

EVALUATION OF AUTUMN PLANTED SUNFLOWER (*HELIANTHUS ANNUUS* L.) HYBRIDS UNDER FAISALABAD AGRO-ECOLOGICAL ZONE

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ABSTRACT

Present study was conducted during autumn seasons, 2010 and 2011 to evaluate the performance of autumn planted sunflower. During 2010, out of 16 sunflower hybrids, the highest plant population (54444 plants/ha) was recorded from the plots of SMH-0907 while SMH-491 produced the lowest plant population (26667 plants/ha). FH-415 and SMH-1001 produced highest seed yield 2691 and 2624 kg/ha, respectively; SMH-491 produced minimum seed yield (1053 kg/ha) possibly because of poor crop stand (26667 plants/ha) but however, this hybrid produced maximum achene test weight (7.22 g/100 achenes). NK-S-278 indicated highest oil contents 38.8 percent as against the lowest 31 percent produced by KSF-7777. In 2011, overall performance of all the 14 hybrids was not encouraging. But however, SMH-0927 and T-40318 was higher achene yielder (1107 and 1091 kg/ha), respectively. Significantly, the more test achene weight (4.03g 100⁻¹ achenes) was produced by the sunflower hybrid Sunstar-333 and it was minimum in case of SH-K-6 (2.68g) for 100 achenes. Maximum oil content 32.8 percent was found in the achenes of SMH-0821 while SMH-0907 produced the least (26.4%) oil contents. It is concluded that an achene yield of more than 2600 kg per hectare during autumn season may help improve economic conditions of farming communities under Faisalabad conditions. This in turn may help reduce import of edible oil. However, the investigations are required to find out reasons as to why a hybrid like NKS-278 performs well in one year and could not germinate in the next year.

KEYWORDS: Sunflower; *Helianthus annuus*; autumn; oil contents; achene weight; hybrid; germination

INTRODUCTION

Pakistan spends annually around Rs. 216.4 billions to import about 2.148 million tonnes of edible oil as its total requirements are 2.748 million tonnes and local production is only 0.636 million tonnes from all domestic resources

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including cottonseed, sunflower, canola and rapeseed & mustard. Sunflower is an important oil seed crop. It is grown on 877 thousand acres, which produces 473 thousand tonnes of its seed (average seed yield 1854 kg per acre) and oil yield of 179 thousand tonnes annually (5). Khan *et al.* (18) concluded that sunflower could play the role in bridging the gap between production of edible oil and its import as its seed may yield up to 50% good quality oil with higher linolenic acid and low linoleic acid and can be successfully grown as autumn and spring crop (13, 17). Sunflower sowing remained restricted in Pakistan due to non availability of locally developed hybrid seed, absence of a systematic marketing mechanism and sale of seed directly to the farmers without their due evaluation under field conditions. Presently, almost whole of the sunflower seed is imported. As these hybrids are developed and evaluated in a different agro-ecological environment than that of us, it is not feasible to get their full yield potential under our conditions. These sunflower hybrids can be attacked rigorously by local insect pests on one hand and they may be helpful in introduction of new insect pests and diseases on the other hand (30). Some researchers (15) have concluded that variations in agro-climatic conditions significantly influence sunflower crop phenology, physiology and thus economic yield, oil contents and fatty acid accumulation. It has been concluded that environmental factors especially temperature plays vital role in affecting duration of crop growth and thus net assimilation rate which ultimately influences yield contributing attributes like achenes per head, 1000-achene weight in sunflower (12, 20, 25, 15) in addition to influencing plant height (1, 35). It is therefore imperative to develop better local sunflower hybrids and study thoroughly the performance of exotic hybrids of sunflower under our local agro-climatic conditions prior to the delivery of their seed to the farmers. The present investigations were therefore initiated to find out the performance of local as well as exotic sunflower hybrids for the economic uplift of the farmers.

