

Breeding for Identification of Superior High Yielding Sunflower (*Helianthus annuus* L.) Hybrids for *rabi* Season in Tolerance to Sunflower Wilt for West Bengal

S. S. Lakshman¹, D. K. Roy², Y.G. Sadkshari³

¹Junior Breeder, AICRP-Sunflower, RAKVK, NIMPITH, 24 PGS (S), West Bengal PIN: 743338

²Agronomist, RAKVK, Nimpith, 24 PGS(S), PIN-743338, West Bengal, India

³Professor and Head, Dept. of Genetics and Plant Breeding, UAS, GKVK, Bangalore

Abstract: An experiment was carried out during December 2012-13 to 2014-15 under AICRP Sunflower, Nimpith Centre of Ramkrishna Ashram Krishi Vigyan Kendra Research Farm, South 24 Parganas, West Bengal, to identify the suitable sunflower hybrids for *rabi*-summer season in West Bengal. The field screening also carried out for sunflower wilt disease resistance in Sunflower in natural field condition. A total of 150 sunflower hybrids developed in AICRP-Sunflower, Nimpith and AICRP-Sunflower, UAS, GKVK, Bangalore were tested including the two National check hybrids namely, KBSH-44 and DRSH-1. Highly significant genetic differences were observed among the hybrids in plant height at harvest, head diameter per plant, seed weight per head, 1000-seed weight, and days to 50% flowering, days to maturity, husk content (%), volume weight (g/cc) and oil percentage and resistance/ tolerance to sunflower wilt. In the 1st year (2012-13), out of 150 sunflower hybrids, 13 nos. were superior hybrids were identified. The field observation reveals that the hybrid PSCHT-12-38(2260 kg/ha, 36.0% oil), PSCHT-12-42 (2250kg/ha, 37.5% oil), PSCHT-12-26(2217kg/ha, 37.7%) and PSCHT-12-36 (2151 kg/ha, 37.9% oil) were recorded higher seed yield as well as high oil content in comparison to the national check hybrids, KBSH-44 and DRSH-1. The field observation also reveals that the new experimental sunflower hybrids like PSCHT-12-42, SAHT-12-09, PSCHT-12-26, PSCHT-12-36, PSCHT-12-38, PSCHT-12-66, PSCHT-12-76 and PSCHT-12-29 were the superior sunflower hybrids for considerable high degree of tolerance to sunflower wilt(PDI score 10-12.5%) in comparison to the national check hybrids, KBSH-44 and DRSH-1(PDI score 20-25%). Considering the other yield attributing parameters like plant height, days to 50% flowering or days to maturity, hull content and volume weight; the sunflower hybrids like PSCHT-12-38, PSCHT-12-42, PSCHT-12-26 and PSCHT-12-36 were observed the best performing sunflower hybrids due to their 7-10 days earliness and 30-50 cm shorter plant height at harvest coupled with good seed yield and oil yield as well as high degree of tolerance to sunflower wilt compare to other sunflower hybrids.

Keyword: Sunflower, Seed Yield, Oil Content, Wilt, West Bengal

1. Introduction

Sunflower is the fourth most important oilseed crop cultivated in India after Groundnut, mustard and Soyabean. Sunflower can play a major role in meeting the shortage of edible oils in the country. Among the oilseed crops, sunflower gain much popularity because of its Photo insensitivity and wider adoptability to different agro-climatic regions and soil types. It was introduced in India for the first time during 1969 and the commercial cultivation of sunflower has become popular in many states like since 1980's. Its adoptability to a wide ranges of soil and climatic conditions which make its cultivation possible during any part of the year in the tropical and subtropical reigns of the country with high yield potential. The crop now widely grown in Karnataka, Maharastra, Andhra Pradesh and Gujrat as monsoon, late monsoon and *rabi* season and recently in northern states like Punjab and Hariayana as Spring crop. Sunflower is an important nontraditional oilseed crop. The present acreage under sunflower cultivation in India is about 6.91lakh ha area with production and productivity of 5.47lakht and 791 kg/ha respectively during 2013-14(Padmaia *et. al.*, 2015).

