cultural practices. Sufficient precipitation, temperature rises, lighting intensity, daylight duration, latitude and longer photo periods during the growing seasons may increase plant heights [9]. Montemurro, De Giorgio [10] indicated that high precipitations improved early vegetative development of sunflower and environmental conditions had positive impacts on plant growth and development.

Head diameter data of 10 confectionary sunflower genotypes and populations were significantly ($P<0.05$) different in the first year of research. The higher head diameter was obtained from Çiğdem-1 cultivar (20.35 cm) and lowest head diameter was from ÇRZ-13-7 genotype (16.64 cm) (Table 3). Second year, head diameters of genotypes were very close to each other due to the higher temperature and less precipitation comparison of first year (Table 2). Coşge and Ulukan [11] reported that head diameter as the most significant yield parameter and positive effects of head diameter on seed yield. However, Kaya, Evci [12]mention that seed yield increases until a head diameter of 24 cm and decreased seed yields over size of 24 cm head diameter.

Table 3. Some agronomic traits of confectionary sunflower cultivars grown in 2015 and 2016

Analysis of Variance	Plant Height (cm)		Head diameter (cm)		Thousand seed weight (g)		Seed yield per plant (g)	
	2015	2016	2015	2016	2015	2016	2015	2016
Replication	6.873	11.132	1.973	0.327	103.273	111.016	3.368	8.095
Cultivars	130.09**	93.64**	3.44*	2.35ns	355.03**	368.43**	311.04**	295.65**
Error	20.76	22.812	1.357	1.606	84.172	53.582	77.725	50.528
CV	3.03%	3.21%	6.28%	7.19%	8.61%	7.78%	7.78%	6.28%
Çiğdem-1	148.90bc	141.90c	20.35a	19.17	120.61ab	105.21abc	122.74a	109.92ab
ÇRZ 13-6	152.27ab	154.27a	18.69abc	17.70	97.91cd	78.53e	95.39c	90.40c
ÇRZ 13-9	141.33c	139.87c	19.35abc	17.41	98.78cd	96.75ad	119.57ab	117.27a
ÇRZ 13-7	160.03a	153.37ab	16.64d	16.25	93.95d	81.70de	100.91bc	92.90c
Elbistan	149.23bc	139.83c	19.74ab	18.80	125.93a	107.80ab	122.71a	118.92a
Hamit	144.27bc	143.17bc	18.62ad	18.12	117.00abc	110.20a	127.51a	113.32ab

Vol. 06, No. 01; 2021

ISSN: 2456-8643

İnegöl	161.33a	144.90abc	17.69cd	16.65	98.35cd	83.87de	108.40abc	97.21bc
PALANCI-1	143.67bc	137.60c	17.96bcd	17.35	104.33bcd	90.57cde	110.92abc	99.97bc
ÇRZ 13-4	149.23bc	146.22abc	18.41ad	17.54	102.46bcd	90.80be	110.33abc	104.40abc
ÇRZ 13-10	152.52ab	146.79abc	18.07bcd	17.39	106.51ad	96.04ad	114.61abc	106.89abc
Mean	150.28	144.79	18.55	17.64	106.58	94.15	113.31	105.12
LSD	10.71	11.07	1.998		21.56	17.20	20.72	16.71

Regarding thousand seed weight, genotypes were significantly (P<0.01) different and ranged from 78.53g to 125.93 g in the research. First year Elbistan (125.93 g) and second year Hamit (110.20 g) were highest thousand seed weight and lowest in 2015 was ÇRZ 13-7 (93.95 g) and ÇRZ 13-6 (78.53 g) was in 2016. Genetics of the cultivars and environmental conditions wit temperature and water stress were effective in differences in thousand seed weights of the cultivars. Westgate [13]reported that the main reason for seed weight reduction is a decrease in grain filling period due to stress. Since our research area was under rainfed agriculture conditions temperature and water stress are important factors on seed weight.

Seed yield per plant data of 10 confectionary sunflower genotypes and populations were significantly (P<0.01) different. The higher seed yield per plant was obtained from Hamit (127.51 g) and Elbistan (118.92 gr) population and lowest was 95.39 g and 90.40 g from ÇRZ-13-6 genotype in 2015 and 2016 respectively (Table 3). According to genotypes and years mean of seed yield per plant was higher in the 2015 growing season and the differences of seed yield per plant was more than 8 g/plant. It means that about 35000 plant/ha x 8g=286 kg ha-1 seed loses. The main reason for this difference was the distinction among climatic conditions of growing seasons. During 2016, the dry and warmer condition was received than 2015. Especially, because of the insufficient rainfall after May and high temperatures probably reduced the seed yield.