MATERIALS AND METHODS

The experimental area lies between 30.35-31.470 N latitude and 72.08-730 E longitude, at an elevation of 150 m from the sea level. In order to find out the best sunflower hybrid suitable for general cultivation the performance of 16 hybrids were evaluated in autumn 2010 and 15 during autumn 2011 on the sandy clay loam soils. Chemical analysis of the soils depicted pH 8.11, ECe 1.50dSm^{-1} , organic matter 0.75 %, available phosphorus 8.81 ppm and available potash 138ppm in 2010 while these values were 8.13 (pH), 1.51dSm^{-1} (ECe), 0.76 % (organic matter), 8.83 ppm (available phosphorus) and 140 ppm (available potash) during 2011.

During first year, crop was planted on 22.8.2010 and harvested on 7.12.2010 and in 2nd year, crop was planted on 29.8.2011 and harvested on 1.12.2011. During both the years, experiments were laid out in randomized complete block design and repeated thrice. The crop was sown with the help of dibbler using seed @ 6.00 kg ha⁻¹ on 75 cm apart ridges maintaining plant-plant distance of 23 cm in plots measuring 4.83 m X 3.00m. The crop was supplied with nitrogen (N), phosphorus (P₂O₅) and potassium (K₂O) @ 140, 57 and 62 kg ha⁻¹, respectively. Whole of the P₂O₅ and K₂O was applied at sowing while N was applied in three equal splits viz. 1/3rd at sowing, 1/3rd with 1st irrigation and 1/3rd at the flowering stage. The crop was thinned out at 4-5 leaf stage in all the trials. The crop received 2 irrigations during 2010 and four during 2011. Plant protection measures were provided as and when required.

Plant height (cm): Ten plants / plot were selected randomly from the central two rows to record plant height (at maturity) from base to top with the help of a measuring tape and averaged.

Head diameter (cm): Head diameter of the randomly selected 10 plants was measured with the help of the measuring tape from one edge of the disc to the other and averaged.

Days to flower initiation: Days of flower initiation were recorded when about 5% of the buds/plot opened to flower and days to flower completion were recorded when 90% of the buds/plot opened to flower.

Physiological maturity: Physiological maturity was recorded when more than 85% of the heads turn yellow and their bracts started turning brownish in colour.

After physiological maturity, the crop (whole plot leaving half meter from both sides) was harvested, kept for 10 days under the shade in the field for sun drying and threshed manually.

Fresh seed yield: Fresh seed yield was recorded on plot basis at the prevailing moisture level.

Three, handful of fresh seeds from the achene heap of each plot were taken and weighed immediately with the electronic balance. Thereafter, these seed samples were oven dried to calculate achene yield at 8% moisture level per unit area.

$$\text{Seed yield} = \text{Moisture factor} \times \text{Fresh seed yield}$$

Where,

Moisture factor = (Dried weight of seed sample/Fresh weight of the seed sample) x100

100 achenes per dried sample were counted and weighed to record achene test weight.

Oil contents: Oil contents were determined by low resolution pulsed wave Nuclear Magnetic Resonance [NMR MQA 7500 (4.5 mhz) Oxford Instruments, England] with sample size 50 mL in 40-mm diameter tubes in the oil technology laboratory of the Institute following AOCS (1999).

The data were analyzed by Fisher's analysis of variance techniques and least significant difference test at 5% level of probability was used to compare the differences among treatment means (32).

RESULTS AND DISCUSSION

Plant population per unit area

It is evident from Table-1 and 2 that number of plants per hectare was significantly different for different hybrids during both the years. During 2010 maximum plant population was observed in plots of SMH-0907 (54444 ha⁻¹) SMH-416 and KSF-7777 (54000 ha⁻¹), which were statistically similar with each other. The sunflower hybrids FH-415 and FH-419 followed them very closely with a plant population of 53778 and 52889 per hectare, respectively. The lowest plant population 26667ha⁻¹ was recorded in plots of the sunflower hybrid SMH-491. During 2011, the sunflower hybrid NK-S-278 did not germinate. Maximum plant population during 2011 was observed in plots of SMH-0821 (54000/ha) which was followed by plant population of 53333 ha⁻¹ recorded for hybrids SH-K-4 and SMH-0945, which were statistically similar with one and other. The lowest plant population 26000 ha⁻¹ was recorded in plots of the sunflower hybrid SMH-0934.

