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Variability and Correlation Analysis for Oil Yield and Component Traits in a Mapping Population of Sunflower

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Studies on variability and association analysis was carried out for RIL F5 generation of a cross TNHSF239-68-1-1-1 x 17B in sunflower (Helianthus annuus L.) for oil yield and component traits. The highest GCV and PCV were observed for oil yield, seed yield, stripes between margins, stripes on margin and seed colour. High heritability accompanied with high genetic advance as per cent of mean was observed for pollen colour, stripes on margin, stripes between margin, seed colour, hull weight, kernel weight and 100-seeds weight. Association studies revealed that, oil yield per plant had significant and positive correlation with volume weight, 100-seeds weight, hull weig ht, kernel weight and oil content. Seed yield per plant had significant and positive correlation with volume weight, 100-seeds weight, hull weight, kernel weight and oil content. The stripes (on margin and between margins) had significant negative association with seed color, 100-seeds weight and kernel weight.

Key words: Sunflower, Genetic variability, Heritability, Correlation, Seed morphological traits, Oil yield.

Crop improvement depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. Genetic improvement for quantitative traits can be achieved through a clear understanding of the nature and amount of variability present in the genetic stocks and the extent to which the desirable traits are heritable. Since variability is a prerequisite for selection programme, it is necessary to detect and document the amount of variation existing in the population. Knowledge on association among components of economically important traits can help efficient selection. The present investigation was undertaken to find out the extent of genetic variation present for oil yield and component traits in a RIL population.

Materials and Methods

In any breeding programme, the choice of the parents is an important aspect for the success of the crop improvement. Especially to create a suitable mapping population for a trait, parents have to be divergent for that trait. In the present study, two sunflower inbred lines *viz.,* TNHSF239-68-1-1-1 and 17B with significant differences for seed morphological traits and oil content (Table 1) were selected as female and male parents. Moreover, it is essential to know the magnitude and type of association between yield and its component characters. Knowledge on association among components of economically important traits can help in providing the information for efficient selection.

One hundred and forty one recombinant inbred lines along with two parents were evaluated in randomised blocks design with a spacing of 60 × 30 cm during kharif, 2011 in the Department of Oilseeds, Tamil Nadu Agricultural University, Coimbatore. Observations were recorded on five randomly selected competitive plants of each genotype from the middle of the row. Data were recorded on morphological traits *viz.,* days to 50 per cent flowering, plant height (cm), head diameter (cm), pollen color (score), seed stripes on margin (score), seed stripes between margin (score), seed colour (score), volume weight (g), 100- seeds weight (g), hull weight (g/100 seeds), kernel weight (g/100 seeds), hull content (%), oil content (%), seed yield (g/ per plant) and oil yield (g/plant) (Table 2).

Analysis of variance was carried out as suggested by Panse and Sukhatme (1961). GCV and PCV were calculated using the formula suggested by Burton (1953). The heritability estimate in the broad sense was calculated by the method proposed by Lush (1949) and for simple correlation utilizing the formula suggested by Aljibouri *et al.* (1985).

Results and Discussion

Genetic variability, heritability and genetic advance

The analysis of variance revealed significant differences among the genotypes for the characters studied except for plant height and head diameter. The mean GCV, PCV, heritability (h2) (broad sense) and GA as percentage of mean (GAM) were presented (Table 3). PCV ranged from 4.61% (days to 50 % flowering) to 50.76 % (oil yield). GCV ranged from 1.44% (plant height) to 33.36 % (stripes between margin). GCV and PCV was low (<10%) for days to 50 per cent flowering. Similar findings of low GCV were reported for days to 50 per cent flowering by Janamma *et al.* (2008). Oil yield, seed yield, stripes

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Table 1. Description of Morphological characters of parents

