

Original Research Article

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Correlation and Path Coefficient Analysis for Some Yield-Related Traits in Pomegranate (*Punica granatum* L.) under Mid-Hill Conditions of Himachal Pradesh, India

Suparna Sinha^{1*}, Dinesh Singh Thakur², Ankita Aman¹, R.R. Singh¹ and H. Mir¹

¹Department of Horticulture (Fruit and Fruit Tech.), Bihar Agricultural University, Sabour, Bhagalpur-813210, India

²Department of Horticulture, Dr. Y. S. P. U. H. & F, Nauni, Solan-173230, India

*Corresponding author

ABSTRACT

Keywords

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Twenty pomegranates (*Punica granatum* L.) accessions were studied to determine inter-relationship of traits as well as to study genetic variation among yield attribution traits to understand the usefulness of genotypes in the breeding programme. It establishes that among all the parameters analyzed, a significant genetic difference was present for yield and yield attribution traits for exotic germplasm of pomegranate under study.

Introduction

Considering the increasing world population, expanding pomegranate cultivation may contribute towards providing the effective source of food and nutritional security.

Therefore, to sustain pomegranate industry in non-traditional areas one of the strategies is attention should be given on germplasm introduction. The pomegranate possesses a low genetic base and variability in India with a wide scope of being improved further, through

a conventional or non-conventional method of breeding.

Characters of exotic germplasm of pomegranate are of great interest to breeder while those are complex in nature and also the result of the interaction of a number of components.

In the present study, an effort was represented to know the association and path analysis of component characters for fruit yield in pomegranate germplasms.

Table.1 Correlation coefficients at genotypic (G) and phenotypic (P) levels with respect to fruit weight and yield component traits in twenty exotic pomegranate germplasms

