Ann. Agric. Res. New Series Vol. 43 (4) : 492-498 (2022)

Correlation and path coefficient analysis for quality and yield contributing parameters in chrysanthemum (*Dendranthema grandiflora* Tzvelev)

Maya Priya[1], Deepti Singh[2] and Priyanka Kumari

Department of Horticulture, Bihar Agricultural University, Sabour, Bhagalpur
E-mail: singh.deepti2008@gmail.com

Received: May 2022; Revised Accepted: October 2022

Abstract

Correlation and path analysis were carried out in twenty genotypes of chrysanthemum (*Dendranthema grandiflora* Tzvelev) for different quality and yield attributing traits. Among twenty two different parameters to differentiate the contribution made by each parameter in the final flower yield. The results revealed that the genotypic correlation were higher than the phenotypic correlation for the characters obtained, indicating the high heritable nature of the characters. Number of flowers per plant (0.394,0.393) and average fresh weight of flower (0.488, 0.487)were reported highly significant and positive correlation with flower yield per plant and number of ray florets (0.296,0.300) significant and positive correlation with flower yield per plant at both genotypic and phenotypic level, respectively. Since these association are in desirable direction and selection of these traits may ultimately improve the yield. Path coefficient result revealed that characters like number of flowers per plant (1.525, 0.845), number of leaves per plant (0.891, 0.673), average fresh weight of flower (0.754, 0.041) and number of ray florets (0.739, 0.424) were showed direct positive effect towards flower yield per plant at both phenotypic and genotypic level, respectively through facilitates the selection of superior genotypes of chrysanthemum.

Keywords: Chrysanthemum, Correlation, Path coefficient.

Chrysanthemum (*Dendranthema grandiflora* Tzvelev) is the leading commercial flower crop grown for cut, loose flowers and pot plants. It is commercially known as 'Queen of East', 'Autumn Queen' and 'Guldaudi'. The genus Chrysanthemum belongs to the family 'Asteraceae'. It ranks second in the international cut flower trade. In India, its germplasm has been screened but the information on the performance for the higher yield of the cut flower and yield contributing parameters of Chrysanthemum is meagre. Many cultivars have been developed from local material collected from different parts of the country. In spite of varietal development there is need to develop genotypes with still better yield, quality and their adaptation under different environment. A variety may perform well only in a particular environment and therefore the genetic potentiality of different genotypes and their interaction with environmental condition are to be established and according to their performance, selection of best growth and flowering traits genotype needs to be done. The wide range of groups and varieties of this flower made the workers research more complex. Its flower yield is a complex character and is the result of interrelation-ship of various components. Correlation and path coefficient analysis furnishes information regarding the nature and magnitude of various associations and help in the measurement of direct influence of one variable on others. The correlation coefficient indicates the degree of relationship between char-

acters. The type of association between flower yield and yield attributes to judge the direct and indirect influences of flower yield components through path coefficient analysis for selecting suitable genotypes for improving the flower yield

Materials and Methods

The present study was conducted was at College Garden of Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India during winter season, 2020-21. Bihar Agricultural University is located in Bhagalpur district of Bihar. Latitudinal existence of BAU is on the latitude of 25° 15′ 40′′ North and longitudinally the location is of 80° 2′ 42′′ east. It is located on the vast Indo-Gangetic plains of north India at an altitude of 46 meter above mean sea level. The experiment was laid out in Completely Randomized Design (CRD) with three replications. The experiment was conducted in pots using soil, sand, FYM, leaf mould (2:1:1:1) was used for growing in pots. Rooted cutting planted in the pot. Uniform recommended package of practices were followed along with nutritional application and normal irrigation. Pinching was done at 30 days after planting by removing the terminal portion of the plants. The data on plant height at Harvesting stage (cm), number of secondary branches/ plant, number of leaves/ plant, leaf biomass (g), stem diameter (cm), plant spread (cm), days taken to first flower bud appearance, days taken to first flower opening, days taken for full blooming, flower duration (days), flower longevity (days), flower diameter (cm), number of ray florets, flower peduncle length (cm) and flower yield/plant (g)were recorded. Correlation coefficient and path analysis were computed by the formula suggested by Al-Jibauri *et al*., 1958, Dewey and Lu, 1959.

Results and Discussion

Correlation coefficient

The correlation coefficient between different characters in chrysanthemum depicted in Table 1. In majority of the characters genotypic correlation coefficient was greater than phenotypic correlation coefficient, indicating a strong inherent association among various characters but their phenotypic expression was impeded by the influence of environmental factors.Table1 revealed that at phenotypic level, plant height at first bud appearance showed highly significant and positive correlation with plant height at harvesting stage (0.738), number of secondary branches per plant(0.414), inter nodal length (0.510), plant spread (0.348), flower duration (0.366), number of flowers per plant (0.504) and vase/shelf life (0.414)Similar results were concluded by finding by Suvija *et al*., 2016, Kaur *et al*., 2018, Mishra *et al*., 2013, Bindhushree *et al.,* 2019 and Sahu and Sharma, 2014.whereas highly significant but negative correlation was observed with average fresh weight of flower (-519) and significant and negative correlation with flower diameter (-0.282).