Characters	TNHSF239-68-1-1-1 (P1)	17B (P2)
Seed stripes	No stripes on the surface of seeds	Stripes present on surface; stripes strongly expressed in the margins
Pollen colour	Yellow	White
Seed colour	Black	Brown colour
100 seeds weight(g)	3.7	5.2
Hull weight/100 seeds(g)	1.5	2.5
Hull(%)	25	35
Oil content	Very high (40-42%)	Very low < 33%
Seed yield/plant	Low	High
Oil yield	Low	High

between margins, stripes on margin, pollen color, seed color, hull weight, kernel weight and 100-seeds weight recorded high PCV (> 20%) values. These results are in agreement with Rao *et al*. (2003), Sridhar *et al.* (2006), Mijic *et al.* (2009) and Dhillon *et al.* (2011). Moderate PCV (10-20%) values were noticed for hull content, oil content, head diameter, volume weight and plant height. These results are also in agreement with Sujatha *et al.* (2002) and Dhillon *et al* (2011). GCV values were high (> 20%) for the characters like stripes between margins, stripes on margin, pollen colour, oil yield, seed yield and seed colour. Moderate GCV (10-20%) values were noticed for kernel weight, hull weight, 100-seeds weight, oil content and hull content. Low GCV was exhibited for volume weight, head diameter and plant height. These results are also in agreement with Tyagi *et al.* (2011). These result indicated that sufficient level of variability had existed for most of the traits in this population.

Heritability value alone may mislead during selection. Therefore, heritability and genetic advance together should be taken into consideration for selection (Johnson *et al.,* 1955). The range of heritability (in broad sense) was from 1.44 % (plant height) to 80.14 % (pollen colour). High heritability and high genetic advance as percentage of mean were recorded for the traits pollen color, stripes on margin, stripes between margins, seed color, hull weight, kernel weight and 100-seeds weight. High heritability and high genetic advance as percentage of mean indicates the presence of additive gene action. Directional selection for these traits would be more effective for desired genetic improvement. These results are also in agreement with Sridhar *et al.* (2006), Sujatha and Vishnuvardhan Reddy (2009), Janamma *et al.* (2009) and Makane (2011). High heritability and low genetic advance as a percentage of mean were observed for days to flowering, volume weight, hull content, oil content, seed yield and oil yield. This result is also in agreement with Sutar *et al.* (2010). It indicates that the expression of this trait is unstable due to environmental influence. Low heritability and low genetic advance was recorded for

Table 2. Scoring for pollen colour, seed stripes and seed colour

Pollen color	Seed stripes on margin	Seed stripes between margins	Seed main color	Score
White	None or very weakly expressed	None or very weakly expressed	White	1
Yellow	Weakly expressed	Weakly expressed	Whitish grey	2
	Strongly expressed	Strongly expressed	Grey	3
			Light brown	4
			Medium brown	5
			Dark brown	6
			Black	7
			Purple	8

plant height and head diameter. This indicated that these traits were highly influenced by environment. It may be concluded that directional selection would be effective for the traits that had high h2 and GAM *viz.,* pollen colour, stripes on and between margins, seed colour, hull weight, kernel weight and 100-seeds weight for oil yield and component traits.

Oil yield vs other characters

Oil yield had significant and positive correlation with seed yield per plant (Table 4). Other researchers Manivannan *et al.,* 2007 and Anandhan et al., 2010 indicated a positive relationship between seed yield and oil yield. Volume weight, 100 seeds weight, hull weight, kernel weight and oil content recorded significant correlation with oil yield. These results confirm the earlier findings of Kumar *et al.* (2003), Sridhar *et al.* (2005), Vidhyavathi *et al.* (2005), Ravi *et al.* (2006) and Sowmya *et al.* (2010).

Seed yield vs component characters

Table 3. Estimates of variability and genetic parameters of F5 progenies for various characters

Character	Minimum	Maximum	Mean	PCV	GCV	Heritability	GA %
Days to 50% flowering	51.00	62.50	55.45	4.61	2.91	39.79	0.93
Plant height	110.95	165.62	137.21	11.25	1.44	1.65	0.38
Head diameter	6.06	23.23	12.55	15.42	3.79	6.05	0.24
Pollen color	1	2	1.44	34.58	30.96	80.14	102.59
Stripes on margin	1	4	1.93	41.76	32.96	62.29	52.38
Stripes between margins	1	4	1.83	44.08	33.36	57.28	48.84
Seed color	2	7	5.55	33.06	23.33	49.83	13.05
Volume weight	28	46	37.34	11.57	9.2	63.18	2.77
100-seeds weight	2.89	7.55	4.72	21.78	16.96	60.63	20.59
Hull weight	0.87	2.86	1.49	25.39	17.71	48.63	46.95
Kernel weight	1.80	5.23	3.24	25.80	19.05	54.53	25.63
Hull content	19.68	46.90	31.87	19.78	10.94	30.58	1.09
Oil content	19.01	48.97	34.93	17.03	12.67	55.39	2.43
Seed yield	2	55.7	23.93	47.64	26.81	31.66	1.53
Oil yield	2.20	21.08	8.34	50.76	27.81	30.01	4.06

