Identification of Superior Sunflower (*Helianthus annuus* L.) Hybrids for *rabi-summer* Season for West Bengal

S.S. Lakshman¹, D.K. Roy² and N.R. Chakraborty³

¹AICRP-Saunflower, RAKVK, NIMPITH, 24 PGS (S), West Bengal ²Division of Agronomy, RAKVK, Nimpith, 24 PGS(S), West Bengal

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 rabisummer season in west Bengal. 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. In the 1^{st} year (2012-13), out of 150 sunflower hybrids, 13 nos. were superior hybrids. In the next two years, (2013-14 & 2014-15) the same hybrids were tested in another two locations i.e. at Research Farm, Institute of Agriculture Sciences, Calcutta University, Baruipur and Radhakantapur (KVK-adopted Village of Mathurapur-II block of south 24 Parganas district) in Multilocation trial. 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. Considering the other yield attributing parameters like plant height, days to 50% flowering or days to maturity, 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 observed the best performing sunflower hybrids due to their 7-10 days earliness and 30-50 cm shorter plant height at harvest as well as good seed yield and oil yield as compare to other hybrids.

Keyword: Sunflower Hybrid, Seed Yield, Oil Content, West Bengal.

1. INTRODUCTION:

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. National sunflower hybrid (development) breeding programme is continuous programme which started in our country in early 1980s. 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 grown on about 8.0 million ha (Anonymous, 2016) and 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 rabisummer season and it was grown on about 21,000 ha in last rabi season (2014-15). Due to short winter spell and delayed and heavy rainfall during rainy seson, the sowing of mustard was delayed which ultimate reduced the production of rapeseed-mustard. The delayed sowing also invites the insect pests in most of the years. Sunflower being a photoperiod natural crop has wide scope to replace the rapeseed-mustard cultivation with high yield potentiality. Keeping in this mind the AICRP on Sunflower, Nimpith centre under the Indian Institute of Oilseed Research (ICAR- IIOR) at Ramkrishna Ashram Krishi Vigyan Kendra Research, Nimpith, South 24 Parganas district has started hybrid sunflower development programme since 2009. Present research programme was carried out during December 2012-13 to 2014-15 with a total of 150 sunflower hybrids which were tested including the two

National check hybrids, KBSH-44 and DRSH-1. 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.

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 folier 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). 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:

The final plant height of sunflower hybrids were varied significantly.P-KH-12-38,P-KH-12-36, P-KH-12-68,SAHT-12-18,P-KH 12-42, P-KH 12-66 and SAHT-K-12-09 were recorded higher plant height (Table 1). The statistical significant variation was also noticed among the sunflower hybrids in terms of days to 50% flowering and maturity, head diameter (cm), 100 seed weight (g), volume wt(g/100cc) and hull content(%).

However, the maximum days to 50% flowering (74 days) and days to maturity (104 days) was recorded in hybrid P-KH-12-38 and P-KH-12-68 whereas the minimum days to 50% flowering (64days) and days to maturity (94 days)were recorded in hybrid SAHT-KH-12-15 and P-KH-12-35 which was closely followed by P-KH-12-29;SAHT-KH-12-21 and SAHt-KH-12-09. The higher plant height was observed in the sunflower hybrids which took more days to flower. Over the three years study in " On station" hybrid trial and multilocation trial (Table 1) the maximum oil content (%) was recorded in DRSH-1 (39.1%) which was closely followed by SAHT-KH-12-18(38.4%) and SAHT-KH-12-29(38.1%) & SAHT-KH-12-18(38.1%) respectively. The significant variation in seed yield of different hybrids was recorded in On Station Trial (table 2). The Higher seed yield was 2260 kg/ha in PSCHT-12-38 followed by P-KH-12-42.

The comparative performance of various yield attributes of the 15 sunflower hybrids were presented in Table-1. The significant variation in Head diameter was observed among the hybrids of sunflower. However, maximum head diameter was recorded in hybrid KBSH-44 and P-KH-12-38(15.3cm and 14.9 cm respectively) which was closely followed by SAHT-KH-12-18(14.8 cm), P-KH-12-36(14.7 cm) and P-KH-12-68 (14.6 cm).