Plant height at harvesting stage exhibited highly significant and positive correlation with number of secondary branches per plant (0.592), plant spread (0.331), number of flowers per plant (0.450) and vase/ shelf life (0.417),similar result finding by Suvija *et al*., 2016, Kaur *et al*., 2018, Mishra *et al.,* 2013, Bindhushree *et al*., 2019 and Sahu and Sharma, 2014, whereas significant and positive correlation with days taken to flower bud appearance (0.275), flower duration (0.270) and significant and negative correlation with average fresh weight of flower(-0.308). Number of primary branches per plant recorded highly significant and positive correlation with number of flowers per plant (0.406), whereas significant and positive correlation was seen with average fresh weight of leaves (0.318) and highly significant but negative correlation with flower diameter (-0.331), number of ray florets (-0.679) and average fresh weight of flower (-0.402).

Number of primary branches per plant recorded highly significant and positive correlation with number of flowers per plant (0.406), whereas significant and positive correlation was seen with average fresh weight of leaves (0.318) and highly significant and negative correlation with flower diameter (-0.331), number of ray florets (-0.679) and fresh weight of flower (-0.402).Number of secondary branches per plant showed highly significant and positive correlation with number of flowers per plant (0.531), vase/ shelf life (0.402), whereas significant positive correlation with plant

Table4.1. Genotypic and phenotypic correlation among vegetative attributes for twenty-two characters of twenty genotypes of chrysanthemum.

PHB- Plant height at first bud appearance (cm), PHH- Plant height at harvesting stage (cm), PB/P- Number of primary branches per plant, SB/P- Number of secondary branches per plant, L/P- Number of leaves per plant, IL-

Trait		PHH	PB/P	SB/P	L/P	LB	IL	SD	PS	FWL
PHB	P	0.738**	0.215NS	0.414**	-0.042NS	-0.077NS	0.510**	0.061NS	0.348**	0.042NS
	G	0.749**	0.232NS	0.443**	-0.051NS	-0.099NS	0.565**	0.086NS	0.421**	0.029NS
PHH	P		0.068NS	0.592**	-0.195NS	-0.162NS	0.101NS	0.157NS	0.331**	0.064NS
	G		0.074NS	0.630**	-0.222NS	-0.203NS	0.116NS	0.189NS	0.401**	0.050NS
PB/P	P			0.190NS	-0.100NS	0.087NS	0.127NS	0.025NS	-0.048NS	0.318*
	G			0.190NS	-0.103NS	0.091NS	0.134NS	0.035NS	-0.059NS	0.329*
SB/P	P				0.033NS	-0.230NS	0.006NS	0.198NS	0.316*	-0.216NS
	G				0.033NS	-0.244NS	0.004NS	0.215NS	0.343**	-0.229NS
L/P	P					0.553**	-0.048NS	0.168NS	0.196NS	-0.418**
	G					0.554**	-0.048NS	0.176NS	0.218NS	-0.431**
LB	P						-0.067NS	0.059NS	-0.102NS	0.470**
	G						-0.074NS	0.065NS	-0.164NS	0.457**
IL	P							-0.104NS	0.011NS	0.080NS
	G							-0.128NS	-0.001NS	0.077NS
SD	P								0.196NS	-0.175NS
	G								0.219NS	-0.185NS
PS	P									-0.227NS
	G									-0.300*

