

# Assessment of Different Sunflower Genotypes under Agro-Climatic Conditions of District Malakand Khyber-Pakhtunkhwa



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**Submission:** January 15, 2018 ; **Published:** January 24, 2018

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## Abstract

The present study was conducted with the aim to evaluate sunflower hybrids under agro climatic conditions of district Malakand. A set of 8 sunflower hybrids was evaluated in randomized complete block design having two replications in spring 2014. Each sunflower genotype was sown in five meter long two rows 75cm apart with P-P distance 25cm. Data were recorded on yield and associated traits such as days to flower initiation, days to flower completion, days to maturity, plant height, head diameter, grain yield and 100 grain weight. Significant differences were observed among the genotypes for all the studied traits. The minimum days (80) to flower initiation were observed in Hybrid-14013 while maximum days (85) to flower initiation were observed in Hybrid-14009. Data regarding flower completion showed that Hybrid-14021 took maximum days (95) in flower completion while minimum days (86) was recorded for Hybrid-14013. Data pertaining to plant maturity compiled that Hybrid 14021 took maximum days (120) followed by one day (119) interval rest of all. A maximum plant height (132cm) was observed in Hybrid-14035 while minimum of 109cm in Hybrid-14013. Data related to head diameter showed that a maximum diameter of 17.80cm was recorded for Hybrid-14021 and minimum of 14.20 cm for Hybrid-14048. Maximum 100 seed weight 5g recorded in Hybrid-14041 while maximum (1666kg ha<sup>-1</sup>) grain yield were noticed in Hybrid 14021 and minimum yield of (661 kg ha<sup>-1</sup>) in Hybrid-14048. It is concluded that Hybrid- 14021 performed better in agro-climatic condition of Malakand valley and produced maximum yield.

**Keywords:** Genotypes; Hybrids; Traits

## Introduction

Sunflower (*Helianthus annuus L.*) is an annual plant native to the Americas. Early settlers grew sunflower for food and garden decoration. European brought sunflower along trade routes to Spain, Italy, Egypt, Afghanistan, China, Russia [1]. It possesses a large flowering head, which is inflorescence of sunflower. The sunflower is named for its huge, fiery blooms, whose shape and image are often used to depict the sun. It has a rough, hairy stem, broad, coarsely toothed, rough leaves and circular heads of flowers. The heads consist of many individual flowers which mature into seeds, often in the hundreds, on a receptacle base.

In Pakistan although it was introduced as an oilseed crop 40 years back but its expansion in acreage and production is fluctuating due to various production and socio-economic constraints. Its seed contains 35-55% oil contents. Research work on this crop has shown that there is great potential of growing it under all the soil and climatic conditions in rain-fed

as well as irrigated farming system in different agro-ecological zones (PARC).

The total cultivated area of Pakistan is 20.69 million ha. Out of this cultivated area, 16.48 million ha or 79.65% of the total cultivated area are irrigated. In 1970-71, oilseeds occupied nearly 3% of the total cultivated area, which decreased to 2.5% by 2002-03 [2]. Major share in domestic production of edible oil comes from cottonseed and canola, 67 and 19.6%, respectively. The remaining 13.4% are contributed mainly by sunflower [3]. Edible oil is basic need of every country. In country like Pakistan, About 70% of the total needs are met through imports while only 30% come from local production. Major growing areas of sunflower in Pakistan includes, Multan, Bahawalpur, Sargodha, Faisalabad in Punjab, Peshawar, Malakand in Khyber Pakhtoonkhwa, Khairpur and districts of Hyderabad division in Sindh [4]. During the year 2011-12, the total availability of edible oil was 2.748 million tons. Local production of edible

oil remained 0.636 million tons while imports were 2.148 million tons. The import bill during 2011-12 stood at Rs.216.4 billion (US\$ 2.426 billion). During the year 2012-13 (July-March), 1.738 million tons of edible oil valued at PRs. 153.3 billion (US\$ 1.595 billion) has been imported. The local production during 2012-13 (July-March) was 0.612 million tons. Total availability of edible oil from all sources is provisionally estimated at 2.35 million tons during 2012-13 (July-March). (Economic survey of Pakistan 2012-13)

### Uses of sunflower

- I. Sunflower oil is used as edible oil in many parts of the world.
- II. Sunflower oil could be used as fuel for cars or trucks.
- III. Sunflower oil is an ingredient in salad dressings and cooking.
- IV. Sunflowers are used to prepare some special paints.
- V. Sunflower oil is used to prepare certain kinds of glue.
- VI. Soaps made with sunflower oil.
- VII. It has been used in certain paints, varnishes and plastics because of good semidrying properties without color modification associated with oils high in linoleic acid.
- VIII. The use of sunflower oil (and other vegetable oils) as a pesticide carrier, and in the production of agrichemicals, surfactants, adhesives, plastics, fabric softeners, lubricants and coatings has been explored
- IX. Also use as bird feed.
- X. In human diet it is used as snacks and this trend is increased since 15years.
- XI. It can be used as a double crop after early harvested small grains or vegetables, an emergency crop, or in areas with a season too short to produce mature corn for silage.
- XII. Non-dehulled or partly dehulled sunflower meal has

been substituted successfully for soybean meal in isonitrogenous (equal protein) diets for ruminant animals.