Plant height at maturity

Plant height an important plant growth indicator (35) was significantly variable for different hybrids during both years (Table-1 and 2). During 2010 the range of plant height remained 110-159cm. significantly the maximum plant height (159 cm) was recorded for the sunflower hybrids KSF-7777, SMH-416 and

Hysun-33 and was followed by plant height 151 cm and 148 cm acquired by SMH-1001 and SMH-0907, respectively. However, the differences for plant height among these hybrids were non-significant. During 2011, plants of the sunflower hybrid T-40318 were significantly taller (183 cm) compared to all others. Plants of the sunflower hybrids SMH-1023, SH-K-6, SMH-0927 followed T-40318 with their height 151, 154, 157 cm; but however, they were non-significant with each other as well as T-40318 and Hysun-33 for this character. The sunflower hybrid Sun star-333 and SMH-0945 produced the plants with shortest stature viz., 90 and 96 cm, respectively.

Duration from flower Initiation to completion:

The data presented in Table-1 and 2 indicated that flowering phase of different sunflower hybrids included in the studies was significantly affected by various hybrids during both the years.

During 2010, significantly the maximum number of days was availed by the sunflower hybrid Hysun-33 (59 days) and NK-S-278 (58 days) to complete flowering phase. They were followed closely by the sunflower hybrids SH-3915 and Ausigold-7 which took 57 days to complete this reproductive phase. FH-415 availed the least number 46, of days for this phase (Table-1). During 2011, the sunflower hybrid T-40318 took 63 days to complete flowering and was followed very closely by the sunflower hybrid Hysun-33 and SMH-0927 which completed flowering in 62 and 60 days, respectively; the differences for flower completion between these two hybrids were however, non-significant (Table-2). The sunflower hybrids SMH-0821 and SMH-0945 took significantly the minimum number 48 of days for flower completion during 2011.

Days taken to maturity

The data (Table 1 and 2) indicated that there were significant differences among various hybrids as regard to number of days taken by them to maturity. During 2010, significantly the highest number of days for physiological maturity was recorded for sunflower hybrids Hysun-33 (87 days) and NK-S-278 (86 days). The sunflower hybrids SH-3915 and SMH-1001 recorded 85 days for their maturity. Minimum number of days 79 for maturity was noted for sunflower FH-415 (Table-1). During 2011, most of the sunflower hybrids (SH-K-6, SH-K-4, SMH-0916, SMH-1028, SMH-1023,

