TARIM BiLiMLER[ DERGiSi 2004, 10 (1) 111-115
DOI: 10.1501/Tarimbil_0000000878

# Correlations between Some Yield aiid Yield Components in Sunflower *(Helianthus annuus* L.) Hybrid, Line and Varieties ·

Belgin COŞGE[1] Nil.gün BAYRAKTAR[2]

Geliş Tarihi: 10.04.2003

Abstract: This study was conducted an experimental field of Field Crops Department at Agricultural Faculty ol Ankara University in 1995, 1997 and 1998. The trials were designed in randomized block design with three replications Genetic male sterile lines, hybrids and Ek.iz-1, Vnıımk-8931 and Super-25 varieties were used asa materlal. According to the results of correlation analysis; posftive correlations between SeY, SY, HD and PH; between OR, TSW, SeY arıd HD: between SeY, TSW and SY were recorded.

Key Words: Sunflower, yıeld, corretation

## Ayçiçeği *(Helianthus annuus* L.) Melez, Hat ve Çeşitlerinde Bazı Verim ve Verim Öğeleri arasındaki Korelasyon

Özet: Bu araştımıa; 1995, 1997 **ve** 1998 yıllarında Ankara Üniversitesi Ziraat Fal<ültesi, Tar1a BitRlleri Bölümü deneme tarlasında tesadüf blokları deneme desenine göre Oç tekerrllrlO olarak kurulmuştur. Deneme materyali olarak genetik erkısır hatlar, melezler ve Ekiz-1, Vnıımk-8931 **ve** Süper-25 çeşitleri kullanılmıştır. Korelasyon Anarız.; sonuçlarına göre; bitki boyu ile tabla çapı, sap verimi ve tohum verimi; tabla çapı ile sap verimi, tohum verfmi, 1000 tohum ağırlığı ve yağ oranı; sap verimi ile 1000 tohum ağırlığı **ve** tohum verimi arasında olumlu bir ilişki kaydedilmiştir.

Anahtar Kelimeler: Ayçiçeği, verim, ikili ilişkiler (korelasyon)

## Introduction

Surıflower *(He/ianthus annuus* L.) is widely grown in many parts of the world and one of the more important oil seed crops.

it is sown and produced in many regions of Anatolia, mostly in Thrace and in Marmara. 80% of oil productlon in our countıy consists of vegetable oils.

Today, oonsumed vegetable oils are especially suntlower, cotton and olive oils. Sources of produced vegetable oils are sunflower, cotton, soybean, and otive.

Considering the proportion (%) of produced ,oil from oil plants in Turkey; the highest rate belongs to the sunflower of 57% followed by cotton of 21.4%, olive of 10.7%, soybean, sesame, opium poppy and rape of 7% (Coşge, H199).The consumption of oil per person in our countıy ls 14 kg/year and our annual total oil need is 840 000 ton. Our vegetable oil production is 380 000 ton/year. Cotton, corn. olive and soybean are *grown* in limited areas. Considerin9 these circumstances. it is required to increase the production of sunflower.

New varieties of oil crops are resistant pests and diseases, productive and high quality. Producing of these ones will be assisted in solution to our shortage of oil which continues tor years.

Cottelatlons between ·yield and some yield components are required tor supflower breedirıg works.

The some of studles in this subject were given below.

Kovacık and Skauld {1976} *found* that husk ratio and kernel ratio were negatively correlated.

Zali and Somadi (1978) reported that there was a positive correlation between seed yield and head diameter.

Alba and Grec-0 (1979), and Alba et al. (1979) pointed out a direct effect of seed weight on seed yıeld of (-0.686), and (0.015), respectively.

it was found that seed oil concentration was most. highly correlated with seed yield (r= 0.7.15). Also, seed yield was related to 200-seed weight (r= 0.481) and seed number per plant (r= 0.626) (Benjamin and Geng, 1982}.

