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Correlation and Path Coefficient Studies in Sunflower

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Abstract: Correlation and relative contribution by different yield attributing characters towards seed yield of sunflower (*Helianthus annuus* L.) were studied from a field experiment conducted during 1994 and 1995 at PAU, Ludhiana. Seed yield of sunflower showed positive correlation with leaf area index, capitulum weight, 1000-grain weight, grains per capitulum, capitulum diameter and root length density during 1994. However, during 1995, positive correlation of seed yield was found with all the above characters except leaf area index. In both the years, highly significant correlation of seed yield was found with yield attributing characters, viz., capitulum weight, 1000-grain weight, number of grains per capitulum and capitulum diameter. Path coefficient analysis revealed that among different characters, contribution of leaf area index was highest (0.1485) during 1994 followed by capitulum diameter (0.0877). During 1995, highest contribution towards seed yield was made by capitulum diameter (0.4255) followed by 1000-grain weight (0.0465).

Key words: Correlation, path coefficient, sunflower.

Sunflower (*Helianthus annuus* L.) is a short-duration, thermo- and photo-insensitive oil seed crop with wide adaptability to the varied climatic conditions. It contains 40-45% oil with high degree of polyunsaturated fatty acids (PUFA).

In Punjab, sunflower crop is sown in spring season. Late sowing of sunflower crop decreases yields as well as delays the sowing of the succeeding *kharif* crop. Irrigation plays an important role in ripening and synchronous maturity of the heads as they exhibit hydropositive features. Wide gap exists between the realised and realizable yields. Being a new oilseed crop, it is necessary to study the correlation and relative contribution of different characters towards seed yield.

Materials and Methods

A 2-year study was conducted from January to May during 1994 and 1995 at Punjab Agricultural University research farm, Ludhiana. A field trial was laid out in split plot design with three dates of planting (January 1, 20 and February 10) in main plots and seven methods of planting-cum-irrigation application, viz., (i) planting on flat bed and irrigation application by border method (F-bed), (ii) planting on southern side of E-W ridge and irrigation in every furrow (SEW-E), (iii) planting on southern side of E-W furrow and irrigation in alternate furrow (SEW-A), (iv) planting on top of E-W furrow and irrigation in every furrow (TEW-E), (v) planting on top of E-W ridge and irrigation in alternate furrow (TEW-E), (vi) planting in ditch of E-W furrow and

Table 1. Anova table for different characters

Source	d.f.	Seed yield		Head weight		1000-grain wt.		Grains/head		Head diameter	
		1994	1995	1994	1995	1994	1995	1994	1995	1994	1995
Reps	3	0.14ns	0.036**	765.05ns	556.87**	4.766ns	0.117ns	1880.12ns	765.14ns	0.399ns	0.427ns
Dates(D)	2	3.778**	1.320**	155044**	128751**	632.98**	251.49**	670.61**	141047**	26.82**	7.58**
Error a	6	0.008	0.004	649.80	681.79	4.66	0.0928	1390.6	1218.9	0.762	0.287
Methods (M)	6	0.969**	0.896**	115.93**	521.19ns	125.97**	13.99**	13970**	15072.2**	15.67**	2.38**
D x M	12	0.028*	0.008**	351.26**	160.75ns	18.38**	0.998**	507.71ns	1818.36ns	2.47**	0.210ns
Error b	54	0.022	0.021	64.55	446.19	0.139	1936.44	1936.44	1242.7	0.565	0.444

** Significant.

irrigation in every ditch (DEW-E), (vii) planting in ditch of E-W furrow and irrigation in alternate ditch (DEW-A) in subplots. Irrigations were applied at 25% available soil moisture depletion (ASMD) from profile depth of 22.5 cm to 37.5 cm. In crop planted on flat bed the depth of each irrigation was 7.5 cm, whereas in every ridge/furrow method of planting-cum-irrigation, the furrows were filled to their possible capacity and depth of water applied was calculated to be 5 cm on plot area basis (66.7% of water applied in flat beds) and in alternate furrow/ditch the depth of water applied was calculated to be 4 cm on plant area basis (53.5% of water applied in flat bed). Gross plot size was 6.5 x 3.0 m. Sunflower variety MSFH 8 was planted at 60 x 30 cm spacing using seed rate of 5 kg ha^{-1}. Recommended rates of N and P were applied at the time of sowing. Presowing irrigations were applied to all the three dates on different times. Subsequent irrigations were applied as per the requirement of the treatments. Crop was harvested on different dates when it had physiologically matured.

The data on different yield attributing characters and yield were collected at harvest and statistically analysed. Root study was conducted at seed filling stage of the crop from one replication only and root length density (RLD) was calculated following Newman (1965). Similarly water use was calculated from one replication only. Dry matter and leaf area were recorded at 30, 50, 70, 90 and 110 days after sowing. Consumptive water use was calculated by the formulae given by Singh *et al.* (1960). Path coefficiency analysis of the correlation coefficient was carried out according to Li (1971).