Table 1. Performance of various sunflower hybrids during Autumn-2010

| Hybrid | Plants/ha | Days to flower | | | Plant height (cm) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/ha) | Oil contents (%) |
|------------|----------------|----------------|------------|----------|-------------------|--------------------|---------------------|--------------------|------------------|
| | | Initiation | Completion | Maturity | | | | | |
| DK- 3849 | 27556 f | 49 d | 52 d | 83 e | 110d | 17.70 a | 6.34 b | 1578 c | 34.70 b |
| FH-415 | 53778 ab | 43 l | 46 g | 79 h | 121cd | 13.89 c | 5.87 bc | 2691 a | 31.60 c |
| FH-417 | 48444 c | 47 f | 50 e | 82 f | 129c | 14.00 c | 4.25 d | 2052 b | 34.60 b |
| FH-419 | 52444 ab | 44 h | 48 f | 80 g | 131c | 12.10 cd | 4.06 d | 2081 b | 36.00 ab |
| KSF-7777 | 54000 a | 48 e | 51 de | 84 d | 159a | 12.50 d | 5.48 c | 2029 bc | 31.00 c |
| SH-3915 | 43778 e | 53 b | 57 b | 85 c | 131c | 12.50 d | 5.42 c | 1532 c | 37.10 ab |
| Ausigold-7 | 43778 e | 53 b | 57 b | 84 d | 134bc | 12.50 d | 5.67 bc | 1445 c | 34.20 bc |
| SMH-1002 | 52667 ab | 46 g | 49 ef | 83 e | 144b | 11.80 d | 5.33 c | 1961 bc | 34.60 b |
| Pan-8-101 | 52889 ab | 46 g | 49 ef | 82 f | 121cd | 12.50 d | 5.36 c | 1696 c | 35.90 ab |
| SMH-0907 | 54444 a | 36 j | 47 fg | 80 g | 148ab | 11.90 d | 4.90 cd | 2055 b | 34.10 bc |
| SMH-1001 | 51111 b | 48 e | 53 cd | 85 c | 151ab | 12.00 d | 5.15 c | 2624 a | 36.20 ab |
| SMH-416 | 54000 a | 50 c | 54 c | 83 e | 159a | 13.40 cd | 4.69 cd | 1929 bc | 34.00 bc |
| SMH-491 | 26667 f | 50 c | 54 c | 80 g | 130c | 12.10 d | 7.22 a | 1053 d | 33.40 bc |
| Hysun-33 | 46000 d | 54 a | 59 a | 87 a | 159a | 13.10 cd | 4.87 cd | 2014 bc | 35.50 b |
| NK-S-278 | 41778 e | 53 b | 58 ab | 86 b | 149ab | 15.30 b | 5.59 bc | 1971 bc | 38.80 a |
| Ausigold-4 | 51778 b | 47 f | 53 cd | 84 d | 133bc | 11.70 d | 4.96 cd | 1706 c | 34.70 b |
| Range | 26667 to 54444 | 36-54 | 46-59 | 79-87 | 110-159 | 11.7-17.7 | 4.06-7.22 | 1053-2691 | 31-38.8 |
| C.V. (%) | 13.89 | 1.18 | 13.2 | 0.66 | 5.18 | 5.55 | 9.30 | 10.35 | 5.13 |
| LSD (0.05) | 2014 | 0.96 | 1.13 | 0.91 | 11.92 | 1.19 | 0.82 | 328 | 2.97 |

Note: Any two means not sharing a letter in common differ significantly from each other at level of 0.05 probability.

Table 2. Performance of various sunflower hybrids during Autumn-2011.

| Hybrids | Plants/plant | Days to flower | | | Maturity | Plant height (cm0) | Head diameter (cm) | 100-seed weight (g) | Seed yield (kg/ha) | Oil contents (%) |
|-------------|--------------|----------------|------------|--------|----------|--------------------|--------------------|---------------------|--------------------|------------------|
| | | Initiation | Completion | | | | | | | |
| SH-K-6 | 47333 ef | 48 d | 54 d | 75 abc | 154 b | 7.14 c | 2.68 c | 485 c | 28.2 b | |
| SH-K-4 | 53333 b | 51 c | 54 d | 75 abc | 122 e | 10.52 ab | 3.31 bc | 737 b | 28.7 b | |
| SMH-0916 | 44667 g | 48 d | 55 cd | 75 abc | 124 de | 7.50 c | 3.07 bc | 503 c | 32.00 ab | |
| SMH-1028 | 45333 g | 46 f | 52 e | 75 abc | 117 e | 8.80 bc | 3.72 ab | 588 bc | 27.6b | |
| SMH-1023 | 38667 i | 47 e | 51 ef | 75 abc | 151 bc | 6.29 c | 3.86 ab | 479 c | 29.6 ab | |
| SMH-0917 | 42000 f | 47 e | 51 ef | 75 abc | 130 d | 9.00 bc | 3.7 ab | 604 bc | 28.3 b | |
| SMH-0907 | 26667 j | 51 c | 56 c | 88 a | 144 c | 9.00 bc | 3.55 ab | 607 bc | 26.4 b | |
| SMH-0927 | 52667 bc | 53 b | 60 b | 75 abc | 157 b | 12.11 a | 3.32 b | 1107 a | 28.1 b | |
| Hysun-33 | 50000 cd | 57 a | 62 a | 81 ab | 152 b | 10.10 b | 3.53 ab | 707 b | 29.4 ab | |
| SMH-0934 | 26000 j | 48 d | 54 d | 75 abc | 125 de | 6.29 c | 3.63 ab | 429 c | 27 b | |
| T-40318 | 48667 e | 57 a | 63 a | 94a | 183 a | 12.14 a | 3.63 ab | 1091 a | 30.9 ab | |
| Sunstar-333 | 48000 e | 47 e | 53 de | 75 abc | 90 g | 7.50 c | 4.03 a | 508 c | 29.4 ab | |
| SMH-0821 | 54000 b | 43 h | 48 f | 75 abc | 105 f | 6.18 c | 3.88 ab | 415 c | 32.8 a | |
| SMH-0945 | 55333 a | 44 g | 48 f | 75 abc | 96 g | 6.59c | 3.32 b | 482 c | 30.3 ab | |
| Range | 26000-55333 | 43-57 | 48-63 | 75-94 | 90-183 | 6.18-12.14 | 2.68- 4.03 | 415-1107 | 26.4- 32.8 | |
| CV% | 15.24 | 0.98 | 1.76 | 5.54 | 3.23 | 11.24 | 10.71 | 17.56 | 7.49 | |
| LSD(0.05) | 1129 | 0.81 | 1.61 | 7.22 | 7.17 | 1.89 | 0.63 | 184 | 3.67 | |