Trait		FBA	FFO	FB	FDU	FL	FDI	F/P	RF	FFW	FPL	VL/SL	FY/P
PHB	P	0.157NS	0.027NS	-0.088NS	0.366**	0.052NS	-0.282*	0.504**	-0.073NS	-0.519**	-0.243NS	0.414**	-0.084NS
	G	0.175NS	0.066NS	-0.117NS	0.497**	0.079NS	-0.315*	0.555**	-0.076NS	-0.567**	-0.279*	0.475**	0.186NS
PHH	P	0.275*	0.179NS	0.045NS	0.270*	-0.004NS	-0.144NS	0.450**	-0.080NS	-0.308*	-0.209NS	0.417**	0.135NS
	G	0.316*	0.289*	0.058NS	0.357**	-0.047NS	-0.158NS	0.485**	-0.100NS	-0.339**	-0.236NS	0.443**	0.334**
PB/P	P	0.022NS	-0.222NS	-0.120NS	0.037NS	-0.166NS	-0.331**	0.406**	-0.679**	-0.402**	-0.243NS	-0.164NS	-0.213NS
	G	0.017NS	-0.288*	-0.141NS	0.055NS	-0.183NS	-0.335**	0.410**	-0.698**	-0.406**	-0.248NS	-0.164NS	-0.217NS
SB/P	P	0.003NS	-0.060NS	-0.046NS	0.097NS	0.234NS	-0.148NS	0.531**	-0.190NS	-0.168NS	-0.284*	0.402**	0.137NS
	G	0.001NS	-0.082NS	-0.055NS	0.103NS	0.265*	-0.152NS	0.534**	-0.193NS	-0.169NS	-0.304*	0.411**	0.138NS
L/P	P	0.089NS	0.058NS	0.193NS	0.063NS	0.073NS	-0.047NS	0.059NS	0.221NS	0.013NS	-0.072NS	-0.437**	0.043NS
	G	0.092NS	0.090NS	0.235NS	0.072NS	0.075NS	-0.048NS	0.062NS	0.229NS	0.011NS	-0.073NS	-0.447**	0.043NS
LB	P	0.260*	-0.008NS	0.219NS	0.126NS	0.191NS	-0.077NS	-0.065NS	0.200NS	0.032NS	0.072NS	-0.446**	0.160NS
	G	0.262*	-0.034NS	0.257*	0.130NS	0.204NS	-0.083NS	-0.064NS	0.209NS	0.030NS	0.077NS	-0.467**	0.160NS
IL	P	-0.233NS	-0.183NS	-0.252NS	0.179NS	0.066NS	-0.049NS	0.107NS	-0.023NS	-0.163NS	-0.161NS	0.494**	-0.143NS
	G	-0.250NS	-0.250NS	-0.350**	0.180NS	0.097NS	-0.050NS	0.109NS	-0.026NS	-0.166NS	-0.171NS	0.505**	-0.146NS
SD	P	0.076NS	-0.104NS	-0.264*	0.306*	0.133NS	-0.229NS	0.103NS	0.016NS	-0.229NS	-0.181NS	-0.221NS	-0.150NS
	G	0.066NS	-0.177NS	-0.446**	0.343**	0.187NS	-0.243NS	0.109NS	0.005NS	-0.241NS	-0.206NS	-0.235NS	-0.156NS
PS	P	-0.086NS	-0.054NS	-0.048NS	0.004NS	0.077NS	-0.077NS	0.430**	0.206NS	-0.010NS	0.065NS	-0.099NS	0.209NS
	G	-0.167NS	-0.228NS	-0.186NS	0.043NS	0.058NS	-0.080NS	0.486**	0.220NS	-0.014NS	0.129NS	-0.130NS	0.235NS
FWL	P	0.027NS	-0.202NS	-0.082NS	-0.039NS	0.136NS	0.036NS	-0.037NS	-0.124NS	0.136NS	0.106NS	-0.019NS	0.218NS
	G	0.006NS	-0.311*	-0.135NS	-0.059NS	0.149NS	0.034NS	-0.036NS	-0.130NS	0.137NS	0.108NS	-0.021NS	0.221NS
FBA	P		0.679**	0.658**	0.452**	0.151NS	-0.095NS	0.117NS	-0.135NS	-0.404**	0.216NS	0.013NS	-0.039NS
	G		0.793**	0.783**	0.528**	0.196NS	-0.100NS	0.123NS	-0.151NS	-0.425**	0.240NS	0.006NS	-0.040NS
FFO	P			0.795**	0.002NS	-0.025NS	0.210NS	-0.179NS	-0.101NS	-0.198NS	0.324*	0.184NS	-0.188NS
	G			0.875**	0.060NS	-0.062NS	0.274*	-0.244NS	-0.133NS	-0.262*	0.397**	0.243NS	-0.254NS
FB	P				-0.028NS	0.007NS	0.159NS	-0.093NS	-0.040NS	-0.108NS	0.425**	0.050NS	-0.013NS
	G				-0.032NS	0.001NS	0.212NS	-0.116NS	-0.041NS	-0.152NS	0.573**	0.051NS	-0.17NS
FDU	P					0.151NS	-0.399**	0.360**	0.088NS	-0.461**	-0.290*	0.025NS	-0.037NS
	G					0.196NS	-0.466**	0.417**	0.105NS	-0.523**	-0.359**	0.024NS	-0.036NS
FL	P						0.254*	-0.023NS	0.031NS	0.201NS	0.252NS	0.199NS	0.069NS
	G						0.280*	-0.019NS	0.034NS	0.223NS	0.349**	0.222NS	0.077NS
FDI	P							-0.444**	0.019NS	0.738**	0.440**	0.272*	0.240NS
	G							-0.447**	0.021NS	0.742**	0.461**	0.280*	0.242NS
F/P	P								-0.232NS	-0.382**	-0.426**	-0.029NS	0.394**
	G								-0.238NS	-0.383**	-0.451**	-0.030NS	0.393**
RF	P									0.265*	0.088NS	-0.075NS	0.296*
	G									0.270*	0.093NS	-0.088NS	0.300*
FFW	P										0.225NS	-0.005NS	0.488**
	G										0.235NS	-0.006NS	0.487**
FPL	P											0.008NS	-0.063NS
	G											0.001NS	-0.068NS
VL/SL	P												-0.076NS
	G												-0.081NS
FY/P	P												-
	G												-

