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Genetic variability, character association and path analysis for yield, its component traits and late leaf spot, *Phaeoisariopsis personata* (Berk and curt), in groundnut

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SUMMARY

High estimates of PCV, GCV, heritability and genetic advance as per cent of mean were observed for late leaf spot disease severity, reducing sugar, kernel yield per plant and pod yield per plant. It indicated the role of additive gene action and hence, the usefulness of phenotypic selection for bringing improvement. Pod yield showed positive significant associations with days to 50 per cent flowering, days to maturity, kernel yield, test weight and oil content, where as negative significant associations with late leaf spot disease severity and reducing sugar indicated that they could be used as selection criteria for developing high yielding late leaf spot disease resistance varieties. The path analysis revealed that high positive direct effect of kernel yield exerted on pod yield as well as indirect effect of oil content, strong mature kernel, days to 50 per cent flowering, test weight, days to maturity, and non reducing sugar through kernel yield. Therefore, it would be rewarding to lay due emphasis on the selection of these characters for rapid improvement in pod yield.

Key words : Groundnut, Correlation coefficient, Path analysis and leaf spot

Groundnut *(Arachis hypogaea* L.) is a major oilseed crop grown predominantly during rainy season. The average productivity in rainy season is below one tonne per hectare. This is mainly because the crop is subjected to varieties of rainfall and is also damaged due to pests and diseases. Among several diseases attacking groundnut, late leaf spot caused by *Phaeoisariopsis personata* resulting reduction in pod and haulm yield of 25.3 and 53.0 per cent, respectively (Eswara Reedy and Venkateshwara Rao, 1999). The success of any crop improvement programme essentially depends on the genetic variability present in the crop. Information on phenotypic and genotypic interrelationship of pod yield with its components characters and also among the characters themselves would be very much useful to the plant breeder in developing an appropriate breeding strategy. But yield is a complex character and is influenced by number of traits which in turn are interrelated. The interdependence of these characters will influence pod yield either directly or indirectly and as a result the information obtained on the association of these traits become unreliable. Therefore, path coefficient analysis permits the separation of direct effects from indirect effects and gives more realistic relationship of the characters and help in effective selection. Therefore, the study was undertaken to find out extent of variability, heritability genetic advance, correlation and path analysis for various traits in groundnut.

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MATERIALS AND METHODS

The experimental material comprising of 20 genotypes including four checks *viz.*, JL-24, TAG-24, LGN-l and GPBD-4 were studied in three replicated randomized block design during *kharif* 2006 at Oilseeds Research Station, Latur. The observations were recorded on selected five plants for twelve characters *viz.*, days to 50 per cent flowering, days to maturity, kernel yield per plant, test weight, shelling percentage, oil content, strong mature kernel, harvest index, late leaf spot severity (%), non reducing sugar, reducing sugar and pod yield per plant. The phenotypic and genotypic correlations were worked out by following Falconer (1964) and path analysis as suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The mean performance of an individual genotype showed significant differences for all the characters (Table 1). The pod yield per plant ranged from 10.40 g (LGN-125) to 4.06 g (LGN-124). Maximum oil content (48.76%) was recorded in genotype (LGN 126) while minimum (40.00%) was reported in LGN-105. Check TAG-24 was found to be early among the all genotypes. The genotype

Table 1 : Mean performance of genotypes for yield and late leaf spot disease resistance in groundnut