Note: Any two means not sharing a letter in common differ significantly from each other at level of 0.05 probabilities.

SMH-0917, SMH-0927, SMH-0934, SMH-0821, SMH-0945 and Sun star-333) attain their maturity in significantly least duration 75 days while the sunflower hybrid T-40318 matured in maximum number of days (94) and was followed by SMH-0907 the maturity by which was attained in 84 days

Head diameter

Sunflower head size, an important yield contributing factor (34) was significantly influenced by different sunflower hybrids during both the years (Table-1 and 2). The sunflower hybrid DK- 3849 produced significantly the largest heads of 17.7 cm and was followed by head size of 15.3 cm resulted from the sunflower hybrid NK-S-278 in 2010 (Table 1). The heads of smallest size 11.7 cm were produced by Ausigold-4. Overall the smaller heads were produced by the hybrids Ausigold-4, SMH-1002, SMH-0907, SMH-1001 and SMH-491 in 2010 (Table-1). During 2011, sunflower hybrids T-40318 and SMH-0927 produced significantly the largest heads of 12.14 and 12.11 cm, respectively; however, the differences between these hybrids were non-significant (Table 2). Heads of minimum size with non-significant differences were obtained from the hybrids SMH-0821 (6.18 cm), SMH-1023, SMH-0934 (6.29cm) and SMH-0945 (6.59 cm), respectively (Table 2).

100-achene weight:

100 achene weights have direct bearing on final achene yield. Analysis of the data presented in Table 1 and 2 revealed highly significant differences among various hybrids for 100-achene weight. It became evident from the data (Table-1) that significantly the achenes obtained from the sunflower hybrids SMH-491 (7.22 g/100 achenes) and DK- 3849 (6.34 g/100 achenes) were the heaviest i.e. 7.22 g /100 achenes and (6.34 g/100 achenes), respectively, compared to achenes of all the rest of the hybrids during 2010. However, the achene weight resulted from these two hybrids was non-significant. The sunflower hybrids FH-415, Ausigold-7, NK-S-278, KSF-7777, SH-3915, Pan-8-101, SMH-1002 and SMH-1001 followed these hybrids viz., SMH-491 and DK-3849 by producing 100 achenes weight of 100 achenes 5.87, 5.67, 5.59, 5.48, 5.42, 5.36, 5.33 and 5.15g, respectively. The differences for 100 achene weight among these hybrids as well as with that of DK- 3849 were however, non-significant. The sunflower hybrid FH-419 produced the minimum achene weight 4.06 g/100 achenes (Table-1). During 2011, the sunflower hybrids Sun star-333, SMH-0821, SMH-1023, SMH-1028, SMH-0917, SMH-0934, T-40318, SMH-0907 and Hysun-33 remained at the top by producing 100 achene weight of 4.03, 3.88, 3.86, 3.72, 3.70, 3.63, 3.55,

3.53g, respectively, but however, the differences among these hybrids for this trait were non-significant. The lowest 100 achene weight 2.68g was received from the sunflower hybrid SH-K-6 (Table 2) in 2011.