After soyabean, Sunflower (*Helianthus annuus* L.; $2n=2x=34$) is the second important source of vegetable oil in the world due to its low to moderate production requirements, high oil quality, protein content, and utilization of all plant parts. Sunflower became an oilseed crop around the world during the end of the 19th century, when 'popular selection' was practiced in several parts of Russia to improve sunflower populations grown at that time.

Development of hybrids is the primary objective of most sunflower breeding programs in the world. Sunflower hybrid breeding was started economically in discovering CMS by Leclercq in 1960 and restorer genes by Kinman in 1970 (Miller and Fick, 1997). First sunflower hybrids were produced in US in 1972 and reached 80% of production in five years (Fick and Miller, 1997). Single-cross hybrids quickly became dominantly in sunflower cultivars in the world. Hybrids were preferred by farmers due to its high yield and quality potential, homogeneity, same time maturing and easy possibility of cultural applications both in India and the world. Use of hybrids was reached over 95% in India sunflower production in last 10 years. In India, the sunflower is mostly grown in the states of Karnataka, Maharastra, AP and Tamil Nadu with potential scope of

growing in the non-traditional areas like West Bengal (Dutta, 2011). In West Bengal, Sunflower is second important oilseed crop after rapeseed-mustard during *rabi*-summer season and it was grown on about 21,000 ha in last *rabi* season (2014-15). Sunflower being a photoperiod natural crop has wide scope to replace the rapeseed-mustard cultivation with high yield potentiality.

Sunflower wilt (caused by *S. scleroceorum* (*S. rolsii*) pv. *helienthii*) one of the most important disease of sunflower and in West Bengal it is the most important disease next to NSD. Sclerotinia commonly called 'white mold' affects most broad leaf crops and weeds. It can be a devastating disease and in sunflower it is highly dependent on weather conditions. Sunflower can be affected in three ways: 1. Root infection which results in wilt or stalk rot; 2. Midstalk infection; and 3. Head infection or head rot. The latter two infections are dependent on ascospore infection.

Disease Cycle: Sclerotia are hard small black bodies produced by the disease in a host of broad leaf crops. Sclerotia over winter in the soil and exist in the soil for many years. Wet soil conditions over a period of 10 to 14 days can stimulate the sclerotia to germinate creating tiny mushrooms. These mushrooms produce apothecia or tiny spores which can be wind-blown to nearby fields. The spores need dew or rain and dead or senescing plant tissue such as dead florets to germinate and infect. The infection occurs via the sunflower roots which stimulate the nearby sclerotia to germinate. The infection moves into the plant via the roots and the plant dies suddenly or literally wilts. Sclerotia develop at the base of the diseased plant and return to the soil.

The present study was aimed to (i) Evaluate the performance of the sunflower hybrids in respect to yield and yield component and (ii) To identify the superior sunflower hybrids suitable for *rabi*-summer season in West Bengal agro-climatic condition which have a considerable degree of **genetic background in tolerance to sunflower Wilt**.

2. Materials and Methods

The experiment was carried out during December 2012-13 to 2014-15 under AICRP Sunflower, Nimpith Centre of