Sr. No.	Genotypes	Days to 50% flowering	Days to maturity	Kernel yield / plant (g)	Test weight (g)	Shelling (%)	Oil content (%)	Strong mature kernel (%)	Harvest index (%)	Late leaf spot severity (%)	Non reducing sugar (mg/g)	Reducing sugar (mg/g)	Pod yield/ plant (g)
1.	LGN-69	30.66	115.66	4.66	30.66	58.01	48.00	82.60	26.97	0.88	15.83	0.733	7.96
2.	LGN-74	28.66	110.33	4.26	31.66	68.15	45.50	89.51	38.00	61.88	11.83	1.500	6.26
3.	LGN-75	31.66	114.00	4.46	37.33	57.59	45.43	87.47	25.79	40.44	9.55	2.383	7.73
4.	LGN-80	31.66	115.66	4.53	34.66	59.56	48.50	83.94	31.58	50.55	11.91	2.200	7.60
5.	LGN-105	30.66	103.00	3.46	22.00	63.65	40.00	82.31	39.69	69.99	7.85	1.533	5.46
6.	LGN-107	29.66	101.00	3.33	23.33	58.30	45.36	78.91	38.73	64.33	12.55	1.917	5.73
7.	LGN-111	29.66	104.33	4.00	41.33	60.57	47.60	88.69	26.20	46.77	11.83	2.350	6.63
8.	LGN-115	29.33	115.00	4.20	31.33	53.48	46.80	89.02	41.70	49.09	13.60	1.950	7.86
9.	LGN-119	32.66	116.33	4.60	34.00	49.22	48.63	88.33	30.97	0.66	9.80	0.967	9.33
10.	LGN-121	31.33	119.66	3.33	28.00	62.38	45.53	82.00	31.85	47.33	15.26	1.933	5.33
11.	LGN-124	29.66	109.66	2.59	26.00	63.26	40.63	82.14	29.33	68.10	10.85	2.433	4.06
12.	LGN-125	31.66	115.00	6.53	35.00	62.85	48.53	89.15	33.36	0.66	12.83	0.933	10.40
13.	LGN-126	33.33	119.00	5.13	29.33	59.26	48.76	87.09	29.39	0.77	13.73	1.117	8.66
14.	LGN-127	33.33	115.66	6.00	36.00	59.98	48.73	89.49	37.97	0.66	11.26	0.717	9.90
15.	DH-52	32.33	107.66	4.00	29.33	60.87	47.13	75.68	32.41	0.88	11.61	1.617	6.53
16.	R-8808	30.66	115.33	2.13	27.33	45.15	40.86	81.11	34.31	68.10	10.38	1.500	4.73
17.	GPBD-4 (C)	31.33	110.66	4.66	30.66	55.96	48.70	84.34	34.42	0.44	12.41	1.200	8.33
18.	JL-24 (C)	28.66	107.33	2.93	23.33	59.44	44.90	81.29	26.55	66.33	10.41	2.217	4.93
19.	T AG-24 (G)	29.66	100.66	2.60	29.33	55.67	44.66	82.93	29.31	65.11	8.41	1.700	4.66
20.	LGN-1C)	29.66	105.66	3.60	22.66	62.03	48.06	80.84	38.86	43.66	9.07	1.13.3	5.80
	Mean	30.82	111.08	4.053	30.667	58.772	46.11	83.345	32.877	37.380	11.652	1.602	0.898
	S.E.±	0.329	0.414	0.25	1.608	2.196	0.323	1.930	2.581	1.116	0.236	0.060	0.363
	C.D. (P=0.05)	0.944	1.187	0.720	4.606	6.288	0.925	5.527	7.389	3.196	0.677	0.172	1.040
	CV(%)	1.853	0.6465	10.757	9.0871	6.4 73	1.214	3.964	13.597	5.173	3.517	6.509	9.123

LGN-I05 was highly susceptible to late leaf spot (69.99%) while LGN-125 and LGN-127 showed least leaf spot severity (0.66%). The estimates of genetic parameter (Table 2) revealed that there was closer correspondence between GCV and PCV for all characters except harvest index indicating that all the characters had less interaction with the environment. High GCV and PCV values were observed for late leaf spot severity (GCV = 77.25, PCV = 77.42), reducing sugar (GCV = 34.78, PCV= 35.39), kernel yield (GCV = 26.66, PCV = 28.75) and pod yield

Table 2 : Parameters of genetic variability for yield and late leaf spot in groundnut