Achene yield

Achene yield, a function of cumulative behavior of all the yield components (30) was influenced significantly by various sunflower hybrids during both the years (Table 1 and 2). Data presented in the Table 1 revealed that during 2010 significantly the highest achene yield was produced by SMH-1001 (2624 kg/ha) and FH-415 (2691 kg/ha). The differences for achene yield between them were non-significant. Although non-significant among themselves, but the sunflower hybrids FH-419(2081 kg/ha), SMH-0907 (2055 kg/ha) FH-417 (2052 kg/ha⁻¹), KSF-7777 (2029 kg/ha) and Hysun-33 (2014 kg/ha⁻¹) followed the aforementioned hybrids closely. The lowest achene yield 1053 kg/ha⁻¹ was obtained from the sunflower hybrid SMH-491 in 2010 (Table 1). During 2011 significantly the maximum achene yield 1107 kg/ha and 1091 kg/ha⁻¹ was produced by the sunflower hybrids SMH-0927 and T-40318. The differences between these two hybrids for achene yield were non-significant; but however, they were significantly higher yielder than rest of all the hybrids studied during 2011 (Table 2). The minimum achene yield 415 kg/ha was recorded for the sunflower hybrid SMH-0821 and remained at par to those of SH-K-6, SMH-0945, SMH-1023, SMH-0934, SMH-0916 and Sun star-333 (Table 2).

Achene oil contents (%)

Achene oil contents the ultimate goal of breeding and management practices is to increase oil contents. Oil contents of sunflower achenes were significantly influenced by different sunflower hybrids during both the years (Table-1 and 2). The data presented in table-1 indicated that achene oil contents of sunflower hybrid NK-S-278 were significantly the maximum (38.8%), however, its oil contents were at par to those detected for the seeds of sunflower hybrids SH-3915 (37.1%), SMH-1001 (36.2%), FH-419 (36%) and Pan-8-101 (35.9%). The achene oil contents of sunflower hybrids FH-415 (31.6%) and KSF-7777 (31%) were the minimum (Table 1). During 2011, significantly maximum achene oil contents was recorded for sunflower hybrid SMH-0821 (32.8 %); it however remained statistically at par to that recorded for the sunflower hybrid SMH-0916 (32%), T-40318 (30.9%), SMH-0945(30.3%), Hysun-33 and Sun star-333 (29.4 %). The lowest achene oil

contents (Table-2) were obtained from the sunflower hybrid SMH-0907 (26.4%).

Variation in plant population at harvest in contrary reported by Rafiq *et al.* (27) and Shahid *et al.* (31) could be due to diversity of genetic material included in the present studies as there was least genetic diversity in their studies. The existing studies included 16 hybrids during 2010 and 14 during 2011. However, Bakht *et al.* (8) have reported variable plant population for different sunflower hybrids under similar set of environmental conditions. Auto oxidation of lipid results in increased free fatty acid contents during storage which accelerate damage to seed of oily plants (11) like sunflower. This may result in to weak seedlings which seldom survive giving ultimately poor crop stand. Under present situation, though the production practices were uniform, yet amongst the different seed sources, there might be some loop hole in handling in addition to the genetic one which resulted in variable crop stand. Plant height, an important crop plant growth indicator (35) and a function of genetic constitution coupled with the environmental conditions (14) was influenced significantly by various sunflower hybrids during both the years of studies. The diversification in plant height at maturity, was according to the results narrated earlier (36, 22 and 34). The significant differences for flowering period (Table 1 and 2), one of the key factors in determining the seed yield of sunflower (16), might be due to genetic variability amongst them. Arshad *et al.* (7) have supported the results of present studies suggesting that early flowering in sunflower may support for higher achene yields. The difference in the number of days availed for physiological maturity by various sunflower hybrids grown under similar environmental conditions could basically be due to genetic variations (8, 3) which allows plants to continue for some longer time to synthesize photosynthates or stop this earlier and enter the phase- physiological maturity evident from Table 1 and 2. The sunflower hybrids which mature earlier prove better yielder under normal conditions (2, 8). Head diameter, important determinant for production potential of sunflower achene yield, a factor linked with plant genetics (3) and expressed copiously under favourable environmental conditions (34) was significantly influenced (Table 1 and 2) by different sunflower hybrids due inherent superiority of some of the hybrids over others. Variations in the head size of different sunflower hybrids were also reported by (33, 23). Development of lighter achenes may be due to inadequate provision of assimilates (4) and vice versa. 100-achene weight was affected significantly during both the years (Table 1 and 2) because of differential genetic makeup of different hybrids of sunflower (17) and thus their variable capability to