There were positive correıations between seed yield per plant and thousand seed weight and oil ratio. a negative oorrelation between seed yield per plant and husk ratio recorded by Shrınıvasa (1982).

Incekara et. at. (1983) obtained oil *ratfo* was positively coırelated with seed yield, but negatively correlated with husk ratio, and both of the correlations were significant statistically at 0.01 level. The same findings were observed by Martinez (1987) and Dedio (1993).

---

' Prepared from Doctorate Thesis

1e-mail: b-cosge@yahoo.com
2 Ankara Univ. Faculty of Agriculture, Dept. of Agronomy-Ankara

Lakshmanrai et al. (1985) recorded that there were positive correlations between seed yield and head diameter, thousand seed weight and oil ratio.

Tyagi (1985) stated that seed yield was significant statistically and positively correlated with plant height, head diameter and thousand seed weight. However, the correlations between oil ratio, plant height and head diameter were non-significant statistically.

Gencer (1986) explained that there were indicated positive correlations between oil ratio and plant height at 0.05 level, between seed yield and head diameter at 0.01 level.

Yalçın (1986) observed that seed number per plant was positively associated with head diameter ($r = 0.3828 \pm 0.2206$).

There was significantly positive correlation between seed yield and oil yield. Also, plant height and head diameter had a positive effect on oil yield (Vanozzi, 1987).

Results of the other researches (Marinkovic and Skoric, 1988) showed that there was significantly a positive correlation between seed yield and plant height.

Soltani and Archi (1988) reported that thousand seed weight and oil yield was positively correlated.

Vanisree (1988) found that head diameter, thousand seed weight and plant height were positively related to seed yield.

Yield components such as thousand seed weight, oil ratio and head diameter had an significant and positive effect on oil yield (Visic, 1988).

Correlations between sunflower yield and its components were discussed by Pasda and Diepenbrock (1990) and that number of achenes/plant was concluded to be the most important yield component was recorded.

Sezer (1991) stated that head diameter was highly and positively correlated with seed yield.

Chaudhary and Anand (1993) mentioned that seed filling was positively correlated with plant height, stem diameter, head diameter and stem yield, with stem diameter and head diameter having the greatest direct contribution (0.6 and 1.74, respectively).

It was reported positive correlations between seed yield per plant and head diameter (r= 0.793), between head diameter and seed number per plant (r= 0.863) (Ünlü, 1994).

Miralles et al. (1997) recorded that there were significant positive correlations between number of fertile achenes per head, concentration of oil in the achenes and yield of achenes.

Correlations between crop yield and yield components were determined for sunflowers grown at Navsari, Gujarat / India at different fertilizer and irrigation rates (Narayana and Patel, 1998). In their study, all the parameters examined (plant height, stem width, head diameter, seed number/head, percentage filled seeds, seed index and seed weight/head) were significantly related to seed yield.

In this study, it was aimed to investigate correlations between yield and some yield components in sunflower.

## Materials and Methods

Six genetic male sterile (GMS) lines, Ekiz-1 and Vnıımk- 8931 varieties in 1995; six GMS lines and Ekiz-1 variety in 1997; three GMS lines, their $F_1$ hybrids (GMS line x Ekiz-1), Ekiz-1 and Super-25 varieties in 1998 were used as a material.

Field experiments were conducted at the experimental fields of Field Crops Department at Agricultural Faculty of Ankara University (32° 51" E; 39° 57" N; 860 m above see level) in 1995, 1997 and 1998.

The trials were designed in randomized block design with three replications.

Hundred plants were grown in each plot in sized 30 $m^2$. The sunflowers were planted at a distance of 60 and 50 cm between and within rows, respectively.

The trial materials were sown by hand on 26 April 1995, 7 May 1997 and 8 May 1998. Before sowing, all the seeds were treated with "Aprin" against downy mildew (*Plasmopara halstedii*).

Heads were harvested on 3-11 September 1995, 3-5 September 1997 and 31 August- 1 September 1998.