Internodal length (cm), SD- Stem diameter(cm), PS- Plant spread (cm), FWL- Average fresh weight of leaves (g), FBA- Days taken to first flower bud appearance,, FFO- Days taken to first flower opening, FB- Days taken for full blooming, FDU- Flower duration (days), FL- Flower longevity (days), FD- Flower diameter (cm), F/P- Number of flowers per plant, RF- Number of ray florets, FFW- Average fresh weight of flower(g), FPL- Flower peduncle length (cm), VL/SL- Vase life/ Shelf life, FY/P- Flower yield per plant (g)

spread (0.316) and significant negative correlation with flower peduncle length (-0.284).similar observation resulted by Mishra *et al.*, 2013, Kaur *et al.*, 2018, Prakash *et al.*, 2018, Baskaran *et al.*, 2004 and Kumar *et al.*, 2018.

Number of leaves per plant noticed highly significant and positive correlation with leaf biomass (0.553), whereas highly significant and negative significant correlation with average fresh weight of leaf (-0.418) and vase/ shelf life (-0.437).

Leaf biomass showed highly significant and positive correlation with average fresh weight of leaf (0.470), whereas significant and positive correlation with days taken to flower bud appearance (0.260) and highly significant and negative correlation with vase/ shelf life (-0.446). Internodal length was highly significant and positive correlation with vase/ shelf life (0.494).

Stem diameter showed significant and positive correlation with flower duration (0.306), whereas significant and negative correlation with days taken for full blooming (-0.264). Plant spread obtained highly significant and positive correlation with number of flowers per plant (0.430). Average fresh weight of leaf had no significant positive and negative correlation with other traits.

Days taken to first flower bud appearance recorded highly significant and positive correlation with days taken to first flower opening (0.679), days taken to full blooming (0.658), flower duration (0.452), whereas highly significant and negative correlation with average fresh weight of flower (-

Table 2. Direct and 1ndirect effects of different trait on flower yield per plant of twenty genotypes of chrysanthemum at genotypic level