Results and Discussion

Anova for yield and yield attributing characters are given in Table 1. The correlation coefficient for 9 characters were calculated (Table 2). During 1994, RLD showed a positive correlation with seed yield, 1000-grain weight, number of grains per capitulum and capitulum weight. Seed yield showed positive correlation with RLD, capitulum weight, 1000-grain weight, number of grains per capitulum and capitulum diameter. Capitulum weight showed positive correlation with RLD, seed yield, 1000-grain weight, number of grains per capitulum and capitulum diameter. 1000-grain weight showed positive correlation with RLD, seed

Table 2. Correlation coefficient 'r' between different characters and yield of sunflower

Characters	1	2	3	4	5	6	7	8	9
RLD (1)	–	ns	0.540	ns	0.738	0.659	0.740	ns	ns
		(ns)	(0.443)	(ns)	(0.878)	(0.798)	(0.724)	(0.629)	(ns)
Water use (2)	ns	–	ns	ns	ns	ns	ns	ns	ns
	(ns)	–	(ns)	(ns)	(ns)	(ns)	(ns)	(ns)	(ns)
Seed yield (3)	0.540	ns	–	ns	0.813	0.812	0.876	0.870	ns
	(0.443)	(ns)	–	(ns)	(0.598)	(0.766)	(0.805)	(0.861)	ns
LAI (4)	ns	ns	ns	–	ns	ns	ns	ns	0.856
	(ns)	(ns)	(ns)	–	(ns)	(ns)	(ns)	(ns)	(0.876)
Capitulum	0.738	ns	0.813	ns	–	0.777	0.829	0.648	ns
weight (5)	(0.878)	ns	(0.598)	ns	–	(0.912)	(0.818)	(0.736)	ns
1000-g.wt (6)	0.659	ns	0.812	ns	0.777	–	0.865	0.760	ns
	(0.798)	ns	(0.766)	ns	(0.912)	–	(0.969)	(0.860)	ns
Grain per	0.740	ns	0.876	ns	0.829	0.865	–	0.821	ns
capitulum (7)	(0.724)	ns	(0.805)	ns	(0.818)	(0.969)	–	(0.880)	ns
Capitulum	ns	ns	0.870	ns	0.648	0.760	0.821	–	ns
diameter (8)	(0.629)	ns	(0.861)	ns	(0.736)	(0.860)	(0.880)	–	ns
DM (9)	ns	ns	ns	0.856	ns	ns	ns	ns	–
	(ns)	(ns)	(ns)	(0.876)	ns	ns	ns	ns	–

ns = Non-significant. Values in parenthesis are for 1995.

yield, capitulum weight, number of grains per capitulum and capitulum diameter. Grains per capitulum showed positive correlation with RLD, seed yield, capitulum weight, 1000-grain weight and capitulum diameter. Capitulum diameter showed positive correlation with seed yield, capitulum weight, number of grains per capitulum and 1000-grain weight. Dry matter accumulation showed positive correlation only with leaf area index.

During 1995, RLD showed positive correlation with seed yield, capitulum weight, 1000-grain weight, grains per capitulum and capitulum diameter. Seed yield showed positive correlation with RLD, capitulum weight, 1000-grain weight, grains per capitulum and capitulum diameter. Capitulum weight showed positive correlation with RLD, seed yield, 1000-grain weight, grains per capitulum, capitulum diameter. 1000-grain weight showed positive correlation with RLD, seed yield, capitulum weight, grains per capitulum and capitulum diameter. Grains per capitulum showed positive correlation with RLD, seed yield, capitulum weight, 1000-grain weight and capitulum diameter. Capitulum diameter showed positive correlation with root length density, seed yield, capitulum weight, 1000-grain weight and grains per capitulum. Thus, characters having significant contribution in seed yield were capitulum weight, 1000-grain weight, grains per capitulum and capitulum diameter, but LAI had no consistent effect on yield. Positive correlation between number of siliquae and seed yield have also

Table 3. Direct and indirect effects of various contributing traits to seed yield during 1994 and 1995

	RLD	Water use	LAI	Capitulum weight	1000-Grain weight	Grains per cap.	Capitu-lum diameter	Dry matter
RLD	-0.0095 (-0.2799)	IE	IE	IE	IE	IE	IE	IE
Water use	IE	0.0024 (0.0129)	IE	IE	IE	IE	IE	IE
LAI	IE	IE	0.1486 (-0.3078)	IE	IE	IE	IE	IE
Capitulum weight	IE	IE	IE	0.0023 (-0.0059)	IE	IE	IE	IE
1000 g. weight	IE	IE	IE	IE	0.0099 (0.0465)	IE	IE	IE
Grains per capitulum	IE	IE	IE	IE	IE	0.0020 (0.0021)	IE	IE
Capitulum diameter	IE	IE	IE	IE	IE	IE	0.0977 (0.4255)	IE
Dry matter	IE	IE	IE	IE	IE	IE	IE	0.0064 (0.0083)

IE = Indirect effect. Values in parenthesis are for the year 1995.

been reported by Nathwat *et al.* (1969) in *Brassica juncea* and Stolie (1954) in winter rape. Gill and Narang (1995) also reported positive correlation between seed yield and all other characters except plant height in *Brassica napus*. Similarly, Mathauda (1983) also reported significant positive correlation between seed yield and dry matter accumulation, number of pods per plant and 1000-grain weight in *Brassica juncea*.

Path analysis was done to find out the contribution of each character towards seed yield in sunflower (Table 3). The analysis showed that the contribution of RLD on seed yield was negative during both the years. The contribution of LAI and capitulum weight was also negative during 1995. During 1994, contribution towards seed yield was positive by all the characters except RLD. Whereas, during 1995, positive contribution towards seed yield was by water use, 1000-grain weight, grains per capitulum, capitulum diameter and dry matter accumulation (Table 2).

Thus, characters like 1000-grain weight, grains per capitulum and capitulum diameter had the highest contribution towards seed yield through indirect effect on water use, LAI and dry matter accumulation in sunflower.

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