Hull ratio of seeds data of 10 confectionary sunflower genotypes and populations were significantly (P<0.01) different. The higher hull ratio was obtained from Elbistan (51.34% and 54.37%) population and lowest was 43.71% and 45.85% from Palancı-1 cultivars in 2015 and 2016 respectively (Table 4). According to genotypes and years mean of hull ratio was higher in the 2016 growing season and the differences was about 3%. The main reason for this difference was the distinction among climatic conditions of seed filling period. Especially, because of the insufficient rainfall after July and higher temperatures probably reduced the seed filling.

Table 4. Some agronomic traits of confectionary sunflower cultivars grown in 2015 and 2016

Analysis of	Seed hull rate (%)	Seed yield (kg ha^{-1})	Crude oil rate (%)

Vol. 06, No. 01; 2021

ISSN: 2456-8643

Variance	2015	2016	2015	2016	2015	2016
Replication	2.291	1.47	46428.41	52473.32	0.714	0.809
FactorA	17.86**	20.82**	279556.3**	386949.09**	8.67**	7.93**
Error	3.069	4.754	46092.07	50738.34	1.222	1.568
CV	3.70%	4.63%	6.45%	7.70%	3.58%	3.94%
Çiğdem-1	47.01bcd	50.24abc	3791.39a	3354.09a	28.48d	28.87d
ÇRZ 13-6	45.25cd	48.41bc	2993.38d	2535.03b	32.14ab	32.29abc
ÇRZ 13-9	47.48ad	49.40abc	3127.59cd	2948.00ab	32.16ab	33.40ab
ÇRZ 13-7	45.00cd	48.81bc	2929.50d	2438.54b	33.67a	34.24a
Elbistan	51.34a	54.37a	3771.75ab	3382.12a	28.57d	30.49bcd
Hamit	50.84ab	54.19a	3617.77abc	3418.66a	29.28cd	30.19cd
İnegöl	48.37abc	51.03ab	3312.49ad	2602.45b	30.68bcd	31.36ad
PALANCI-1	43.71d	45.85c	3271.18bcd	2810.49b	30.86bcd	31.76ad
ÇRZ 13-4	46.57cd	48.87bc	3162.67cd	2797.16b	31.99ab	33.09abc
ÇRZ 13-10	48.06abc	51.65ab	3291.58ad	2961.48ab	31.18abc	32.29abc
Mean	47.36	50.28	3326.93	2924.80	30.90	31,80
LSD	4.12	5.13	504.6	529.4	2.60	2.94

In this research, differences of genotypes had significantly (P<0.01) effected seed yield. The highest seed yield (3791.39kg ha^{-1}) was determined from Çiğdem-1 cultivar in 2015 and Hamit population (3418.66 kg ha^{-1}) in 2016, the lowest seed yield (2929.50 and 2438.54 kg ha^{-1}) was obtained from the ÇRZ 13-7 genotype. Generally, 2016 research year was lowest seed yield due to the less rainfall and warmer period after May to maturity stage. In similar studies conducted with confectionary sunflower was reported seed yield between from 2166.60 kg ha^{-1} to 5730.20 kg ha^{-1}[2, 4, 5, 14] In this study lowest seed yield result was over researchers' lowest yield but highest seed yield of this study lower than researchers' highest yield results. Since our research area was under rainfed agriculture conditions temperature and water stress especially insufficient rainfall after flowering stage have negative effect on seed yield.

In the study, the crude oil ratios varied between 28.48% and 34.24%. Differences in crude oil ratios between genotypes were statistically significant(P<0.01). The highest crude oil ratio (33.67

Vol. 06, No. 01; 2021

ISSN: 2456-8643

and 34.24%) was determined from ÇRZ 13-7 cultivar in 2015 and 2016, the lowest crude oil ratio (28.48 and 28.87%) was obtained from the Çiğdem-1 cultivar. Confectionary sunflower, unlike oil sunflower high crude oil content is not desirable. Crude oil ratio is a character that affected by many environmental and genotypic factors. Jocic, Miladinovic [15]stated that the crude oil ratio in confectionary sunflower varieties should be below 40%.