Traits	PHB	PHH	PB/P	SB/P	L/P	LB	IL	SD	PS	FWL	FBA	FO	FB	FDU	FL	FD	F/P	RF	FWF	FPL	VL/SL	r
PHB	**-0.184**	0.548	0.039	-0.170	-0.045	0.091	-0.049	0.023	-0.442	0.020	-0.124	0.022	-0.023	0.036	0.010	0.041	0.845	-0.055	-0.427	-0.172	-0.070	0.186
PHH	-0.137	**0.732**	0.012	-0.242	-0.198	0.188	-0.010	0.051	-0.420	0.035	-0.225	0.099	0.011	0.026	-0.006	0.020	0.739	-0.074	-0.255	-0.145	-0.065	0.334**
PB/P	-0.042	0.054	**0.172**	-0.073	-0.091	-0.084	-0.011	0.009	0.062	0.230	-0.011	-0.099	-0.028	0.003	-0.024	0.043	0.625	-0.516	-0.306	-0.153	0.024	-0.217
SB/P	-0.081	0.461	0.032	**-0.385**	0.029	0.225	-0.001	0.058	-0.360	-0.160	-0.001	-0.028	-0.011	0.007	0.034	0.019	0.814	-0.142	-0.127	-0.187	-0.060	0.138
L/P	0.009	-0.1629	-0.017	-0.012	**0.891**	-0.513	0.004	0.047	-0.229	-0.302	-0.065	0.030	0.047	0.005	0.009	0.006	0.095	0.169	0.008	-0.045	0.066	0.043
LB	0.018	-0.148	0.015	0.093	0.494	**-0.926**	0.006	0.017	0.172	0.320	-0.186	-0.0118	0.052	0.009	0.026	0.010	-0.098	0.154	0.022	0.047	0.069	0.160
IL	-0.104	0.084	0.023	-0.001	-0.042	0.068	**-0.087**	-0.034	0.001	0.054	0.178	-0.086	-0.071	0.013	0.012	0.006	0.165	-0.019	-0.125	-0.105	-0.075	-0.146
SD	-0.015	0.138	0.006	-0.082	0.156	-0.06	0.011	**0.272**	-0.230	-0.129	-0.04	-0.060	-0.090	0.025	0.024	0.031	0.165	0.003	-0.181	-0.127	0.034	-0.156
PS	-0.077	0.293	-0.010	-0.132	0.194	0.152	0.001	0.059	**-1.051**	-0.210	0.118	-0.078	-0.037	0.003	0.007	0.010	0.741	0.162	-0.010	0.079	0.019	0.235
FWL	-0.005	0.036	0.056	0.088	-0.384	-0.423	-0.006	-0.050	0.315	**0.700**	-0.004	-0.10	-0.027	-0.004	0.019	-0.004	-0.055	-0.09	0.103	0.066	0.003	0.221
FBA	-0.032	0.231	0.002	-0.001	0.082	-0.242	0.021	0.018	0.175	0.004	**-0.713**	0.273	0.158	0.038	0.025	0.013	0.187	-0.111	-0.321	0.148	-0.001	-0.040
FO	-0.012	0.212	-0.049	0.031	0.080	0.031	0.021	-0.048	0.239	-0.217	-0.565	**0.344**	0.177	0.004	-0.008	-0.035	-0.372	-0.098	-0.198	0.245	-0.036	-0.254
FB	0.021	0.042	-0.024	0.021	0.209	-0.237	0.030	-0.121	0.195	-0.094	-0.559	0.301	**0.202**	-0.002	0.001	-0.027	-0.176	-0.030	-0.114	0.354	-0.007	-0.017
FDU	-0.091	0.261	0.009	-0.039	0.064	-0.120	-0.015	0.093	-0.044	-0.041	-0.377	0.020	-0.006	**0.073**	0.025	0.060	0.636	0.077	-0.394	-0.221	-0.003	-0.036
FL	-0.014	-0.034	-0.031	-0.102	0.067	-0.188	-0.008	0.050	-0.061	0.104	-0.139	-0.021	0.000	0.014	**0.131**	-0.036	-0.029	0.025	0.168	0.215	-0.032	0.077
FD	0.058	-0.116	-0.057	0.058	-0.042	0.076	0.0043	-0.066	0.084	0.023	0.071	0.094	0.042	-0.034	0.036	**-0.130**	-0.681	0.015	0.560	0.284	-0.041	0.242
F/P	-0.102	0.355	0.070	-0.205	0.055	0.059	-0.009	0.029	-0.510	-0.025	-0.087	-0.084	-0.023	0.030	-0.002	0.058	**1.525**	-0.17	-0.289	-0.278	0.004	0.393**
RF	0.013	-0.073	-0.120	0.074	0.204	-0.193	0.002	0.001	-0.230	-0.091	0.107	-0.045	-0.008	0.007	0.004	-0.002	-0.363	**0.739**	0.204	0.057	0.013	0.300*
FWF	0.104	-0.248	-0.069	0.065	0.010	-0.027	0.014	-0.065	0.014	0.096	0.303	-0.090	-0.030	-0.038	0.029	-0.096	-0.584	0.199	**0.754**	0.145	0.001	0.487**
FPL	0.051	-0.172	-0.042	0.116	-0.065	-0.071	0.015	-0.056	-0.136	0.075	-0.171	0.136	0.116	-0.026	0.045	-0.060	-0.687	0.068	0.177	**0.617**	-0.001	-0.068
VL/SL	-0.087	0.324	-0.028	-0.158	-0.398	0.432	-0.044	-0.064	0.136	-0.014	-0.004	0.083	0.010	0.001	0.029	-0.036	-0.046	-0.065	-0.004	0.001	**-0.148**	-0.081

Unexplained variation-0.13401

PHB- Plant height at first bud appearance (cm), **PHH**- Plant height at harvesting stage (cm), **PB/P**- Number of primary branches per plant, **SB/P**- Number of secondary branches per plant, **L/P**- Number of leaves per plant, **LB**- Leaf biomass, **IL**- Internodal length (cm), **SD**- Stem diameter(cm), **PS**- Plant spread (cm), **FWL**-Average fresh weight of leaf (g), **FBA**- Days taken to first flower bud appearance,**FFO**- Days taken to first flower opening, **FB**- Days taken to full blooming, **FDU**- Flower duration (days), **FL**- Flower longevity (days), **FD**- Flower diameter (cm), **F/P**- Number of flowers per plant, **RF**- Number of ray florets, **FFW**- Average fresh weight of flower(g), **FPL**- Flower peduncle length (cm), **VL/SL**- Vase life/ Shelf life, **FY/P**- Flower yield per plant (g)

0.404). Days taken to first flower opening showed highly significant and positive correlation with days taken for full blooming (0.795), similar result were noticed by Kumar *et al*., 2012, Kaur *et al*., 2018, Suvija *et al*., 2016,whereas significant and positive correlation with flower peduncle length (0.324). Days taken for full blooming exhibited highly significant and positive correlation with flower peduncle length (0.425).

Flower duration reported highly significant and positive correlation with number of flowers per plant (0.360), whereas highly significant and negative correlation with flower diometer, (-0.399), average fresh weight of flower (-0.461) and significant and negative correlation with flower peduncle length (-0.290). Flower longevity showed significant and positive correlation with flower diometer (0.254).