benefit from prevailing environment including soil fertility. Findings of Sarwar *et al.* (30) are in support of the present studies.

Availability of photosynthates in appropriate quantities to crop plants is of utmost importance for higher economic yields (28). Roots of Sunflower hybrids vary in their capability of penetration in to soil, absorption of nutrients and thus indicate variable response for achene yield and in turn yield contributing factors (35). The outcome of collective interplay of yield contributing parameters in collaboration with crop ecology-achene yield (14) was significantly influenced by various sunflower hybrids during both the years (Table 1 and 2). In 2010 higher achene yield ($> 2600 \text{ kg ha}^{-1}$) was recorded in FH-415 (2691 kg ha^{-1}) and SMH-1001 (2624 kg ha^{-1}) due to reasonable crop stand ($53778/\text{ha}$ for FH-415 and $51111/\text{ha}$ for SMH-1001), head diameter (13.89 cm for FH-415 and 13.4cm for SMH-1001), ability of the plants for photosynthates assimilation which resulted in bold achenes for these hybrids ($5.87\text{g}/100$ seeds for FH-415 and $5.15\text{g}/100$ seeds for SMH-100). Maximum achene test weight (7.22 g) for 100 achenes due to sparse crop stand (half of the FH-415 and SMH-1001) alone was unable to equalize achene yield of SMH-491 with the higher yielders i.e. FH-415 and SMH-1001 during 2010 (2, 8). Similarly, during 2011, the year in which there was poor achene yield, the sunflower hybrids SMH-0927 and T-40318 recorded higher achene yields. Although, test achene weight for these hybrids was not so high ($3.32 \text{ g}/100$ seeds for SMH-0927 and $3.63\text{g}/100$ seeds for T-40318), they bore larger head size which certainly accommodated more number of achenes and thus greater yield (28) compared to other hybrids. Novak and Marias (24) reported strong impact of hybrids on oil contents. Balalic *et al.* (9) concluded 69.6% dependence of oil contents on hybrids; but however, the role of weather conditions on oil contents have also been recognized by Bedo (10) and Leon *et al.* (21). During 2010, significantly the higher oil percentage (38.8%) possessed by NK-S-278 and SMH-3915 (37.1%) while during 2011, by SMH-0821 (32.8%) is sufficient testament to the findings of some researchers (10, 21, 9, 24). Least oil contents (31.0%) indicated by sunflower hybrids KSF-7777 (Table 1) and SMH-0907 (26.4%, Table 2) could be due to impaired achene filling and immature seeds at the time of harvest (26).

CONCLUSION

1. Under the agro-climatic conditions of Faisalabad, Pakistan, the hybrids FH-415 and SMH-1001 proved the best by producing achene yields over 2600kg ha^{-1} which is especially encouraging during autumn season.

2. As seeds of the sunflower hybrids NK-S-278 contain higher oil contents efforts must be carried out to incorporate their genes in to these hybrids to get higher achene and oil yields per unit area to help reduce import bill incurred on edible oil import.

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| Fida Hussain | : | Helped in data recording |
| Qamar Ansar Tufail Khan | : | Pathological treatment to seed sown |
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