To determine correlations between yield and some yield components of hybrids, lines and varieties; seed yield (SeY), stalk yield (SY), a thousand seed weight (TSW), head diameter (HD), plant height (PH), husk ratio (HR) and oil ratio (OR) values were recorded.

The fifty plants without broomrape *(Orobanche cumana* Wallr.) parasite of each plot were selected as randomly for investigation.

These plants were harvested separately and obtained seeds were cleaned and weighed and SeY (kg/da) was determined.

For PH (cm), stem length was measured from soil surface to tip of head.

HD (cm) was obtained by measuring diameter of dried heads from selected plants in each plot.

Plants were cut from soil surface and weighed after they were dried on land and SY (kg/da) was counted.

4 x 100 seed was selected as randomly in each plot and weighed in the sensitive scale and TSW (g) was calculated over dry matter weight.

Kernel of 4 x 100 seed, which was selected to calculate TSW, was squashed, OR (%) was determined with soxhelet method using "dry kernel of seed (%) x dry oil (%) / 100" formula given by İlisulu (1968).

Husks of these seeds were dried at 105 ° C for 3 h, and then weighed and HR (%) was recorded over dry matter weight.

All data were biometrically evaluated for "correlation analysis" (Düzgüneş ve ark. 1987).

## Results and Discussion

The average values which were obtained from trial materials in 1995, 1997 and 1998 are given in Table 1. The results of correlations analysis are shown in Table 2, Table 3, and Table 4.

According to the results of three-years, the correlation coefficients indicated that SeY was highly correlated (P<0.01) with HD. Similar findings were reported by Zali and Somadi (1978), Benjamin and Geng (1982), Lakshmanrai et al. (1985), Tyagi (1985), Gencer (1986), Vanisree (1988), Sezer (1991) and Narayana and Patel (1998).

We obtained a low negative correlation (r=-0.102) between SeY and PH in 1995. But, this correlation was a positive effect in 1997 and 1998 (r= 0.337 and r= 0.402, respectively). It was found that SeY was highly significantand positively correlated with PH (Tyagi 1985,

Table1. The yield and yield components values of hybrid, line and varieties

| Year | Material | SeY (kg/da) | SY (kg/da) | TSW (g) | PH (cm) | HD (cm) | HR (%) | OR (%) |
|---|---|---|---|---|---|---|---|---|
| 1995 | GMS line (mean) | 160.28 | 279.53 | 70.91 | 94.73 | 17.64 | 25.24 | 45.23 |
| | Ekiz-1 | 175.66 | 419.30 | 75.56 | 145.83 | 19.95 | 24.52 | 45.38 |
| | Vnnmk-8931 | 117.33 | 341.03 | 58.19 | 131.50 | 15.08 | 22.74 | 46.53 |
| 1997 | $F_1$ hybrid (mean) | 154.49 | 329.83 | 55.23 | 129.78 | 15.92 | 25.94 | 50.84 |
| | Ekiz-1 | 170.29 | 594.02 | 57.56 | 167.59 | 18.93 | 27.09 | 51.67 |
| 1998 | GMS line (mean) | 132.53 | 443.00 | 50.00 | 125.73 | 14.78 | 29.83 | 54.87 |
| | $F_1$ hybrid (mean) | 147.15 | 513.19 | 50.23 | 143.83 | 16.04 | 30.69 | 55.11 |
| | Ekiz-1 | 153.30 | 678.64 | 42.46 | 156.23 | 17.07 | 30.76 | 52.67 |
| | Super-25 | 137.34 | 561.07 | 46.93 | 131.63 | 16.35 | 26.88 | 59.33 |