Sl.No.	Name of the	Avg. Seed	Avg. Oil	Oil%	Days to	Days to	Pl. Ht.	Hd. Dia	100 Seed	Vol.	Hull
	Hybrid	Yield (kg/ha)	Yield (kg/ha)		50% Florencia a	Maturity	(cm)	(cm)	Wt. (g)	Wt.(g/cc)	cont.
		over the ML1 and SHT over			Flowering						(%)
		the Years									
1.	PSCHT -KH-12-38	2296.5	815.0(4 th)	36.0	74.5	104.5	166.2	14.9	5.4	40.1	34.5
2.	PSCHT-KH-12-42	2167.5	839.8 (1st)	37.3	71.0	101.0	149.3	14.6	6.0	43.5	30.5
3.	PSCHT -KH-12-26	2129.5	834.1(2)	37.7	70.5	100.5	156.8	14.3	6.1	42.3	34.4
4.	PSCHT -KH-12-29	1872.0	749.1	38.1*	65.0	95.0	148.3	13.5	5.3	42.6	32.5
5.	SAHT-12-21	2029.5	754.0	35.7	65.0	95.0	147.7	13.0	5.1	41.2	29.5

 Table 1: Evaluation of Superior Sunflower hybrids (Out of 150 Hybrids) in "On Station Trial" at Nimpith, in respect to Yield and yield component

			1			1		1	1		
6.	PSCHT - KH-12-										
	76	1908.5	695.7	37.9	67.0	97.0	150.3	14.0	5.1	39.4	32.8
7	PSCHT -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
8	SAHT-K-12-18	1955.0	805.0(4 th)	38.4	69.5	99.5	152.7	14.8	5.5	39.5	32.5
9	PSCHT -KH-12-35	1727.5	670.7	38.2	64.0	94.0	154.8	14.0	5.9	39.1	37.1
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
11.	PSCHT -KH-12-66	1888.0	764.2	38.5	70.0	100.0	142.3	14.2	5.4	41.9	32.7
12.	PSCHT - KH-12-		rd								
	68	2146.5	828.6 (3)	37.0	74.0	104.0	154.3	14.8	5.5	40.3	34.4
13.	SAHT-KH-12-15	1901.5	696.6	37.7	63.7	93.7	148.4	12.7	5.3	42.5	35.5
14	KBSH-44	2167.0	628.9	28.3	79.0*	109.0	181.7	15.3*	5.7	38.7	37.2
15	DRSH-1	1872.5	748.0	39.1 *	74.0	104.0	166.3	14.5	5.7	41.3	33.0
	G. Mean	1996.1	769.4	37.0	69.5	99.5	154.9	14.5	5.5	40.6	33.3
	S. Em (±)	41.5	14.6	0.14	0.9	0.8	2.3	0.38	0.17	0.26	0.81
	C.D(P=0.05)	130.6	41.2	0.4	2.7	2.3	6.8	1.2	0.5	0.8	2.6
	CV%	9.5	9.4	9.1	8.9	8.1	9.2	8.6	7.8	7.2	8.8

Table 2: 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	a)	Avg. Seed yield (kg/ha)	
		2014-15	2013-14	2012-13		
1	PSCHT- KH-12-38	2480	2256	2044	2260.0	
2	PSCHT-KH-12-42	2130	2233	2389	2250.7	
3	PSCHT-12-26	2153	2156	2330	2216.7	
4	PSCHT-12-29	1740	2111	2044	1964.0	
5	SAHT-12-21	2222	2028	2333	2194.3	
6	PSCHT-12-76	1898	1967	1911	1925.3	
7	PSCHT-12-36	2222	1900	2333	2151.7	
8	SAHT-12-18	2025	5 1889 2367		2093.7	
9	PSCHT-12-35	1820	1760	2200	1926.7	
10	SAHT-KH-12-09	1866	1975	1940	1927.0	
11	PSCHT-KH-12-66	2016	1740	1890	1898.7	
12	PSCHT-KH-12-68	2373	2040	2300	2237.7	
13	SAHT-12-15	1898	1980	2044	1974.0	
14	KBSH-44	2407	2190	2070	2222.3	
15	DRSH-1	2030	1856	1860	1915.3	
S. Em(±)		41.5	32.5	37.8	37.6	
Mean		2096.1	2002.9	2150.5	2083.2	
C.D (5%)		129.2	87.5	114.7	_	
C V (%)		9.7	9.3	9.8	-	