Character		Height of Plant (m)	N-s Sperad (m)	E-w (m)	Girth of Stem (mm)	Numbers of Stems	Fruit Length (mm)	Fruit diameter (mm)	Yield/ Plant kg	Rind Thickness (mm)	Arils/ Fruit	100 Arils Weight (g)	Aril/ Rind Ratio	Aril Length (mm)	Breadth (mm)	Juice %	TSS (%)	Tss/Acidity Ratio	Anthocyanins (mg/100g)	Phenols (mg/100g)	
Height of Plant (m)	G	1.0000																			
	P	1.0000																			
N-s Sperad (m)	G	0.9055	1.0000																		
	P	0.6297	1.0000																		
E-w (m)	G	1.0129	0.9098	1.0000																	
	P	0.6937	0.8839	1.0000																	
Girth of Stem (mm)	G	0.7120	0.4471	0.4757	1.0000																
	P	0.4895	0.4429	0.4696	1.0000																
Numbers of Stems	G	-0.9227	-0.9840	-0.9443	-0.9043	1.0000															
	P	0.1874	0.2577	0.2787	0.1795	1.0000															
Fruit Length (mm)	G	0.2439	0.0830	0.2256	0.0630	-0.8125	1.0000														
	P	0.4514	0.0691	0.1124	0.0244	-0.0544	1.0000														
Fruit diameter (mm)	G	0.2345	-0.0688	-0.0347	-0.0509	0.2953	0.9822	1.0000													
	P	0.1810	-0.0677	-0.0452	-0.0493	-0.0730	0.4793	1.0000													
Yield/ Plant kg	G	0.9940	0.7299	0.7960	0.4874	-0.9632	0.6488	0.3159	1.0000												
	P	0.6952	0.7228	0.7848	0.4865	0.1468	0.3194	0.3083	1.0000												
Rind Thickness (mm)	G	0.0869	0.0957	0.0355	-0.1233	-0.9694	0.5806	0.4587	0.1485	1.0000											
	P	0.0505	0.0876	0.0373	-0.1229	0.1604	0.2935	0.4501	0.1475	1.0000											
Arils/ Fruit	G	-0.0283	-0.0372	-0.0532	0.1478	-0.1735	0.0781	0.3611	-0.0932	0.2477	1.0000										
	P	-0.0204	-0.0353	-0.0558	0.1475	0.0142	0.0406	0.3536	-0.0925	0.2440	1.0000										
100 Arils Weight (g)	G	0.2192	0.0518	0.0907	-0.2460	0.7779	0.0747	-0.0730	0.3392	-0.1639	-0.6656	1.0000									
	P	0.1542	0.0506	0.0888	-0.2441	-0.0669	0.0526	-0.0667	0.3366	-0.1538	-0.6601	1.0000									
Aril/ Rind Ratio	G	-0.0620	-0.0134	-0.1538	0.3274	0.9030	-0.3986	-0.2761	0.0507	-0.3588	0.0730	0.0827	1.0000								
	P	-0.0410	-0.0125	-0.1524	0.3263	-0.1839	-0.1866	-0.2651	0.0506	-0.3537	0.0723	0.0841	1.0000								
Aril Length (mm)	G	0.3363	0.1874	0.2415	-0.1544	-0.1325	0.5106	0.5593	0.5969	0.3478	0.0182	0.3313	-0.1370	1.0000							
	P	0.1284	0.1703	0.2218	-0.1345	-0.0419	0.1849	0.5212	0.5305	0.3172	0.0123	0.2962	-0.1275	1.0000							
Breadth (mm)	G	0.9016	0.4491	0.4964	0.1499	-0.7308	0.9333	0.7409	0.9188	0.4160	-0.1092	0.4218	-0.0912	1.0849	1.0000						
	P	0.0510	0.2614	0.2966	0.0963	-0.0465	0.0123	0.4553	0.5560	0.2291	-0.0685	0.2484	-0.0579	0.6915	1.0000						
Juice %	G	0.4870	0.2177	0.2710	0.0600	0.9272	0.7003	0.2433	0.4517	-0.1539	-0.2397	0.2270	-0.0159	0.2472	0.4565	1.0000					
	P	0.3430	0.2159	0.2684	0.0593	-0.1397	0.3471	0.2347	0.4511	-0.1493	-0.2389	0.2269	-0.0147	0.2140	0.2634	1.0000					
TSS (%)	G	0.3759	0.2417	0.1049	0.2833	-0.8937	0.6139	0.4418	0.3014	0.1534	0.1553	-0.1846	-0.0658	0.3256	0.4417	0.2799	1.0000				
	P	0.1702	0.2311	0.0916	0.2689	0.0013	0.2247	0.3960	0.2856	0.1329	0.1500	-0.1782	-0.0660	0.2719	0.3225	0.2622	1.0000				
Tss/Acidity Ratio	G	0.5652	-0.0180	0.0892	0.2724	0.6723	0.8415	0.3420	0.4803	-0.1674	-0.1936	0.4404	0.2401	0.3828	0.5975	0.5437	0.4904	1.0000			
	P	0.1523	-0.0145	0.0575	0.2291	-0.1091	0.1566	0.2651	0.3880	-0.1511	-0.1605	0.3467	0.1851	0.3748	0.5620	0.4413	0.3948	1.0000			
Anthocyanins (mg/100g)	G	0.0293	0.2662	0.2733	-0.0143	0.4974	0.0327	0.0530	0.1522	0.0135	-0.1315	-0.1659	-0.1209	0.0686	0.2358	0.0635	-0.3428	-0.2314	1.0000		
	P	0.0488	0.2655	0.2704	-0.0151	-0.0514	0.0579	0.0504	0.1525	0.0140	-0.1307	-0.1640	-0.1200	0.0500	0.1011	0.0645	-0.3305	-0.2127	1.0000		
Phenols (mg/100g)	G	-0.1620	0.1479	0.0517	0.0197	0.0286	-0.1211	-0.2086	-0.0929	0.2331	0.2752	-0.3605	0.2298	-0.1184	-0.3376	-0.3991	0.0419	-0.5074	0.0005	1.0000	
	P	-0.1133	0.1483	0.0489	0.0199	0.0088	-0.0596	-0.2031	-0.0924	0.2295	0.2753	-0.3569	0.2293	-0.1044	-0.2021	-0.3975	0.0375	-0.4136	0.0005	1.0000	
Fruit Weight (g)	G	0.4386	0.0717	0.1754	-0.0342	0.9886	0.5955	0.5879	0.3864	0.0963	0.3625	0.2741	-0.0690	0.3659	0.4748	0.1823	0.0260	0.2610	-0.1099	-0.1429	
	P	0.3415	0.0749	0.1751	-0.0341	-0.1136	0.3333	0.5748	0.3831	0.0925	0.3584	0.2697	-0.0673	0.3251	0.2547	0.1809	0.0121	0.1956	-0.1022	-0.1407	

*For value > 0.378 & ** for value > 0.586

Table.2 Estimates of direct and indirect effects of different twenty traits on fruit weight of pomegranate germplasm