Flower diameter exhibited highly significant and positive correlation with average fresh weight of flowers (0.738), flower peduncle length (0.440), whereas significant and positive correlation with vase/ shelf life (0.272) and highly and negative significant correlation with number of flowers per plant (-0.444). Number of flowers per plant showed highly significant and positive correlation with flower yield per plant (0.394), whereas highly significant and negative correlation with average fresh weight of flowers (-0.382), flower peduncle length (-0.426).

Number of ray florets exhibited significant and positive

Table 3: Direct and indirect effects of different trait on flower yield per plant of twenty genotypes of chrysanthemum at phenotypic level

Traits	PHB	PHH	PB/P	SB/P	L/P	LB	IL	SD	PS	FWL	FBA	FO	FB	FDU	FL	FD	F/P	RF	FWF	FPL	VL/SL	r
PHB	**-0.434**	0.066	-0.090	0.092	-0.027	0.061	0.087	-0.002	-0.043	0.044	0.069	-0.006	-0.003	-0.060	-0.008	-0.125	0.425	-0.031	-0.021	0.021	-0.098	-0.084
PHH	-0.320	**0.089**	-0.028	0.132	-0.131	0.130	0.017	-0.005	-0.041	0.067	0.120	-0.042	0.001	-0.044	0.001	-0.064	0.380	-0.034	-0.012	0.018	-0.098	0.135
PB/P	-0.093	0.006	**-0.421**	0.042	-0.067	-0.069	0.021	-0.001	0.005	0.334	0.009	0.052	-0.004	-0.006	0.026	-0.147	0.343	-0.287	-0.016	0.021	0.038	-0.213
SB/P	-0.180	0.053	-0.080	**0.223**	0.022	0.185	0.001	-0.007	-0.039	-0.227	0.001	0.014	-0.001	-0.016	-0.037	-0.066	0.448	-0.080	-0.006	0.024	-0.095	0.137
L/P	0.018	-0.017	0.042	0.007	**0.673**	-0.446	-0.008	-0.006	-0.024	-0.439	0.039	-0.013	0.007	-0.010	-0.011	-0.021	0.050	0.093	0.000	0.006	0.103	0.043
LB	0.033	-0.014	-0.036	-0.051	0.372	**-0.806**	-0.011	-0.002	0.012	0.494	0.114	0.001	0.008	-0.020	-0.030	-0.034	-0.054	0.084	0.001	-0.006	0.105	0.160
IL	-0.221	0.009	-0.053	0.001	-0.032	0.054	**0.172**	0.003	-0.001	0.084	-0.102	0.043	-0.009	-0.029	-0.010	-0.022	0.090	-0.009	-0.006	0.013	-0.117	-0.143
SD	-0.026	0.014	-0.010	0.044	0.112	-0.047	-0.017	**-0.036**	-0.024	-0.184	0.033	0.024	-0.009	-0.050	-0.021	-0.102	0.086	0.006	-0.009	0.015	0.052	-0.150
PS	-0.151	0.029	0.020	0.070	0.132	0.082	0.001	-0.007	**-0.123**	-0.239	-0.037	0.012	-0.001	-0.001	-0.012	-0.034	0.363	0.087	-0.001	-0.005	0.0233	0.209
FWL	-0.018	0.006	-0.134	-0.048	-0.281	-0.379	0.013	0.006	0.028	**1.051**	0.011	0.047	-0.003	0.006	-0.022	0.015	-0.031	-0.052	0.005	-0.009	0.004	0.218
FBA	-0.068	0.024	-0.009	0.001	0.060	-0.209	-0.040	-0.002	0.010	0.028	**0.440**	-0.159	0.024	-0.074	-0.024	-0.042	0.098	-0.057	-0.016	-0.018	-0.003	-0.039
FO	-0.011	0.0160	0.093	-0.013	0.038	0.006	-0.031	0.003	0.006	-0.211	0.298	**-0.235**	0.029	-0.001	0.003	0.093	-0.151	-0.042	-0.008	-0.028	-0.043	-0.188
FB	0.038	0.004	0.050	-0.010	0.129	-0.176	-0.043	0.009	0.0051	-0.086	0.289	-0.186	**0.037**	0.00463	-0.001	0.071	-0.078	-0.017	-0.004	-0.036	-0.011	-0.013
FDU	-0.159	0.024	-0.015	0.021	0.042	-0.101	0.033	-0.011	-0.001	-0.040	0.199	-0.001	-0.001	**-0.165**	-0.023	-0.178	0.30378	0.03727	-0.018	0.025	-0.006	-0.037
FL	-0.022	-0.001	0.069	0.052	0.049	-0.154	0.011	-0.004	-0.009	0.142	0.066	0.005	0.001	-0.024	**-0.158**	0.113	-0.019	0.013	0.008	-0.021	-0.047	0.069
FD	0.122	-0.013	0.139	-0.033	-0.031	0.062	-0.008	0.008	0.009	0.037	-0.041	-0.049	0.005	0.066	-0.040	**0.445**	-0.375	0.008	0.030	-0.038	-0.064	0.240
F/P	-0.219	0.040	-0.170	0.118	0.040	0.052	0.018	-0.003	-0.053	-0.039	0.051	0.042	-0.003	-0.059	0.003	-0.197	**0.845**	-0.098	-0.015	0.037	0.006	0.394**
RF	0.032	-0.007	0.285	-0.042	0.148	-0.161	-0.003	-0.001	-0.025	-0.130	-0.059	0.023	-0.001	-0.014	-0.004	0.008	-0.196	**0.424**	0.010	-0.007	0.017	0.296*
FWF	0.225	-0.027	0.169	-0.037	0.008	-0.026	-0.028	0.008	0.001	0.143	-0.177	0.046	-0.003	0.076	-0.031	0.329	-0.322	0.112	**0.041**	-0.019	0.001	0.488**
FPL	0.105	-0.019	0.102	-0.063	-0.048	-0.057	-0.027	0.006	-0.008	0.111	0.094	-0.076	0.015	0.047	-0.039	0.196	-0.359	0.037	0.009	**-0.086**	-0.001	-0.063
VL/SL	-0.180	0.037	0.069	0.090	-0.294	0.359	0.085	0.008	0.012	-0.019	0.005	-0.043	0.001	-0.004	-0.031	0.121	-0.024	-0.031	-0.001	-0.000	**-0.236**	-0.076