RAKVK Research Farm, South 24 Parganas, West Bengal to identify the suitable sunflower hybrids for cultivation in *rabi*-summer season in West Bengal. A total of 150 sunflower hybrids developed at AICRP-Sunflower, Nimpith centre and collected from AICRP-Sunflower, UAS, GKVK, Bangalore, AICRP-Sunflower, UAS Raichur and AICRP-Sunflower, Latore, Maharashtra were tested including the two National check hybrids, KBSH-44 and DRSH-1 in Randomized complete block design with three replications. The plot size was 4.5m x 3.0 m. In the 1st year (2012-13), a total of 150 sunflower hybrids were tested in RAKVK-AICRP (Sunflower) research farm, Nimpith Centre, South 24 Parganas, West Bengal. Out of the 150 sunflower hybrids, thirteen (13) numbers of superior hybrids were selected as per their better yield and yield attributing components. In the next two years, 2013-14 and 2014-15 the same hybrids were tested including two national check, i.e. KBSH-44 and DRSH-1 in **"On station"** trial at Nimpith centre and another three locations viz.. at Research Farm, Institute of Agriculture Sciences, Calcutta University, Baruipur ; Radhakantapur (KVK-adopted Village of Mathurapur –II block of South 24 Parganas district) and **Kultali** as Multilocation trial. The soil texture was **clay loam** in **"On station"** and **"MLT"** plots. Three irrigations were provided during the cropping period. One foliar spray was given with **Boron** (@ 2g/lit. of water in **ray floret stage**. The row per plot were five in number with a row spacing of 60 cm and plant to plant spacing was 30 cm. Uniform dose of fertilizer @80 kg N,40 Kg P₂O₅ and 40 kg K₂O per ha was applied. The **germinated seed** of sunflower used as the planting materials and one per hill were maintained throughout the cropping period. The data was recorded in ten randomly selected plants from each plot of all replications on the following characters viz., days to 50% flowering, days to maturity, plant height at harvest (cm), head diameter per plant (cm), seed weight per head (g), 100-seed weight (g), husk content (%), volume weight (g/cc) and percentage of infected plants by sunflower wilt (on plot basis). The seed yield (kg/ha), oil percentage and oil yield (kg/ha) were estimated on plot basis. The mean values were subjected to statistical analysis.

3. Result and Discussion

Table 1: Evaluation of Superior Sunflower hybrids (Out of 150 Hybrids) in "On Station Trial" at Nimpith, over the 3 years (2012-2015)

Sl. No.	Name of the Hybrid	Seed yield (kg/ha)			Avg. Seed yield (kg/ha)	PDI of <i>S. rolsii</i> (%)	PDI of <i>S. rolsii</i> (%)	PDI of <i>S. rolsii</i> (%)	Avg. PDI of <i>S. rolsii</i> (%)
		2014-15	2013-14	2012-13					
1	PSCHT- KH-12-38	2480	2256	2044	2260.0	11.5	12.0	11.0	11.5
2	PSCHT-KH-12-42	2130	2233	2389	2250.7	9.0	11.0	10.0	10.0
3	PSCHT-12-26	2153	2156	2330	2216.7	9.5	11.0	9.5	9.5
4	PSCHT-12-29	1740	2111	2044	1964.0	9.0	11.0	10.0	10.0
5	SAHT-12-21	2222	2028	2333	2194.3	12.0	13.0	12.5	12.5
6	PSCHT-12-76	1898	1967	1911	1925.3	12.0	13.5	12.0	12.5
7	PSCHT-12-36	2222	1900	2333	2151.7	9.0	10.0	11.0	10.0
8	SAHT-12-18	2025	1889	2367	2093.7	12.0	13.5	12.5	12.5
9	PSCHT-12-35	1820	1760	2200	1926.7	12.5	14.0	13.0	12.5
10	SAHT-KH-12-09	1866	1975	1940	1927.0	9.0	11.0	10.0	10.0
11	PSCHT-KH-12-66	2016	1740	1890	1898.7	8.0	12.0	10.0	10.0

12	PSCHT-KH-12-68	2373	2040	2300	2237.7	10.0	14.5	13.0	12.5
13	SAHT-12-15	1898	1980	2044	1974.0	14.0	17.0	14.0	15.0
14	KBSH-44	2407	2190	2070	2222.3	22.0	25.0	21.0	22.5
15	DRSH-1	2030	1856	1860	1915.3	19.0	21.5	18.5	20.0
	Mean	2096.1	2002.9	2150.5	2083.2	11.9	14.0	12.5	12.7
	S. Em(±)	41.5	32.5	37.8	37.6	0.68	0.82	0.73	0.74
	C.D (5%)	129.2	87.5	114.7	-	2.12	2.55	2.36	2.5
	C V (%)	9.7	9.3	9.8	-	7.4	8.6	8.1	7.7