XIII. The growing herb is extremely useful for drying damp soils, because of its remarkable ability to absorb quantities of water.

XIV. The Sunflower is a good bee plant, as it furnishes hive bees with large quantities of wax and nectar.

XV. The unexpanded buds boiled and served like Artichokes form a pleasant dish.

XVI. Sunflowers, when the stalks are dry, are as hard as wood and make an excellent fire.

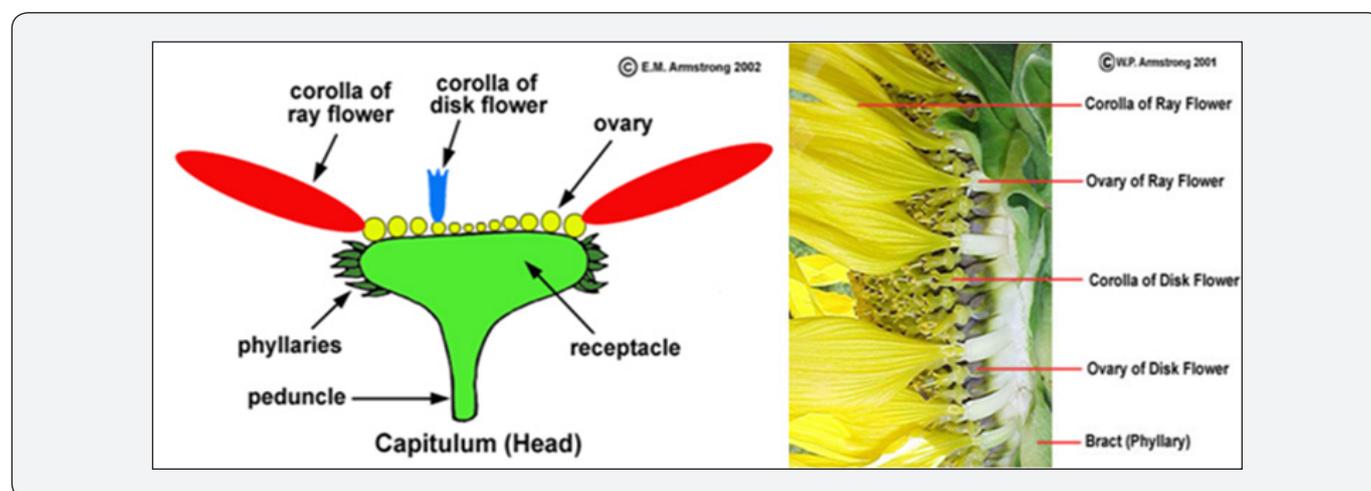
XVII. Of the ash obtained from burning the Sunflower stems and heads (apart from seeds) 62 per cent consists of potash.

XVIII. Being so rich in oil, they are too stimulating to use alone and should only be used in combination with other feeding stuffs.

XIX. The Chinese grow this plant extensively, and it is believed that a large portion of its fiber is mixed with their silks.

### Botany of sunflower

The sunflower is a member of the plant family Asteraceae, or Compositae. Asters are remarkable for their type of inflorescence, which is a head of florets. The head is also called capitulum. The "flower" of the sunflower is actually made up of lots and lots of little flowers, called florets. The center, darker florets are disc florets; while the outer, petal-like ones are ray florets. Sunflower seeds are indehiscent achenes. The genus *Helianthus*, to which the Sunflower belongs, contains about fifty species. It is an annual herb, with a rough, hairy stem, 3 to 12 feet high, broad, coarsely toothed, rough leaves, 3 to 12 inches long and circular heads of flowers, 3 to 6 inches wide in wild specimens and often a foot or more in cultivation. Chromosome number of sunflower is 34. Sunflower is highly cross pollinated crop. For instance, the sunflower genome 3.5 billion bases long [5], slightly longer than the human genome [6].