Unexplained variation-0.11512

PHB- Plant height at first bud appearance (cm), **PHH**- Plant height at harvesting stage (cm), **PB/P**- Number of primary branches per plant, **SB/P**- Number of secondary branches per plant, **L/P**- Number of leaves per plant, **LB**- Leaf biomass, **IL**- Internodal length (cm), **SD**- Stem diameter(cm), **PS**- Plant spread (cm), **FWL**- Average fresh weight of leaf (g), **FBA**- Days taken to first flower bud appearance, **FFO**- Days taken to first flower opening, **FB**- Days taken to full blooming, **FDU**- Flower duration (days), **FL**- Flower longevity (days), **FD**- Flower diameter (cm), **F/P**- Number of flowers per plant, **RF**- Number of ray florets, **FFW**- Average fresh weight of flower(g), **FPL**- Flower peduncle length (cm), **VL/SL**- Vase life/ Shelf life, **FY/P**- Flower yield per plant (g)

correlation with average fresh weight of flower (0.265) and flower yield per plant (0.296). Average fresh weight of flower showed highly significant and positive correlation with flower yield per plant (0.488). Flower peduncle length and vase / shelf life showed no significant positive or negative with other traits.

At genotypic level, it was found that general trends of association were similar to phenotypic level among various traits, except few character combinations like plant height at first bud appearance exhibited negative and significant correlation with flower peduncle length (-0.279), plant height at harvesting stage showed highly significant and positive correlated with flower duration (0.357) and flower yield per plant (0.334), while significant and positive correlated with days taken to first flower opening (0.289) and highly significant and negative correlated with average fresh weight of flower (-0.339), number of primary branches per plant was seen significant and negative correlation with days taken to first flower opening (-0.288), number of secondary branches per plant noticed highly significant positive correlated with plant spread (0.343), whereas significant and positive correlated with flower longevity (0.265),

leaf biomass showed significant positive correlation with days taken of full blooming (0.257), internodal length noticed highly significant and negative correlated with days taken to full blooming (-0.350), stem diameter had highly significant and positive correlated with flower duration (0.343), whereas highly significant and negative correlated with days taken to full blooming (-0.446), plant spread exhibited significant and negative correlation with average fresh weight of leaf (-0.300), average fresh weight of leaves reported significant and negative correlated with days taken to first flower bud appearance (-0.311), days taken to first flower opening recorded highly significant and positive correlated with flower peduncle length (0.397), whereas significant and positive correlated with flower duration (0.274) and significant and negative correlated with average fresh weight of flower (-0.262), flower duration showed highly significant and negative correlated with flower peduncle length (-0.359) and flower longevity obtained highly significant and positive correlated with flower peduncle length (0.349).