Evaluation of resistant sunflower hybrids is considered to be the that among the 150 sunflower hybrids, the new experimental most feasible and durable solution of controlling the wilt sunflower hybrids like PSCHT-12-42, SAHT-12-09, PSCHT-disease. Percent disease incidence was worked out and it varied 12-26, PSCHT-12-36, PSCHT-12-38, PSCHT-12-66, PSCHT- from 5.0-35.0 in sunflower in last three years in natural field 12-76 and PSCHT-12-29 were the superior sunflower hybrids condition when sunflower seed was treated with *T. viride* and *P.* for considerable high degree of tolerance to sunflower wilt (*PDI fluresens*). The study reveals that the maximum number of score (10-12.5%) in comparison to the national check hybrids, entries was grouped under moderately resistant categories in KBSH-44 and DRSH-1 which PDI score was recorded 20-25% resistant to sunflower wilt. The field observation also reveals (Table-1 & 2).

Table 2: Evaluation of Superior Sunflower hybrids (Out of 150 Hybrids) in “On Station Trial” at Nimpith, in respect to Yield and yield component

Sl. No	Name of the Hybrid	Avg. Seed Yield (kg/ha) over the MLT and SHT over the Years	Avg. Oil Yield (kg/ha)	Oil%	Days to 50% Flowering	Days to Maturity	Pl. Ht. (cm)	Hd. Dia. (cm)	100 Seed Wt. (g)	Vol. Wt.(g/cc)	Hull cont. (%)	PDI of <i>S. rolfii</i>
1.	P-KH-12-38	2296.5	815.0(4 th)	36.0	74.5	104.5	166.2	14.3	5.4	40.1	34.5	11.5%
2.	P-KH-12-42	2167.5	839.8 (1 st)	37.3	71.0	101.0	149.3	14.4	6.0	43.5	30.5	10%
3.	P-KH-12-26	2129.5	834.1(2 nd)	37.7	70.5	100.5	156.8	14.3	6.1	42.3	34.4	9.5%
4.	P-KH-12-29	1872.0	749.1	38.1*	65.0	95.0	148.3	14.4	5.3	42.6	32.5	10.0%
5.	SAHT-12-21	2029.5	754.0	35.7	65.0	95.0	147.7	14.2	5.1	41.2	29.5	12.5%
6.	P-KH-12-76	1908.5	695.7	37.9	67.0	97.0	150.3	14.6	5.1	39.4	32.8	12.5%
7.	P-KH-12-36	2041.5	796.5(5 th)	37.8	68.0	98.0	159.3	14.7	5.6	42.5	29.0	10.0%
8.	SAHT-KH-12-18	1955.0	805.0(4 th)	38.4	69.5	99.5	152.7	14.8	5.5	39.5	32.5	12.5%
9.	P-KH-12-35	1727.5	670.7	38.2	64.0	94.0	154.8	14.4	5.9	39.1	37.1	12.5%
10.	SAHT-K-12-09	1838.5	708.0	38.1*	66.8	96.8	144.3	14.6	4.7	41.6	34.0	10.0%
11.	P-KH-12-66	1888.0	764.2	38.5*	70.0	100.0	142.3	14.1	5.4	41.9	32.7	10.0%
12.	P-KH-12-68	2146.5	828.6 (3 rd)	37.0	74.0	104.0	154.3	14.5	5.5	40.3	34.4	12.5%
13.	SAHT-KH-12-15	1901.5	696.6	37.7	63.7	93.7	148.4	14.7	5.3	38.7	35.5	15.0%
14.	KBSH-44	2167.0	628.9	28.3	79.0	109.0	181.7	15.3	5.7	42.5	37.2	22.5%
15.	DRSH-1	1872.5	748.0	39.1	74.0	104.0	166.3	14.5	5.7	41.3	33.0	20.0%
	G. Mean	1996.1	769.4	37.0	69.5	99.5	154.9	14.5	5.5	40.6	33.3	12.7%
	S. Em(±)	41.5	14.6	0.14	0.9	0.8	2.3	0.38	0.17	0.26	0.81	0.74
	CD (at 5%)	130.6	41.2	0.4	2.7	2.3	6.8	1.2	0.5	0.8	2.6	2.5
	CV%	9.5	9.4	9.1	8.9	8.1	9.2	8.6	7.8	7.2	8.8	7.7