**Flower**

Sunflower is a member of the aster family. A capitulum or head, the characteristic inflorescence of the sunflower family (Asteraceae). The inflorescence consists of ray flowers, disk flowers, or both ray and disk flowers. The ovary of each flower is situated below the attachment of the corolla and stamens, a condition referred to as epigenous or inferior. The disc florets are located in the centre of the composite flower, and the ray florets bear the outer ring of petal-like structures. Ray florets are sterile, and disc florets have both male and female structures, including a single ovary that develops into a sunflower seed. A single flower head may have up to two thousand disc florets, each with the potential to develop into a seed (Figure 1).

**Roots system**

Sunflowers (*Helianthus spp.*) have a single taproot and smaller, hairy secondary roots. Sunflower roots usually grow 1 to 3 feet deep, and more than 5 feet long roots are also measured (USDA).

**Stem**

A sunflower stem sample has many vascular bundles along the edge of its sample. Unlike other plants, fibers are visible next to the vascular bundles. The center part of the sample is called pith, in which most cells are found. Stem have leaves and a terminal head (Figure 2).

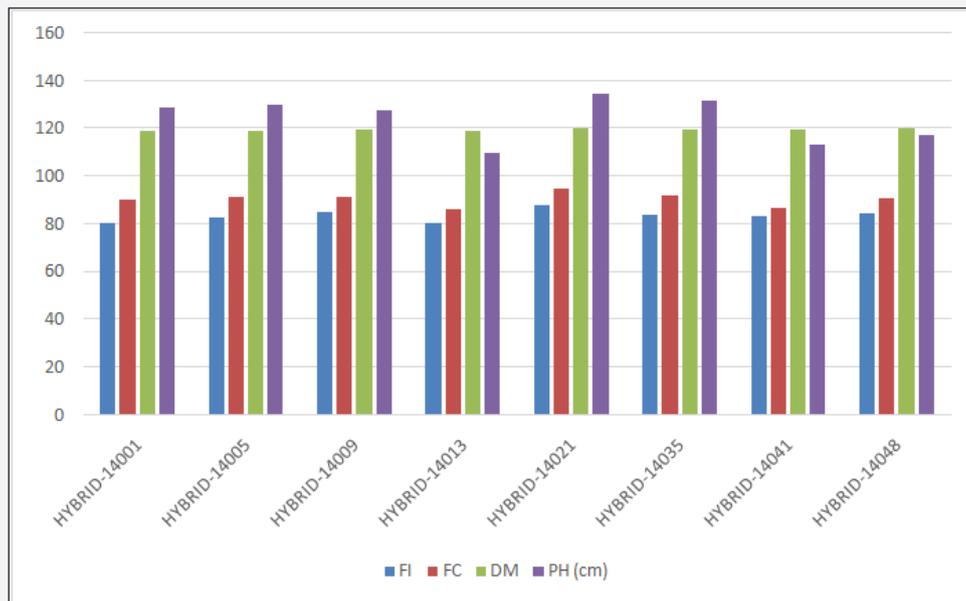


Figure 1

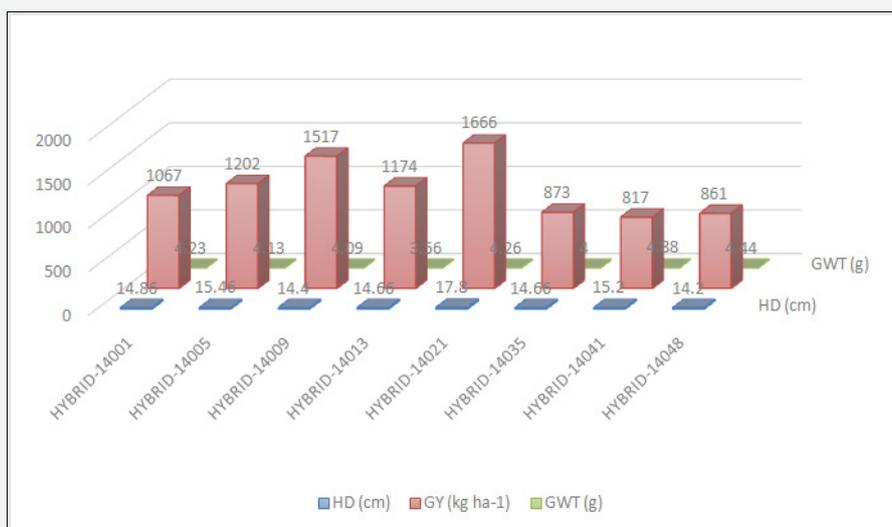


Figure 2: Means in a column following different letters are significantly different at 5% level of probability.