Sr. No.	Parameters	Range	Mean	Genotypic variance (δ^2 g)	Phenotypic variance (δ^2 p)	GCV (%)	PCV (%)	Heritability (BS) (%)	Genetic advance as % of mean
1.	Days to 50 % flowering	28.66-33.33	30.81	1.9553	2.2816	4.5375	4.9015	85.70	8.6536
2.	Days to maturity	100.66-119.66	111.08	34.7272	35.2430	5.3050	5.3443	98.54	10.8480
3.	Kernel yield/ plant (g)	2.13-6.53	4.05	1.1678	1.3579	26.6622	28.7505	86.0	50.9345
4.	Test weight (g)	22.0-41.33	30.66	30.3588	38.1246	17.9670	20.1343	79.63	33.028
5.	Shelling (%)	45.15-68.15	58.77	21.8596	36.3345	7.9551	10.2561	60.16	12.7108
6.	Oil content (%)	40.0-48.76	46.11	7.7816	8.0951	6.0487	6.1693	96.13	12.2166
7.	Strong mature kernel (%)	75.68-89.51	84.34	12.4115	23.5945	4.1769	5.7590	52.60	6.2406
8.	Harvest index (%)	25.79-41.70	32.87	17.7451	37.7312	12.8128	18.6833	47.03	18.1008
9.	Late leaf spot disease severity (%)	0.44-69.99	37.38	833.39	837.63	77.2530	77.4261	99.0	158.785
10.	Non reducing sugar (mg/g)	7.85-15.83	11.65	4.3654	4.5333	17.9313	18.2730	96.36	36.2477
11.	Reducing sugar (mg/g)	0.717-2.433	1.602	0310	0.321	34.7886	35.3923	96.62	70.4419
12.	Pod yield / plant	4.66-- 10.40	6.89	3.2821	3.6781	26.2621	27.8016	89.23	51.1043

per plant (GCV = 26.26, PCV = 27.80) confirming the results of John *et al.* (2006) for late leaf spot disease severity, Misra *et al.* (2000) for reducing sugar and Venkataravana *et al.* (2007) for kernel yield and pod yield.

The coefficient of variation indicate the magnitude of variability present in population, hence selection may, therefore, be effective for these characters. High estimate of heritability was observed for late leaf spot severity (99.0%) followed by days to maturity (98.54%), reducing sugar (96.62%), non reducing sugar (96.36%), oil content (96.13%), pod yield per plant (89.23%), kernel yield per plant (86.0%), days to 50 per cent flowering (85.70%) and test weight (79.63%). High estimates of genetic advance as per cent of mean were recorded for late leaf spot severity (158.78%), reducing sugar (70.44%), pod yield (51.10%), kernel yield (50.93%), non reducing sugar (36.24%) and test weight (33.02%). High heritability coupled with high genetic advance as per cent of mean were obtained for late leaf spot severity, reducing sugar, pod yield, kernel yield, non reducing sugar and test weight indicating the presence of additive gene action suggesting the distinct possibility of improving these traits through selections. Similar findings were reported earlier by John *et al.* (2006) for late leaf spot severity, Chari (2005) for non reducing sugar and Venkataravana *et al.* (2007) for pod yield per plant, 100 kernel weight and kernel yield per plant.

The genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients suggesting strong inherent association among the character studied (Table 3). Pod yield exhibited positive significant associations with days to 50 per cent flowering, days to maturity, kernel yield, test weight and oil content. Similar kind of associations were reported by Mathews *et al.* (2000) for days to 50 per cent flowering, 100 kernel weight and kernel yield. But in the present investigation, the negative significant association of pod yield with late leaf spot disease severity and reducing sugar was observed confirming the earlier findings of Das and Roy (1995).The positive but non significant association exhibited by pod yield with harvest index, strong mature kernel, and non reducing sugar.

Table 3 : Estimates of genotypic and phenotypic correlation coefficients between pod yield and late leaf spot and its components in groundnut