4. YIELD AND YIELD COMPONENT:

Data reported in the table-1 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%) which was marginally higher by SAHT-KH-12-21 (29.5%) and P-KH-12-42(30.5%) respectively (Anonymous, 2015). 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.

		2	2014-15			2013-14						
Sl. No	Name of the Hybrid		Seed Yield(kg	/ha)			Seed Yield(kg/	ha)		Avg. Seed Yield(kg/ha)		
		MLT-1 C.U Research Farm	MLT-2 Radhakantapur	MLT-3 Kultuli	Mean	MLT-1 C.U Research Farm	MLT-2 Radhakantapur	MLT-3 Kultoli	Mean	Over the Years		
1.	PSCHT - KH-12-38	2488	2320	2352	2387	2160	2050	1985	2065	2226		
2.	PSCHT - KH-12-42	2430	2350	2264	2348	2070	1870	1940	1960	2154		
3.	PSCHT - KH-12-26	2353	2274	2100	2242	2070	1870	1960	1967	2105		
4.	PSCHT - KH-12-29	1713	1997	1850	1853	1810	1870	1670	1783	1818		
5.	SAHT-12- 21	2262	2210	2024	2165	1680	1780	1650	1703	1934		
6.	PSCHT - KH-12-76	1898	1821	1804	1841	1970	1790	2020	1927	1884		
7	PSCHT - KH-12-36	2220	2128	2065	2138	1970	1820	1930	1907	2022		
8	SAHT-K- 12-18	2025	1934	1856	1938	2060	1840	2000	1967	1953		
9	PSCHT - KH-12-35	1716	1660	1625	1667	1730	1610	1650	1663	1665		
10	SAHT-K- 12-09	1866	1980	1872	1906	1620	1560	1640	1607	1756		
11.	PSCHT - KH-12-66	2016	1846	1820	1894	2040	1780	1890	1903	1899		
12.	PSCHT - KH-12-68	2373	2245	2052	2223	2040	1830	1980	1950	2087		
13.	SAHT-KH- 12-15	2080	1962	1860	1967	1810	1750	1720	1760	1864		
14	KBSH-44	2307	2220	2164	2230	1910	1850	1760	1840	2035		
15 6 F	DRSH-1	2030	1864	1842	1912	1730	1700	1650	1693	1803		
S. Er	n(±)	42.7	50.2 2054 1	42.7	49.5	34.5 1606.0	4/.2	58.0 1817.6	45.5	40.2 1047		
C.D	(P=0.05)	146.3	2034.1	137.0.0	151.8	1090.9	1093.1	161.2	135.7	1947		
C.V	/0	9.5	9.8	9.7	9.4	8.9	9.5	9.8	9.4	9.5		

Table 3: PERFORMANCE OF SUNFLOWER HYBRID ENTRIES in Multilocation Trial in the last Two years in West Bengal (2013-14 to 2014-15)

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-1) 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.

 Table 4: PERFORMANCE OF SUNFLOWER HYBRID ENTRIES in Multilocation Trial over the 3 years in

 West Bengal (2013-14 to 2014-15)

Sl.		2014-15				2013-14			
No	Name of the Hybrid	Avg. Seed	Avg. Seed	Avg. Seed	Avg. Seed	Seed	Avg. Seed	Avg. Seed Yield	
		Yield	Yield	Yield	Yield	Yield Yield(kg/ha		(kg/ha) over the MLT	
		(kg/ha) over	(kg/ha) in	(kg/ha) over	(Kg/ha)in	in SHT,	over the	and SHT over the	
		the MLT	SHT,	HT, the MLT		MLT(3 Nimpith		Years (2014-15 and	
		(3 Location)	Nimpith and SHT		location)		SHT	2013-14)	
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	

-					1 = 0.0		10.17	2 0 2 0 7
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	$l(\pm)$	49.5	41.5	45.4	32.5	41.5	38.1	41.5
G. M	lean	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

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(Anonymous-2016).