## Leaves

The leaf of a sunflower is considered a simple leaf, which consists of a single blade. The plumule gives rise to the first leaves of the plant that will go on to grow into organs for transpiration, with the opening and closing of the stomata found within the cell structure of leaves; for photosynthesis, and for other metabolic activities.

## Yield contributing traits in sunflower

Seed yield is a quantitative character, which is influenced more from climate and environmental factors in sunflower because of being controlled by large number of genes. To increase seed yield, the study of direct and indirect effects of yield components provides the basis for successful breeding program [7]. Head diameter, 1000 seed weight, plant height are other valuable yield parameters that determine yield improvement in the sunflower [8].

## Objective of the study

Present study was carried out to;

- I. Check performance of eight sunflower hybrids, obtained from National Agricultural Research Centre Islamabad (NARC) under field conditions of district Malakand.
- II. Record data on various quantitative traits.
- III. Find out the best sunflower hybrid for the area.

## Materials and Methods

A total of 8 sunflower hybrids obtained from NARC oilseed section were sown in the field of district Malakand during February 2014 for yield and associated traits. Plant material was sown in randomized complete block (RCB) design having three replications. Each entry was assigned a two row plot having row to row and plant to plant distance of 75 and 25cm, respectively.

## Location

**Table 1:** List of hybrids evaluated at Malakand during spring, 2014.

S.NO	Hybrids	S.NO	Hybrids
1	HYBRID-14001	5	HYBRID-14021
2	HYBRID-14005	6	HYBRID-14035
3	HYBRID-14009	7	HYBRID-14041
4	HYBRID-14013	8	HYBRID-14048

The Research field is located at 34.56 °N, 71.96 °E, at an altitude of 454m above sea level in the Malakand valley. Malakand is located about 1437 km north of the Indian Ocean, 156km from river Kabul, 96km from river Swat and has semiarid climate. The research farm is irrigated by the Dargai canal from the river Swat. Soil texture is clay loam, low in organic matter (0.87%), extractable phosphorus (6.57mg kg<sup>-1</sup>), exchangeable potassium (121 mg kg<sup>-1</sup>), and alkaline (pH 7-8.5) and is calcareous in nature. The climate of the area is semiarid where the mean annual rainfall ranges (400 to 500mm), 60-70% rainfall occurs

in summer, while the remaining 30-40% rainfall occurs in winter (Table 1).

A. Parameters studied: Data were recorded on the following parameters.

B. Days to flowering initiation (DFI): Days to flowering initiation was recorded from date of sowing till about five percent of the buds opened flowers in each plot.

C. Days to flower completion (DFC): Flower completion data was recorded when about 90% of the buds opened flower in each plot. This was also calculated from date of planting.

D. Days to Maturity: Data for days to maturity was recorded when back of the heads turned yellow and bracts started turning brownish in color.

E. Plant height (cm): A total of five plants randomly selected in each plot were measured from ground level to attachment of head with stem to record data on plant height. Plant height was recorded at the time of maturity.

F. Head diameter (cm): Head diameter was calculated as it is yield contributing trait in sunflower. Five plants from each line were selected at random and data for head diameter was recorded. Head diameter was measured from one edge of the disk to other.

G. 100-seed weight (g): 100 seed weight was also calculated for each hybrid. An average of three samples of 100-seeds for each hybrid, were taken to record data on 100-seed weight. Seed was weighed in grams with the help of an electronic balance up to two decimal points.

H. Grain Yield (kg ha<sup>-1</sup>): Total produce after threshing was sun dried for 2-3 days and then seed was weighed with the help of an electronic balance for each hybrid.

I. Statistical analysis: Data after compilation was statistically analysed using STATISTICA 8.1 software and means were separated by LSD test.

## Results and Discussion

### Days to flower initiation

Analysis of variance revealed highly significant (P=0.01) differences among all the Genotypes (Table 2). Days to flower initiation ranged from 80-85 days. Hybrid-14001 took minimum days (80) to flower initiation whereas Hybrid-14009 took maximum days (85) for flower initiation (Table 3). These results are partially in line with those of Shah [9]. The differences in results may be due to differences in Genotypes or due to environmental effects.

### Days to flower completion

Analysis of variance revealed that days to flower completion showed significant (P<0.05) differences among all the Genotypes (Table 2). Days to flower completion ranged from

80-92 days. Hybrid-14023 took minimum days (86) for their flower completion while Hybrid-14035 took maximum days (92) to complete their flowers (Table 3). Furrkh [4] also found significant variation for days to flower completion.