Table 3: Performance of Sunflower Hybrid Entries in Multilocation Trial and Station Hybrid Trial over the 3 years in West Bengal (2013-14 to 2014-15)

Sl. No	2014-15				2013-14			Avg. Seed Yield (kg/ha) over the MLT and SHT over the Years (2014-15 and 2013-14)
	Name of the Hybrid	Avg. Seed Yield (kg/ha) over the MLT (3 Location)	Avg. Seed Yield (kg/ha) in SHT, Nimpith	Avg. Seed Yield (kg/ha) over the MLT and SHT	Avg. Seed Yield (Kg/ha) in MLT(3 location)	Seed Yield(kg/ha) in SHT, Nimpith	Avg. Seed Yield (kg/ha) over the MLT and SHT	
1.	PSCHT -KH-12-38	2387	2480	2433	2065	2256	2160	2296.5
2.	PSCHT -KH-12-42	2348	2130	2239	1960	2233	2096	2167.5
3.	PSCHT -KH-12-26	2242	2153	2198	1967	2156	2061	2129.5
4.	PSCHT -KH-12-29	1853	1740	1797	1783	2111	1947	1872.0
5.	SAHT-12-21	2165	2222	2194	1703	2028	1865	2029.5
6.	PSCHT -KH-12-76	1841	1898	1870	1927	1967	1947	1908.5
7.	PSCHT -KH-12-36	2138	2222	2180	1907	1900	1903	2041.5
8.	SAHT-K-12-18	1938	2025	1982	1967	1889	1928	1955.0
9.	PSCHT -KH-12-35	1667	1820	1744	1663	1760	1711	1727.5
10.	SAHT-K-12-09*	1906	1866	1886	1607	1975	1791	1838.5
11.	PSCHT -KH-12-66	1894	2016	1955	1903	1740	1821	1888.0

12.	PSCHT -KH-12-68	2223	2373	2298	1950	2040	1995	2146.5
13.	SAHT-KH-12-15	1967	1898	1933	1760	1980	1870	1901.5
14	KBSH-44	2230	2407	2319	1840	2190	2015	2167.0
15	DRSH-1	1912	2030	1971	1693	1856	1774	1872.5
	S Em(±)	49.5	41.5	45.4	32.5	41.5	38.1	41.5
	G. Mean	2047.5	2085.3	2066.4	1846.3	2005.4	1925.9	1996.1
	C.D.(P=0.05)	151.8	129.2	139.5	87.5	116.4	122.8	130.6
	C.V%	9.6	9.2	9.4	9.1	9.6	9.5	9.5

For Yield and yield component:

Data reported in the table-2 as demonstrated the comparative effect of different sunflower hybrids on 100 seed weight (g) which differed significantly among the hybrids. The Maximum 100 seed weight of 6.1 g was observed in hybrid P-KH-12-26 and P-KH-12-42 which was closely followed by P-KH-12-35 (5.9g). Dutta (2015) reported significant variation for 100 seed weight and other agronomic variation among the sunflower hybrids. From the study it was reveals that the volume weight (g/100cc), hull content (%) and oil content (%) were significantly varied significantly among the Sunflower hybrids. The highest value for the volume weight (g/100cc) was noticed in P-KH-12-42(43.5g) and P-KH-12-29(42.6g). The lowest hull content (%) was recorded in P-KH-12-36(29%) followed by SAHT-KH-12-21 (HC: 29.5%) and P-KH-12-42(HC: 30.5%) respectively. The similar type of findings was reported by Chandra *et.al.*, 2013.