Seed yield per plant had significant and positive correlation with volume weight, 100-seeds weight, hull weight, kernel weight and oil content. These results confirm the earlier findings of Moorthy (2004), Uttam *et al.* (2006), Manivannan *et al.* (2007), Kaya *et al.* (2008) and Tyagi and Tyagi (2011). Whereas, seed colour had significant and negative correlation with stripes on margin, stripes between margins, hull weight and hull content. It indicated that black colour seed is associated with non stripe on seed surface, low hull weight and hull content. Hull content had negative and significant association with oil content.

Differential association was observed among the yield component characters. Days to flowering had positive and significant correlation with plant height and volume weight, it had negative significant with pollen colour. Plant height had positive and significant correlation with head diameter and volume weight. Similar results were reported by Chikkadevaiah *et al.* (2002), Vidhyavathi *et al.* (2005) and Ravi *et al.* (2006). Head diameter had positive and significant correlation with 100-seeds weight and hull weight as reported by Vidhyavathi *et al.* (2005) and Anandhan *et al.* (2010).

Table 4. Simple correlation coefficients between yield and yield component characters in F5 progenies

Character	Plant height	Head diameter	Pollen color	Stripes onmargins	Stripes betweenmargins	Seed colour	Volume weight	100-seeds weight	Hull weight	Kernel weight	Hull content	Oil content	Seed Yield	Oil Yield
Days to flowering	0.31**	0.00	-0.20*	-0.07	-0.09	-0.01	0.21**	0.01	-0.03	0.02	-0.06	-0.11	0.15	0.08
Plant height		0.38**	-0.03	0.11	0.06	-0.01	0.22	0.10	0.13	0.07	0.07	-0.10	0.11	0.06
Head diameter			0.01	-0.11	-0.08	0.07	0.13	0.16*	0.17*	0.13	0.02	-0.08	0.14	0.10
Pollen color				-0.04	0.05	-0.06	0.00	-0.01	-0.05	0.01	-0.03	0.15	-0.05	0.00
Stripes on margins					0.79**	-0.42**	-0.11	-0.16*	0.14	-0.26**	0.35**	-0.07	-0.10	-0.11
Stripes between margins						-0.29**	-0.01	-0.16*	0.09	-0.23**	0.28**	0.06	-0.02	-0.01
Seed color							-0.01	-0.02	-0.25**	0.09	-0.33**	0.03	-0.01	0.00
Volume weight								0.18*	0.14	0.16*	0.00	0.06	0.20*	0.21**
100 seeds weight									0.69**	0.95**	-0.28**	0.02	0.31**	0.31**
Hull weight										0.43**	0.48**	-0.11	0.28**	0.20*
Kernel weight											-0.57**	0.08	0.27**	0.30**
Hull content												-0.18**	-0.01	-0.12
Oil content													-0.06	0.31**
Seed yield														0.92**

Stripes on margin had positive and significant association with stripes between margins and hull content and it had a negative significant association with seed colour, 100-seeds weight and kernel weight. The trait, stripes between margins had significant and positive correlation with hull content and it had a negative significant association with seed colour, 100-seeds weight and kernel weight. Both stripes had negative and significant association with seed color,

100-seeds weight and kernel weight.

Volume weight had positive and significant correlation with 100-seeds weight, kernel weight, seed yield and oil yield as reported by Chikkadevaiah *et al.* (2002). The trait 100-seed weight recorded highly significant and positive correlation with hull weight, kernel weight, seed yield and oil yield as reported by Kothai *et al.* (2007) and Anandhan *et al.* (2010). It had negative and significant correlation with hull content. Kernel weight had high negative and significant correlation with hull content. Similar results were reported by Sivamurugan (2011).

It may be concluded that the traits *viz.,* seed colour, 100-seeds weight, kernel weight, hull weight and seed yield are important selection indices for both oil and seed yield improvement programme. Stripe on margin and between margins; and seed colour has no association with oil content. However, it had significant and negative association with hull content. Hence, light coloured and striped (both on margin and between margins) seed progenies may be avoided in oil seed sunflower breeding programme.

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