Table2. Results of Correlations Analysis in 1995 year

| Characters | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1. SeY (kg/da) | 1.000 | | | | | | |
| 2. SY (kg/da) | -0.066 | 1.000 | | | | | |
| 3. TSW (g) | 0.588** | -0.132 | 1.000 | | | | |
| 4. PH (cm) | -0.102 | 0.731** | -0.301 | 1.000 | | | |
| 5. HD (cm) | 0.791** | 0.043 | 0.457* | 0.168 | 1.000 | | |
| 6. HR (%) | 0.102 | -0.306 | 0.472* | -0.398 | 0.019 | 1.000 | |
| 7. OR (%) | -0.024 | -0.063 | -0.278 | 0.144 | -0.046 | -0.079 | 1.000 |

*P<0.05, **P<0.01

Table3. Results of Correlations Analysis in 1997 year

| Characters | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. SeY (kg/da) | 1.000 | | | | | |
| 2. SY (kg/da) | 0.494* | 1.000 | | | | |
| 3. TSW (g) | 0.145 | 0.438* | 1.000 | | | |
| 4. PH (cm) | 0.337 | 0.562** | 0.212 | 1.000 | | |
| 5. HD (cm) | 0.617** | 0.598** | 0.417 | 0.601** | 1.000 | |
| 6. OR (%) | 0.043 | 0.101 | 0.270 | 0.105 | 0.366 | 1.000 |

*P<0.05, **P<0.01

Table4. Results of Correlations Analysis in 1998 year

| Characters | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1. SeY (kg/da) | 1.000 | | | | | | |
| 2. SY (kg/da) | 0.542* | 1.000 | | | | | |
| 3. TSW (g) | 0.662* | 0.163 | 1.000 | | | | |
| 4. PH (cm) | 0.402* | 0.352 | -0.051 | 1.000 | | | |
| 5. HD (cm) | 0.828** | 0.667** | 0.507** | 0.281 | 1.000 | | |
| 6. HR (%) | -0.117 | -0.183 | -0.116 | 0.188 | -0.001 | 1.000 | |
| 7. OR (%) | -0.245 | 0.289 | 0.320 | -0.388* | 0.102 | -0.372 | 1.000 |

*P<0.05, **P<0.01

Marinkoviç and Skoric 1988, Chaudhary and Anond 1993, and Narayana and Patel 1998).

As known, seed yield is a product of seed weight and number of seeds (Benjamin and Geng, 1982), Miralles et al. (1997) explained that there was a significant positive correlation between number of fertile achenes per plant and yield of achenes. Also, that number of achenes/plant was concluded to be the most important yield component was reported by Pasda and Diepenbrock (1990).

It was observed that there was a high and positive correlation between SeY and TSW in 1995 and 1998 (r= 0.588 and r= 0.662 respectively). Also, this correlation found significant (P<0.01) statistically. On the other hand, this correlation was weak (r= 0.145) in 1997. These results were similar to those of Alba and Greco (1979), Alba et al. (1979), Benjamin and Geng (1982), Shrınıvasa (1982), Tyagi (1982), Lakshmanrai et al. (1985) and Vanisree (1988).

Besides, Yalçın (1986) and Ünlü (1994) reported that seed number per plant was positively associated with HD (r= 0.382 and r= 0.863, respectively).

Negative correlations which were recorded in our study were not significant statistically. That there will be negative correlations between yield and yield components in sunflower was explained by Martinez (1987). For example, Kovacık and Skould (1976) obtained there was a negative correlation between HR and kernel ratio. Also, a negative correlation between SeY per plant and HR was recorded by Shrınıvasa (1982).

According to our results, it was observed a low correlation between PH and OR in 1995 and 1997 (r= 0.144 and r= 0.105, respectively). In 1998, this correlation was a negative effect and non-significant statistically. Gencer (1986) stated that OR was correlated with PH at 0.05 level.

Results indicated that weak correlations between OR and the other yield and yield components were found in 1995. However, these correlations were negative effect, except for correlation between OR and PH. In 1997, OR and HD were negatively correlated (r= -0.366). In 1998, OR and TSW were positively correlated (r= 0.320) but, OR and PH, OR and HR were negatively correlated (r= -0.388 and r= -0.372, respectively). These results were in agreement with those of İncekara et al. (1983), Tyagi (1985), Gencer (1986), Martinez (1987) and Dedio (1993).