Sr. No.	Characters		Days to maturity	Kernel yield / plant (g)	Test weight (g)	Shelling (%)	Oil content (%)	Strong mature kernel (%)	Harvest index (%)	Late leaf Spot severity (%)	Non reducing sugar (mg/g)	Reducing sugar (mg/g)	Pod yield/ plant (g)
1.	Days to 50 %	G	0.594*	0.639*	0.388	-0.197	0.458	0.181	-0.186	-0.774**	0.068	-0.493*	0.705**
	flowering	P	0.544**	0.530**	0.332*	-0.166	0.388*	0.149	-0.053	-0.713**	0.075	-0.43**	0.591 **
2.	Days to maturity	G		0.483*	0.352	-0.250	0.348	0.464 *	-0.160	-0.488*	0.524*	-0.298	0.557*
		P		0.446*	0.301*	-0.187	0.336*	0.341 *	-0.094	-0.484**	0.518**	-0.285*	0.518*
3.	Kernel yield/ plant	G			0.610*	0.163	0.763**	0.746	0.071	-0.805**	0.321	-0.569*	0.971 **
	(g)	P			0.588**	0.288*	0.707**	0.460**	0.045	-0.740**	0.283*	-0.51 **	0.915**
4.	Test weight (g)	G				-0.179	0.589*	0.786	-0.377	-0.530	0.169	-0.077	0.668*
		P				-0.048	0.523**	0.458**	-0.247	-0.466**	0.141	-0.065	0.595**
5.	Shelling (%)	G					0.010	0.016	0.126	0.092	0.126	0.125	-0.1 04
		P					0.0312	0.033	0.047	0.070	0.079	0.104	-0.056
6.	Oil content (%)	G						0.426	-0.1 08	-0.757**	0.423	-0.435	0.782**
		P						0.303*	-0.098	-0.738**	0.393**	-0.43**	0.729**
7.	Strong mature	G							0.019	-0.283	0.075	-0.219	0.781
	kernel (%)	P							0.013	-0.213	0.055	-0.141	0.451*
8.	Harvest index (%)	G								0.209	-0.190	-0.316	0.070
		P								0.1 09	-0.110	-0.211	0,0193
9.	Late leaf spot	G									-0.348	0.698**	-0.84**
	severity (%)	P									-0.344*	0.680**	-0.79**
10.	Non reducing	G										-0.116	0.281
	sugar (mg/g)	P										-0.083	0.261 *
11.	Reducing sugar	G											-0.598*
	(mg/g)	P											-0.55**

* and ** indicates significant of values at P=0.05 and 0.01, respectively
G = Genotypic correlation coefficient, P = Phenotypic correlation coefficient

The interrelationships were positive and significant among components of yield and late leaf spot characters like reducing sugar with late leaf spot disease severity, days to maturity with non reducing sugar, strong mature kernel with days to maturity, oil content with kernel yield and test weight, test weight with kernel yield and kernel yield with days to maturity and days to 50 per cent flowering. Similar kind of interrelationships have been reported by Lakshmidevamma *et al.* (2004) for days to 50 per cent flowering, days to maturity, test weight and kernel yield. Venkataramana (2001) also reported similar kind of results for oil content with 100 kernel weight, strong mature kernel and kernel yield. Late leaf spot and reducing sugar content showed significant negative association with days to 50 per cent flowering, days to maturity, kernel yield and oil content. Vasanthi *et al* (1998) also reported similar negative association of late leaf spot with days to 50 per cent flowering and days to maturity.

Path analysis gives a more realistic relationship of characters and helps to identify the effective components of pod yield in groundnut. A perusal of path coefficients (Table 4) among the characters which showed significant positive correlation with pod yield revealed that kernel yield per plant exerted the highest positive direct effect on pod yield. This is in accordance with earlier report of Lakshmidevamma *et al.* (2004), whereas shelling percentage exerted high but negative direct effect on pod yield. It was also observed that the high indirect effect was exerted through kernel yield per plant on pod yield through days to 50 per cent flowering, days to maturity, oil content, strong mature kernel and test weight. This is in accordance with the findings of Lakshmidevamma *et*

Table 4 : Direct (Diagonal) and indirect effect of yield and late leaf spot character on pod yield in groundnut