4. CONCLUSION

Differences in climate and environmental factors of the experimental years significantly affected the investigated traits of confectionary sunflower genotypes. While rainy growing season of 2015 had positive effects on yield and yield parameters, negative effects of less rainfall and warmer climate condition was determined in 2016 comparing the yield and yield parameters results of genotypes. Especially seed filling period, because of the insufficient rainfall and warmer weather condition after June, probably negatively affected the yield parameters such as table diameter, thousand seed weight, seed yield per plant etc. and resulted decrease in seed yield. Rainfed agriculture condition especially in semi-arid climate zone, rainfall in growing period is important climate factor on seed yield. After flowering stage dry and hotter climate condition reduce seed yield and seed quality. Genotypes have important role with under stress conditions. In this study it was determined that genetic capability of variety under stress condition had important role on sufficient seed yield. In this study new cultivar Çiğdem-1 had highest seed yield in wet season but Hamit, Elbistan and Çiğdem-1 highest in dry and hotter condition. When stress conditions increase, local populations can be better in seed yield. So, breeding research have important for generate new generation for dry and hotter climate condition with use of local populations.

REFERENCES

[1] R.B. Duane, "Sunflower production," *NDSU Extension Service, ND Agricultural Experiment Station, North Dakota State University, America,* 2007.

[2] M. Sincik, and A.T. Goksoy, "Investigation of correlation between traits and path analysis of confectionary sunflower genotypes," *Notulae Botanicae Horti Agrobotanici Cluj-Napoca,* vol. 42, no. 1, pp. 227-231, 2014.

[3] Y.E.C. Sağlam, "Bazı çerezlik ayçiçeği (Helianthus annuus L.) çeşitlerinin tekirdağ koşullarında verim ve verim unsurları," *Tekirdağ Ziraat Fakültesi Dergisi,* vol. 2, no. 3, pp. 221-227, 2005.

[4] V. Pekcan, E. Goksel, İ.M. Yİlmaz, and K. Yalcin, "Developing confectionery sunflower hybrids and determination of their yield performances in different environmental conditions," *Ekin Journal of Crop Breeding and Genetics,* vol. 1, no. 2, pp. 47-55, 2015.

[5] G. Yilmaz, A. Kinay, E. Turan, and Ş. Dökülen, "Tokat şartlarında farklı çerezlik ayçiçeği (Helianthus annuus L.) genotiplerinin performanslarının belirlenmesi," *Tarla Bitkileri Merkez Araştırma Enstitüsü Dergisi,* vol. 26, no. 2, pp. 161-169, 2017.

[6] B. Kacar, *Bitki ve toprağın kimyasal analizleri*, Ankara Ünİversitesi Ziraat Fakültesi Eğitim, Araştırma ve Geliştirme Vakfı, 1994.

Vol. 06, No. 01; 2021

ISSN: 2456-8643

[7] O. Düzgüneş, T. Kesici, O. Kavuncu, and F. Gürbüz, "Araştırma ve deneme metodları (İstatistik Metodları-II)," *Ankara Üniversitesi Ziraat Fakültesi Yayınları*, vol. 1021, pp. 295, 1987.

[8] D. Russell, "MSTAT-C package programme," *Crop and Soil Science Department, Michigan State University, USA*, 1986.

[9] Y. Kaya, *Genotype and environment interactions with physiological maturity of sunflower (Helianthus annuus L.) hybrids in western Nebraska*, University of Nebraska, Lincoin, NE. USA., 1998.

[10] F. Montemurro, D. De Giorgio, F. Fornaro, E. Scalcione, and C. Vitti, "Influence of climatic conditions on yields, N uptake and efficiency in sunflower," *Italian Journal of Agrometeorology*, vol. 2, pp. 28-34, 2007.

[11] B. Coşge, and H. Ulukan, "Ayçiçeği (Helianthus annuus L.) Yetiştiriciliğimizde Çeşit ve Ekim Zamanı," *Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, vol. 9, no. 3, pp. 43-48, 2005.

[12] Y. Kaya, G. Evci, V. Pekcan, T. Gücer, and M. Yilmaz, "The determination relationships between oil yield and some yield traits in sunflower," *Tarim Bilimleri Dergisi*, vol. 15, no. 4, pp. 310-318, 2009.

[13] M.E. Westgate, "Water status and development of the maize endosperm and embryo during drought," *Crop science*, vol. 34, no. 1, pp. 76-83, 1994.

[14] A.Ş. Tan, "Characterization of Confectionary Sunflower (Helianthus annuus L.) Genetic resources of denizli and erzurum provinces," *Anadolu Ege Tarımsal Araştırma Enstitüsü Dergisi*, vol. 23, no. 1, pp. 5-11, 2013.

[15] S. Jocic, D. Miladinovic, and Y. Kaya, "Breeding and genetics of sunflower" in *Sunflower*, pp. 1-25, Elsevier, 2015.