No	Character	Height of Plant (m)	N-s Sperad (m)	E-w(m)	Girth of Stem (mm)	Number of Stems	Fruit Length (mm)	Fruit diameter (mm)	Yield/ Plant kg	Rind Thickness (mm)	Arils/ Fruit	100 Arils Weight (g)	Aril/ Rind Ratio	Aril Length (mm)	Breadth (mm)	Juice%	TSS(%)	Tss/Acidity Ratio	Antho cyanins (mg/100g)	Phenols (mg/100g)	r _{xy}		
		X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19			
X1	Height of Plant(m)	-0.3313	-0.1664	0.8349	0.4641	0.0460	-0.0237	0.2180	-0.8046	-0.0037	-0.0289	0.3626	0.0091	0.0506	-0.3606	0.2276	0.0001	-0.0113	0.0074	-0.0511	0.4386		
X2	N-sSperad (m)	-0.3000	-0.1838	0.7499	0.2914	0.0475	-0.0081	-0.0640	-0.5908	-0.0041	-0.0380	0.0857	0.0020	0.0282	-0.1603	0.1017	0.0000	0.0004	0.0673	0.0467	0.0717		
X3	E-w(m)	-0.3356	-0.1672	0.8242	0.3101	0.0561	-0.0219	-0.0322	-0.6443	-0.0015	-0.0544	0.1501	0.0227	0.0363	-0.1772	0.1266	0.0000	-0.0018	0.0691	0.0163	0.1754		
X4	Girth of Stem(mm)	-0.2359	-0.0822	0.3921	0.6518	0.0384	-0.0061	-0.0473	-0.3945	0.0053	0.1510	-0.4070	-0.0482	-0.0232	-0.0535	0.0280	0.0000	-0.0054	-0.0036	0.0062	-0.0342		
X5	Numbers of Stems	0.6370	0.3647	-1.9322	-1.0457	-0.0239	0.0790	0.2745	1.0225	0.0717	-0.1773	1.2870	-0.2508	-0.0199	0.2608	0.6201	-0.0001	-0.0134	0.1257	0.0090	0.9886		
X6	Fruit Length (mm)	-0.0808	-0.0153	0.1859	0.0411	0.0195	-0.0972	0.9130	-0.5252	-0.0249	0.0798	0.1236	0.0587	0.0768	-0.4401	0.3272	0.0001	-0.0168	0.0083	-0.0382	0.5955		
X7	Fruit Diameter (mm)	-0.0777	0.0127	-0.0286	-0.0332	-0.0071	-0.0955	0.9296	-0.2557	-0.0197	0.3689	-0.1208	0.0407	0.0841	-0.2644	0.1137	0.0001	-0.0068	0.0134	-0.0658	0.5879		
X8	Yield/Plant kg	-0.3294	-0.1342	0.6561	0.3177	0.0303	-0.0631	0.2937	-0.8094	-0.0064	-0.0952	0.5611	-0.0075	0.0898	-0.3279	0.2111	0.0001	-0.0096	0.0385	-0.0293	0.3864		
X9	Rind Thickness (mm)	-0.0288	-0.0176	0.0293	-0.0804	0.0400	-0.0564	0.4264	-0.1202	-0.0429	0.2531	-0.2712	0.0529	0.0523	-0.1485	-0.0719	0.0000	0.0033	0.0034	0.0735	0.0963		
X10	Arils/Fruit	0.0094	0.0068	-0.0439	0.0963	0.0042	-0.0076	0.3357	0.0754	-0.0106	1.0216	-1.1012	-0.0107	0.0027	0.0390	-0.1120	0.0000	0.0039	-0.0332	0.0868	0.3625		
X11	100Arils Weight(g)	-0.0726	-0.0095	0.0748	-0.1604	-0.0186	-0.0073	-0.0679	-0.2745	0.0070	-0.6800	1.6544	-0.0122	0.0498	-0.1505	0.1061	0.0000	-0.0088	-0.0419	-0.1138	0.2741		
X12	Aril/Rind Ratio	0.0205	0.0025	-0.1268	0.2134	-0.0408	0.0388	-0.2567	-0.0411	0.0154	0.0745	0.1369	-0.1473	-0.0206	0.0326	-0.0074	0.0000	-0.0048	-0.0306	0.0725	-0.069		
X13	Aril Length (mm)	-0.1114	-0.0345	0.1990	-0.1007	0.0032	-0.0496	0.5199	-0.4832	-0.0149	0.0186	0.5481	0.0202	0.1504	-0.3872	0.1155	0.0001	-0.0076	0.0174	-0.0374	0.3659		
X14	Breadth (mm)	-0.3349	-0.0826	0.4092	0.0977	0.0175	-0.1199	0.6888	-0.7437	-0.0179	-0.1116	0.6978	0.0134	0.1632	-0.3569	0.2133	0.0001	-0.0119	0.0596	-0.1065	0.4748		
X15	Juice%	-0.1614	-0.0400	0.2234	0.0391	-0.0318	-0.0681	0.2262	-0.3656	0.0066	-0.2449	0.3756	0.0023	0.0372	-0.1629	0.4673	0.0000	-0.0108	0.0161	-0.1259	0.1823		
X16	TSS(%)	-0.1245	-0.0444	0.0865	0.1846	0.0214	-0.0597	0.4107	-0.2440	-0.0066	0.1587	-0.3054	0.0097	0.0490	-0.1576	0.1308	0.0002	-0.0098	-0.0867	0.0132	0.0260		
X17	Tss/Acidity Ratio	-0.1873	0.0033	0.0736	0.1776	-0.0161	-0.0818	0.3179	-0.3888	0.0072	-0.1978	0.7286	-0.0354	0.0576	-0.2132	0.2541	0.0001	-0.0199	-0.0585	-0.1601	0.2610		
X18	Anthocyanins (mg/100g)	-0.0097	-0.0489	0.2253	-0.0093	-0.0119	-0.0032	0.0493	-0.1232	-0.0006	-0.1343	-0.2745	0.0178	0.0103	-0.0842	0.0297	-0.0001	0.0046	0.2528	0.0002	-0.1099		
X19	Phenols (mg/100g)	0.0537	-0.0272	0.0426	0.0129	-0.0007	0.0118	-0.1939	0.0752	-0.0100	0.2811	-0.5965	-0.0339	-0.0178	0.1205	-0.1865	0.0000	0.0101	0.0001	0.3155	-0.1429		
																					R ²	0.6931	
																						R.E.	0.7208