Sr. No.	Characters		Days to 50% flowering	Days to maturity	Kernel yield / plant (g)	Test weight (g)	Shelling (%)	Oil content (%)	Strong mature kernel (%)	Harvest index (%)	Late leaf spot severit	Non reducing sugar	Reducing sugar (mg/g)	Pod yield /plant (g)
1.	Days to 50 % flowering	G	**-0.0961**	0.0764	0.5838	-0.0481	0.0398	0.0440	0.0135	-0.0143	0.1957	-0.0123	-0.0879	0.7041
		P	**-0.0529**	0.0193	0.5111	-0.0088	0.0532	0.0156	0.0000	-0.0005	0.0922	-0.0047	-0.2083	0.5905
2.	Days to maturity	G	-0.0571	**0.1286**	0.4412	-0.0436	0.0506	0.0334	0.0346	-0.0141	0.1235	-0.0940	-0.0532	0.5574
		P	-0.0288	**0.0355**	0.4306	-0.0079	0.0601	0.0135	-0.0001	-0.0010	0.0626	-0.0324	-0.0183	0.5185
3.	Kernel yield/ plant	G	-0.0614	0.0621	**0.9140**	-0.0755	-0.0330	0.0733	0.0554	0.0079	0.2035	-0.0576	-0.1013	0.9719
		P	-0.0280	0.0158	**0.9646**	-0.0147	-0.0925	0.0284	-0.0001	0.0005	0.0957	-0.0177	-0.0332	0.9115
4.	Test weight (g)	G	-0.0373	0.0453	0.5571	**-0.1239**	0.0363	0.0565	0.0585	-0.0272	0.1340	-0.0302	-0.0137	0.6679
		P	-0.0175	0.0107	0.5830	**-0.0264**	0.0154	0.0210	-0.0001	-0.0027	0.0603	-0.0088	-0.0042	0.5945
5.	Shelling (%)	G	0.0189	-0.0322	0.1493	0.0222	**-0.2022**	0.0010	0.0010	0.0093	-0.0234	-0.0226	0.0223	-0.1045
		P	0.0088	-0.0066	0.2778	0.0013	**-0.3212**	0.0013	0.0000	0.0005	-0.0091	-0.0049	0.0067	-0.0560
6.	Oil content (%)	G	-0.0441	0.0448	0.6972	-0.0729	-0.0020	**0.0961**	0.0317	-0.0061	0.1915	-0.0760	-0.0776	0.7812
		P	-0.0205	0.0119	0.6816	-0.0138	-0.0100	**0.0402**	-0.0001	-0.0011	0.0955	-0.0246	-0.0280	0.7279
7.	Strong mature kernel (%)	G	-0.0175	0.0598	0.6810	-0.0975	-0.0028	0.0409	**0.0743**	0.0018	0.0717	-0.0 136	-0.0391	0.7805
		P	-00079	0.0121	0.4436	-0.0121	-0.0105	0.0122	**-0.0002**	0.0001	0.0275	-0.0035	-0.0091	0.4518
8.	Harvest index (%)	G	0.0160	-0.0210	0.0837	0.0392	-0.0220	-0.0068	0.0015	**0.0860**	-0.0397	0.0323	-0.0632	0.0704
		P	0.0027	-0.0034	0.0436	0.0065	-0.0154	-0.0039	0.0000	**0.0108**	-0.0142	0.0069	-0.0137	0.0193
9.	Late leaf spot severity	G	0.0744	-0.0628	-0.7353	0.0656	-0.0187	-0.0727	-0.0211	0.0135	**-0.2530**	**0.0625**	0.1243	-0.8437
		P	0.0377	-0.0172	-0.7139	0.0123	-0.0226	-0.0297	0.0000	0.0012	**-0.1294**	**0.0215**	0.0438	-0.7946
10.	Non reducing	Go	-0.0066	0.0674	0.2934	-0.0209	-0.0254	0.0407	0.0056	-0.0155	0.0881	-0.1795	**-0.0207**	0.2804
		P	-0.0.040	0.0184	0.2727	0.003 7	-0.0253	0.0158	0.0000	-0.0012	0.0445	-0.0626	**-0.0053**	0.2609
11.	Reducing sugar (mg/g)	G	0.0474	-0.0384	-0.5196	0.0096	-0.0253	-0.0418	-0.0163	-0.0305	-0.1765	0.0208	0.1781	**-0.5989**
		P	0.0232	-0.0101	-0.4971	0.0017	-0.0333	-0.0175	0:0000	-0.0023	-0.0880	0.0052	0.0644	**-0.5538**

Residual effect: Genotypic = 1.0192; Phenotypic = 0.2073. Diagonal entries (bold figures) are direct effects, off diagonal entries are indirect effect

al. (2004). Late leaf spot. disease severity also exerted negative direct as well as indirect effect through days to maturity, kernel yield per plant, shelling per cent and oil content on pod yield. High GCV, h^2 and GA for late leaf spot indicate additive gene action, which is amenable for selection for late leaf spot resistance. It is evident that kernel yield per plant emerged as major components of pod yield to emphasize selection. Since the characters *viz.*, oil content, strong mature kernel, days to 50 per cent flowering, days to maturity and non reducing sugar through kernel yield are also included in formulating the selection criterion for improving pod yield in groundnut.

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