Statistical analysis of the data on seed yield in multilocation trial over the years (table 3) reveals that highest seed yield of 2226 Kg/ha was recorded in the sunflower hybrid P-KH-12-38 which was closely followed by hybrid P-KH-12-42 and hybrid P-KH-12-26 with 2154 Kg/ha and 2105 Kg/ha respectively. The best national check hybrid, i.e. KBSH-44 was recorded at par yield (2035 kg/ha) and less yield was 1805 kg/ha in DRSH-1. Statistical analysis of the data on seed yield in MLT and in "On Station" hybrid trial (average data from MLT & SHT over three years in Table-2) reveals that highest seed yield of 2296 Kg/ha was recorded in the sunflower hybrid P-KH-12-38 which was closely followed by hybrid P-KH-12-42 and hybrid P-KH-12-68 with 2167Kg/ha and 2146 Kg/ha, respectively. The seed yield of the best national check hybrid, i.e. KBSH-44 and DRSH-1 were recorded 2167 Kg/ha and 1872 Kg/ha respectively.

From the experiment and statistical analysis (over the three years in Table-5) reveals that in response to oil yield (kg/ha), the hybrids were significantly high oil yielder over the national check hybrids, i.e. KBSH-44 and DRSH-1. From the study it was observed that the P-KH-12-42 was the highest oil yielding sunflower hybrid which was 839 Kg/ha (37.3% oil) which was closely followed by hybrid P-KH-12-26, P-KH-12-68, P-KH-12-38 and SAHT-KH-12-18 with oil yield 834 Kg/ha (37.7% oil), 828 kg/ha(37.6%), 815 Kg/ha (36 % oil) and 805 Kg/ha (38.4 % oil) respectively. The oil yield of the best national check hybrid, i.e. KBSH-44 and DRSH-1 were recorded 629 Kg/ha (28.3 % oil) and 748 Kg/ha (39.1% oil) respectively. The oil yield (kg/ha) of the sunflower hybrid P-KH-12-42 was 12.3% higher over the DRSH-1 followed by P-KKH-12-26, P-KH-12-68, P-KH-12-38 and SAHT-KH-12-18 with 11.5%, 9.0%, 10.1% and 7.6 % respectively. Evaluation for sunflower hybrids resistant to sunflower wilt is considered to be the most feasible and durable solution of controlling the wilt disease. Percent disease incidence (PDI) was worked out and it varied from 5.0-35.0 in sunflower in last three years in natural field condition when sunflower seed was treated with *T. viride* and *P. fluresens*. The study reveals that the maximum number of entries was grouped under moderately resistant categories in resistant to sunflower wilt. The field observation also reveals that among the 150 sunflower hybrids, the new experimental sunflower hybrids like **PSCHT-12-42, PSCHT-12-26, PSCHT-12-38 and SAHT-KH-12-18** were the superior sunflower hybrids for considerable high degree of tolerance to sunflower wilt(PDI score 10-12.5%) in comparison to the national check hybrids, KBSH-44 and DRSH-1 which PDI score was recorded 20-25% (Table-5 & 6).

Table 4: Evaluation of Superior Sunflower hybrids (Out of 150 Hybrids) in "On Station Trial" at Nimpith over the 3 years (2012-13 to 2014-2015) in respect to Seed yield (kg/ha) and Oil yield (kg/ha)