Materials and Methods

Twenty pomegranate germplasm having diversity for various morphological characters (during flowering, growth condition of the plant, fruits, and quality) were taken in a randomized block design with three replication at Experimental farm of Fruit Science, Dr. Y. S. Parmar University of Horticulture and Forestry, Nauni, Solan (Himachal Pradesh, India) during 2013. Plant protection means were also applied uniformly for all the plots during the period of the experiment. Five representative fruits were taken in each replicates at optimum maturity. The phenotypic and genotypic correlation coefficients were estimated as per Burton (1952). Direct and indirect paths analyses at a genotypic level were obtained by according to Dewey and Lu (1959).

Results and Discussion

Commonly, the value of genotypic correlations is greater than phenotypic correlations (Table 1). This indicates that there are inherent associations among various traits and environment had not played much sole in reducing their actual association. Fruit weight showed positive and significant correlations number of stems at genotypic level. Ece and Darakci (2007) in tomato reported positive correlations of fruit weight with number of stem. Also, Fruit diameter had positive and highly significant correlation with fruit weight at phenotypic and genotypic levels. Positive association of fruit weight with fruit diameter have been reported by Pandey and Bist (1998). Hence, selection of germplasm(s) with number of stems per plant, and fruit diameter would be effective to obtain higher fruit weight.

Path coefficient analysis provides a realistic ground for allocation of appropriate weightage to different independent traits

while designing a pragmatic plan for improving fruit weight. The data on path coefficient analysis at genotypic level showed the direct and indirect effects of important traits over fruit weight had been presented in Table 2. The data revealed that fruit weight has a maximum positive direct effect on 100 arils weight (1.6544) followed by arils/fruit (1.0216), fruit breadth (0.9296), E-W spread (0.8242), girth of stems (0.6518), juice % (0.4673) and phenols (0.3155). Maximum negative effect of yield (-0.8094), aril breadth (-0.3569) and height of plant (-0.3313) was observed on fruit weight. The residual effect value (0.7208) shows that there are few other possible independent traits which were not included in this study. By path coefficient analysis observation, it can be concluded that these traits could be utilized by breeders as selection criteria to select the accessions influencing fruit weight. The direct effect of yield is negative for fruit weight, but the correlation coefficient is positive which shows we can get best results by applying selection indices.

Path analysis revealed that 100 arils weight followed by arils/fruit, fruit breadth, E-W spread, girth of stem, juice %, and phenols are the strongest forces influencing fruit weight.

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