**Table 2:** Mean squares for various traits of sunflower evaluated at district Malakand during spring 2014.

TRAITS	Mean Squares			CV
	Replication	Genotype	Error	
Days to flower initiation	4.6250	24.285*	5.9107	2.69
Days to flower completion	3.3750	19.470*	5.8988	2.90
Days to maturity	12.8750	0.9940 <sub>NS</sub>	0.4940	0.59
Plant height	1260.56	266.18 <sub>NS</sub>	169.29	10.47
Head diameter	63.7117	3.9160*	1.3802	7.75
Seed yield	914015	2924 <sub>NS</sub>	122988	30.56
Hundred seed weight	1.43465	0.421 <sub>NS</sub>	0.46899	16.30

\*\*\*Significant at 5 and 1% level of probability respectively, whereas NS= Non-significant.

### Days to maturity

### Grain yield (kg ha<sup>-1</sup>)

**Table 3:** Mean values for days to flower initiation(FI), flower completion (FC) maturity (DM), plant height (PH), head diameter (HD), grain yield (GY) and 100 grain-weight (GWT) of eight sunflower hybrids evaluated at University of Malakand during 2014.

Hybrids	FI	FC	DM	PH (cm)	HD (cm)	GY (kg ha <sup>-1</sup> )	GWT (g)
HYBRID-14001	80.33c	90.33bcd	119b	129.07ab	14.86b	1067ab	4.23ab
HYBRID-14005	83bc	91.66ab	119b	129.87ab	15.46b	1202ab	4.13ab
HYBRID-14009	85.33ab	91.33ab	119.67ab	127.53 ab	14.40b	1517a	4.09ab
HYBRID-14013	80.33c	86.33d	119 b	109.67b	14.66b	1174ab	3.56b
HYBRID-14021	88a	95a	120.33a	134.93a	17.80a	1666a	4.26ab
HYBRID-14035	84 abc	92 ab	119.67ab	132ab	14.66b	873b	4.00ab
HYBRID-14041	83.33bc	86.66cd	120ab	113.13ab	15.20b	817b	4.88a
HYBRID-14048	84.66ab	90.66bc	120.33a	117.53ab	14.20b	861b	4.44ab
LSD	4.25	4.25	1.2309	22.785	2.05	614	1.19

Analysis of variance showed non-significant (P>0.05) differences for grain yield among all the genotypes (Table 2). Grain yield ranged from 817-1666kg ha<sup>-1</sup>. Hybrid-14041 had minimum grain yield (817 kg ha<sup>-1</sup>) whereas Hybrid-14021 had maximum grain yield (1666 kg ha<sup>-1</sup>) (Table 3) Khalid [8] also found Non-significant relation for Grain Yield kg ha<sup>-1</sup>.

### 100-grain weight (g)

Analysis of variance revealed that 100-grain weight showed non-significant (P>0.05) differences among all the genotypes (Table 2). 100-grain weight ranged from 04-05g. Hybrid-14013 had minimum 100-grain weight (04g) whereas Hybrid-14041 had maximum 100-grain weight (05g) (Table 2). Anjum [1] also got non-significant difference for 100 grain weight.

Analysis of variance revealed that days to maturity showed non-significant (P>0.05) differences among all the Genotypes (Table 2). Days to maturity ranged from 119-120. Hybrid-14005 took minimum days (119) to be matured whereas Hybrid-14021 took maximum days (120) to be matured (Table 3). Khalid [8] also found non-significant differences for days to maturity.

### Plant height (cm)

Analysis of variance revealed that plant height showed non-significant (P>0.05) differences among all the genotypes (Table 2). Plant height ranged from 110-135cm. Hybrid-14013 had minimum (110cm) plant height whereas Hybrid-14021 had maximum (135cm) plant height (Table 3). Khalid [8] found the plant height to be non-significant.

### Head diameter (cm)

Analysis of variance revealed that head diameter showed significant (P<0.05) differences among all the Genotypes. Head diameter ranged from 14-18cm. Hybrid-14048 had minimum (14cm) head diameter while Hybrid-14021 had maximum (18cm) head diameter. These results confirmed the earlier findings of Arshad [1] also found significant variation for head diameter.

## Conclusion and Recommendations

There is sufficient genetic variability in the tested sunflower hybrids which is useful tool for grouping of different hybrids according to their adaptation through the environmental condition, Hybrid 14021 produced highest grain yield (1666kg ha<sup>-1</sup>) followed by hybrid 14009 (1517kg ha<sup>-1</sup>) and thus are considered best among all hybrids evaluated during this study. From the above study and data obtained from results it is recommended that Hybrid 14021 and 14009 fits well in the agro-climatic conditions of Malakand valley and produce maximum yield [10-12].

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DOI: [10.19080/CTBEB.2018.11.555810](https://doi.org/10.19080/CTBEB.2018.11.555810)

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