Sl. No	Name of the Hybrid	Oil %			Avg. Oil %	Oil yield(Kg/ha)			Avg. Seed yield (kg/ha)	Avg. Oil yield (Kg/ha)	Oil Yield Improvement over the DRSH-1	PDI of <i>S. rolfsii</i>
		2014-15	2013-14	2012-13		2014-15	2013-14	2012-13				
1	PSCHT-KH- 12-38	35.6	36.4	36.2	36.0	852.9	812.5	776.4	2260.0	815.0(3 rd)	9.0	11.5%
2	PSCHT-KH-12-42	36.3	36.8	38.7	37.3	773.2	821.7	924.5	2250.7	839.8 (1 st)	12.3	10%
3	PSCHT-KH-12-26	36.5	37.9	38.6	37.7	785.8	817.1	899.4	2216.7	834.1(2 nd)	11.5	9.5%
4	PSCHT-KH-12-29	38.4	38.2	37.8	38.1*	708.2	760.4	772.6	1964.0	749.1	0.1	10.0%
5	SAHT-KH-12-21	35.4	35.2	36.5	35.7	786.6	713.9	751.5	2194.3	754.0	0.8	12.5%
6	PSCHT-KH-12-76	37.3	37.8	38.6	37.9	708.0	693.5	680.6	1925.3	695.7	-7.0	12.5%
7	PSCHT-KH-12-36	37.7	36.8	37.6	37.8	825.5	725.9	837.2	2151.7	796.5(5 th)	6.5	10.0%
8	SAHT-KH 12-18	38.4	37.6	39.2	38.4	832.9	812.5	776.4	2093.7	805.0(4 th)	7.6	12.5%
9	PSCHT-KH 12-35	37.6	38.2	38.8	38.2	684.3	672.3	653.6	1926.7	670.7	-10.3	12.5%
10	SAHT-KH-12-09	37.5	38.2	38.5	38.1	732.9	712.5	676.4	1927.0	708.0	-5.3	10.0%
11	PSCHT-KH-12-66	38.9	38.1	38.6	38.5	812.0	752.9	729.5	1898.7	764.2	2.2	10.0%

12	PSCHT-KH-12-68	36.6	37.0	37.5	37.0	858.5	804.8	832.5	2237.7	828.6 (3 rd)	10.5	12.5%
13	SAHT-KH-12-15	37.6	37.4	38.0	37.7	723.6	690.5	676.7	1974.0	696.6	-6.9	15.0%
14	KBSH-44	27.9	27.5	29.6	28.3	671.6	602.3	612.7	2222.3	628.9	-	22.5%
15	DRSH-1	38.5	39.2	39.5	39.1	781.6	727.6	734.7	1915.3	748.0	-	20.0%
	S Em(±)	0.09	0.12	0.13	0.12	13.7	11.6	18.1	41.5	14.6	-	12.7%
	Mean	36.6	36.8	37.6	37.0	767.2	736.4	804.5	2083.2	769.4	-	0.74
	C.D	0.28	0.36	0.41	0.35	41.6	34.7	54.2	130.6	44.2	-	2.5
	C.V%	8.9	9.4	9.1	9.2	9.3	9.1	9.7	9.5	9.4	-	7.7

Table 5: Ranking of Sunflower hybrids as per their preference in On station and Multilocation trial

Sl No.	Name of the Hybrid	Oil %			Avg. Oil %	Oil yield(Kg/ha)			Avg. Seed yield (kg/ha)	Avg. Oil yield(Kg/ha)	PDI of <i>S. rolfisii</i>
		2014-15	2013-14	2012-13		2014-15	2013-14	2012-13			
1	PSCHT-KH- 12-42	36.3	36.8	38.7	37.3	773.2	821.7	924.5	2250.7	839.8 (1 st)	10.0%
2	PSCHT-KH-12-26	36.5	37.9	38.6	37.7	785.8	817.1	899.4	2216.7	834.1(2 nd)	9.5%
3	PSCHT-KH-12-68	36.6	37.0	37.5	37.0	858.5	804.8	832.5	2237.7	828.6 (3 rd)	12.5%
4	PSCHT-KH-12-38	35.6	36.4	36.2	36.0	852.9	812.5	776.4	2260.0	815.0(4 th)	11.5%
5	SAHT-KH-12-18	38.4	37.6	39.2	38.4	832.9	812.5	776.4	2093.7	805.0(5 th)	12.5%
	DRSH-1 (Ch-1)	38.5	39.2	39.5	39.1	781.6	727.6	734.7	1915.3	-	20.0%
	KBSH-44(Ch-2)	27.9	27.5	29.6	28.3	671.6	602.3	612.7	2222.3	-	22.5%

4. Conclusion

Based on the overall performance in various locations and various year, PSCHT- KH-12-26, PSCHT-KH-12-42 and PSCHT-KH-12-38 is required to be promoted for the new Sunflower hybrids, through All India Coordinated trial (IHT) under AICRP (Sunflower) programme for cultivation in *rabi*-*summer* season in West Bengal Agro-climatic condition.

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