We obtained that there was a high and positive correlation between HD and TSW in 1995, 1997 and 1998 (r= 0.457, r= 0.417 and r= 0.507, respectively).

The other results which were obtained from our study were below:

**1.** It was observed that HR adversely affected SY in 1995 (r= -0.306) and 1998 (r= -0.183).

**2.** PH and HD had a positive effect on SY. It was found significant (P<0.01) statistically these correlations.

**3.** Correlations between SY, TSW and SeY were positive in 1997 and 1998. But in 1995, these two correlations were low and negative effects.

**4.** In 1997, correlation between PH and HD had high and positive effect (P<0.01). In 1995 and 1998, this correlation was also positive, but a low effect.

**5.** On the contrary correlation in 1998, PH was negatively associated with HR (r= -0.398) in 1995.

**6.** In 1995, there was a significant (P<0.05) and positively effect correlation between TSW and HR.

## Conclusion

The important yield components of sunflower consist of SeY, SY, PH, HD, TSW, HR, OR and oil yield. These characters affect positively or negatively on each other. For example, SeY, PH, HD, OR and TSW had positive effects on oil yield (Vanozzi 1987, Soltani and Archi 1998 and Visic 1998). According to results of correlations analysis in the study; HD, SY, PH and TSW; PH; HD and SY had a positive effect on SeY; HD; TSW respectively. In addition, OR and HD were adversely correlated in 1997. The development of new varieties with high seed yield and oil concentration, and low husk ratio is an important goal among sunflower breeders. To attain this aim, it is required that bilateral relations in between yield and its components are known. For example, Toms and Pooni (1995) used analysis of correlations between the characters to investigate whether there were barriers to obtaining hybrids with a favorable combination of traits for early flowering, short stature and high yield. Therefore, we think that these findings obtained from our study may be useful for researchers who want to study in sunflower breeding.

## References

Alba, E., A. Benvenuti, R. Tuberosa and G. P. Vanozzi, 1979. A path coefficient analysis of some yield components in sunflower. Helia, 2: 25-28.

Alba, E., I. Greco, 1979. An analysis of the association factors influencing seed yield in sunflower (*Helianthus annuus* L.). Sunflower Newsl. 3 (2): 13-15.

Benjamin, H. and S. Geng, 1982. Interrelationships of morphological and economic characters of sunflower. Crop Sci. 22: 817-822.

Chaudhary, S. K. and I. J. Anand, 1993. Relationship of metric traits with seed filling in sunflower (*Helianthus annuus* L.) under open pollination. Int. J. of Tropical Agriculture, 11 (2): 146-148.

Coşge, B. 1999. Ayçiçek yağının tıbbi önemi ve ayçiçek yağı sanayii. Ekin, 3 (9) : 90-95.

Dedio, W. 1993. Heterosis and prediction of achene's oil content in sunflower hybrids from parental lines. Can. J. Plant Sci. 73: 737-742.

Düzgüneş O., T. Kesici, O. Kavuncu ve F. Gürbüz, 1987. Araştırma ve Deneme Metotları (İstatistik Metotları II). Ankara Üniv. Ziraat Fak. Yay. No: 1021, 298 s., Ankara.

Gencer, O. 1986. Ayçiçeğinde verim ve unsurlarının korelasyon ve path katsayısı analizi üzerinde bir araştırma. TÜBİTAK Yayın No: 629, Ankara.

İlisulu, K. 1968. Erkısır, kendilenmiş hat ve normal ayçiçeği çeşitleri ile bunlara ait melezlerde verimle ilgili bazı vasıfların mukayesesi. Ankara Üniv. Ziraat Fak. Yay. No: 309, 55 s., Ankara.

İncekara, F., W. Schuster and M. E. Tugay, 1983. Çeşitli yağ bitkilerinde kimi nicelik özelliklerinin kalıtsal yapıya ve çevreye bağlı değişimi. Ege Üniv. Ziraat Fak. Yay. No: 473, Bornova.