Table 5: Evaluation of Superior Sunflower hybrids (Out of 150 Hybrids) in "On Station Trial" at Nimpith over the3 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 yield(Kg/ha) Oil %				Avg. Seed yield (kg/ha)	Avg. Oil yield (Kg/ha)	Oil Yield Improvement over the Check hybrid,DRSH-1
		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
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
3	PSCHT-KH- 12-26	36.5	37.9	38.6	37.7	785.8	817.1	899.4	2216.7	834.1(2)	11.5
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
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
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
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
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
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
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
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
12	PSCHT-KH- 12-68	36.6	37.0	37.5	37.0	858.5	804.8	832.5	2237.7	828.6 (3)	10.5

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
14	KBSH-44	27.9	27.5	29.6	28.3	671.6	602.3	612.7	2222.3	628.9	-
15	DRSH-1	38.5	39.2	39.5	39.1	781.6	727.6	734.7	1915.3	748.0	-
	S Em(±)	0.09	0.12	0.13	0.12	13.7	11.6	18.1	41.5	14.6	-
Mean	1	36.6	36.8	37.6	37.0	767.2	736.4	804.5	2083.2	769.4	-
C.D		0.28	0.36	0.41	0.35	41.6	34.7	54.2	130.6	44.2	-
C.V%	0	8.9	9.4	9.1	9.2	9.3	9.1	9.7	9.5	9.4	-

5. CONCLUSION

Based on the overall performance in various locations and various year, the AICRP-sunflower, Nimpith centre is going to be promoted the Sunflower hybrids, PSCHT- KH-12-26, PSCHT-KH-12-42 and PSCHT-KH-12-68 through All India Coordinated trial (IHT) of AICRP (Sunflower) for cultivation in *rabi-summer* season in West Bengal Agro-climatic condition.

6. ACKNOLEDGEMENT

The author is grateful to Dr. KS. Varaprasad, Director, Indian Institute of Oilseed Research, Rajendranagar, Hyderabad for providing financial and Technical Support to conduct the hybrid trial.

REFERENCES

- Anonymous, 2015. Annual report of AICRP Sunflower (2014-15). Directorate of Oilseed Research, ICAR, Hyderabad; pp-106-110.
- [2] Anonymous, 2016. Annual report of AICRP Sunflower (2015-16). Directorate of Oilseed Research, ICAR, Hyderabad; pp-57-58.
- [3] Dutta, A. 2011.Effects of sowing dates on yield and yield components of hybrid sunflower (*H.annuus L.*) in nontraditional areas of West Bengal. Journal of Crop and Weed. 7(2): 216-228.
- [4] Dutta, A 2015.Performance of sunflower hybrids (H.annuus L.) under West Bengal condition. Journal of Oilseeds Research,32(2): 129-132.
- [5] Gvozdenovic S; Joksimovic J and Skoric D 2005.Gene effect and combining ability for Plant Height and head Diameter in Sunflower.Genetica.37(1):57-64.
- [6] Leclercq, P., 1969.Line sterile cytoplasmic quechezktournesol. Ann. AmeliorPlanta, 12: 99-106.
- [7] Limbore, A.R., Weginwar D.G., Gite B.D. and Ghorade R.B., 1997.Combining ability in sunflower (*Helianthus annuus* L.), *Helia*,20: 79-88.
- [8] Kinman, M.L., 1970.New development in the USDA and State Experiment Station, Sunflower breedingprogramme. In: *Proc. of the Fourth Int. Sunflower Conference*, Memphis, Tennessa, pp. 181-183.
- [9] Chandra, B.S., Ranganatha A.R.G. and Kumar S.,(2013). Heterosis studies for yield and it's components in sunflower hybrids over locations. *Madras Agric. J.*, 100(13):23-29.