Kovacık, A. and V. Skauld, 1976. Changes in kernel-husk relationship in sunflower inbreeding-heterosis selection. Proc. VII. Int. Sunflower Conf. 1: 327-329.

Lakshmanrai, N. G., Shambulingappa, K. G., P. Kusumakumari, 1985. Studies on path-coefficient analysis on sunflower. Proc. XI .Int. Sunflower Conf., 10-13 March, Argentina.

Marinkovic, R., D. Skoric, 1988. Path-coefficient analysis of Components of sunflower seed yield. Proc. The 12th . Int. Sunflower Conf. 1; 25-29 July, Yugoslavia.

Martinez, J. F. 1987. Efficient strategies and techniques in oilseed. Crop Breeding. Dept. of Breed. and Agron. Center of Agrarian Res. of Cordoba Apatado 240, Spain.

Miralles, O. B., J. A. Juan, and F. M. Santa, 1997. Growth, development and yield of five sunflower hybrids. European J. of Agron. 6 (1-2):47-59.

Narayana, E. and J. C. Patel, 1998. Correlation studies in sunflower. Gujarat Agric. University Res. J. 23 (2): 100-102.

Pasda, G. and W. Diepenbrock, 1990. The physiological yield analysis of sunflower (*Helianthus annuus* L.). Part I: Basic biology and yield formation. Fett Wissenschaft Technologie, 92:8.

Sezer, C. S., 1991. Orobanşa dayanıklı ayçiçeği (*Helianthus annuus* L.) hatları ile dayanıklı genetik erkısır hatlar arası melez ve heterosis. Doktora tezi (basılmamış). Ankara Üniv. Ziraat Fak. Tarla Bitkileri Bölümü, Ankara.

Shrinivasa, K. 1982. Inheritance of fertility restoration and oil content in sunflower (*Helianthus annuus L.*). Thesis Abst. Plant Breed. Abst., 8 (1): 70-71.

Soltani, E. and Y. Archi, 1988. Correlation between oil content and 1000 kernels weight their narrow sense heritability on sunflower variety (Zarja) in dry farming condition. Proc. Int. Sunflower Conf., 23-27 July, Minnesota-USA.

Toms, E. M., H. S. Pooni, 1995. An evaluation of crosses between some French male sterile and UK restorer lines of the sunflower. Helia, 18:22.

Tyagi, A.P., 1985. Association and path analysis of yield components and oil percentage in sunflower (*Helianthus annuus L.*). Proc. XI. Int. Sunflower Conf. Republican Argent, Argentina.

Ünlü, G. 1994. Orobanşa (*Orobanche cumana* Wallrr) dayanıklı genetik erkısır kaynaklı ayçiçeği (*Helianthus annuus* L.) hatlarının melez ve atalarında verim, verim öğeleri, fertil ve erkısır oranları. Yüksek lisans tezi (basılmamış). Ankara Üniv. Ziraat Fak. Tarla Bitkileri Bölümü, Ankara.

Vanisree, V. D. 1988. Correlation and path co-efficient analysis in sunflower. J. of Oilseeds R. 5 (2): 46-51.

Vanozzi, G. P. 1987. Correlations among yield components in sunflower. Field Crop Abst. 40: 80.

Visic, M. 1988. Interdependence of characteristics and their influence on the yield with sunflower hybrids. Proc. 12th . Int. Sunflower Conf., 1: 25-29 July, Yugoslavia.

Zali, A. A. and B. Y. Somadi, 1978. Association of seed yield and seed oil content with other plant and seed characteristics in sunflower (*Helianthus annuus L.*). Proc. 8th. Int. Sunflower Conf., 23-27 July, Minnesota-USA.

**İletişim adresi:**
Belgin COŞGE
25 Mart Mah. SSK Blokları
06200 4/12 Lalegül Ankara
Tel: 0 312 387 06 29