Path coefficient analysis

At genotypic level, number of flowers per plant (1.525) had very high direct positive effect towards flower yield per plant, whereas number of leaves per plant (0.891), average fresh weight of flower (0.754), number of ray floret per flower (0.739), plant height at harvesting stage (0.732), average fresh weight of leaves (0.700), flower peduncle length (0.617) and days taken to first flower opening (0.344) had high direct positive effect towards number of flower per plant. Stem diameter (0.272), days taken for full blooming (0.202) had moderate direct positive effect on flower yield per plant, while number of primary branches per plant (0.172) and flower longevity (0.131) had low direct positive effect on flower yield per plant. Flower duration (0.073) had negligible direct positive effect on flower yield per plant, this might be due to the more regional adaptability and genetical growth habit of the genotypes resulting in higher proportion of morphological growth in terms of vigour and reproductive growth leading to increased flower yield. Similar results were finding in chrysanthemum by Suvija *et al*., 2016, Prakash *et al*., 2018, Kumar *et al*., 2012, Misra *et al*., 2013, Sahu and Sharma, 2014, Sirohi and Bahera, 1999, Beeralingappa *et al*., 2019, Kameswari *et al*., 2015 and Deka and Paswan, 2002 in chrysanthemum. Whereas very high direct negative effect was reported by plant spread (-1.051). High direct negative effect was exhibited via leaf biomass (-0.926), days taken to first flower bud appearance (-0.713), number of secondary branches per plant (-0.385), whereas low direct negative effect via plant height at first bud appearance (-0.184), flower diameter (-0.130) and vase life/ shelf life (-0.148) was recorded on flower yield per plant. Negligible direct negative effect via inter nodal length (-0.087) was observed on flower yield per plant.

At phenotypic level, Average fresh weight of leaves (1.051) had very high and high direct positive effect on flower yield per plant via number of flowers per plant (0.845), number of leaves per plant (0.673), flower diameter (0.445), days taken to first flower bud appearance (0.440), number of ray florets (0.424), whereas number of secondary branches per plant (0.223) showed medium direct positive effect, inter nodal length (0.172) had low and plant height at harvesting stage (0.089), average fresh weight of flowers (0.041), days taken for full blooming (0.037) showed negligible direct positive effect towards flower yield per plant. However high direct negative effect was exhibited by leaf biomass (-0.806), plant height at flower bud appearance (-0.434), primary branches per plant (-0.421), medium direct negative effect via days taken to first flower opening (-0.235), vase life/ shelf life (-0.236), low direct negative effect via plant spread (-0.123), flower duration (-0.165), flower longevity (-0.158) and negligible direct negative effect by flower peduncle length (-0.086) and stem diameter (-0.036) on flower yield per plant similar results given by Sahu and Sharma, 2014, Sirohi and Bahera, 2000, Beeralingappa *et al*., 2019, Kameswari *et al*., 2015.

Conclusion

Based on correlation and path analysis characters of chrysanthemumlike flower diameter, number of flowers per plant, number of ray florets and average fresh weight of flowers showed

direct positive effect towards flower yield per plant and also reflected positive correlation which facilitates selection of superiorgenotypes.

References

Al-Jibouri, H.A., Miller. and Robinson, H.F. 1958. Genotypic and environmental variation and correlation in upland cotton cross of interspecies origin. *Agronomy J.*,**50**: 633-637.

Baskaran, V., Janakiram, T. and Jayanthi, R. 2004. Correlation and Path coefficient analysis studies in chrysanthemum. *J.Orna. Hort*., **7**(3-4): 37-44.

Beeralingappa, P., Kumar, H., Hegde, P.P. and Chandrashekhar, S.Y. 2019. Correlation and Path Coefficient Analysis for Yield Contributing Parameters in Chrysanthemum (*Dendranthema grandiflora* Tzvelev). *Inter. J.Curr. Microbio. and Applied Sci*.,**8**(07): 2564-2574.

Bindhushree, M.P., Patil, B.C., Shiragur, M., Patil, S.R., Bhat, A.S. andMasuthi, D.K.A. 2019. Correlation and Path Analysis in Annual Chrysanthemum (*Chrysanthemum coronarium*L.). *Inter. J.Curr.Microbio. and Applied sci*., **8**(9): 936-942.

Damke, M.M., Jadho, B.J., Hedau, C.V. and Patil, V.S. 1998. Performance of chrysanthemum varieties for flower production under Akola conditions. *MPKV Research J*., **22**(1): 148-150.

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agronomy J*., **51**: 515-518.

Kameswari, P.L., Pratap, M., Hameedunnisabegum. and Anuradha, G. 2015. Studies on genetic variability and character association for yield and its attributes in chrysanthemum (*Dendranthema grandiflora* Tzvelev). *Agricultural Sci. Digest*, **35**(1).

Kaur, M., Dahiya, D.S., Kumar, S., Yadav, G. and Malik, A. 2018. Appraisal for flower yield and genetic correlation of *Chrysanthemum morifolium* genotypes in semi-arid Haryana. *J. Pharma. and Phyto*., **7**(4): 1267-1272.

Kumar, M., Kumar, S., Singh, M.K., Malik, S. and Kumar, A. 2012. Studies on correlation and path analysis in chrysanthemum (*Dendranthema grandiflora* T.). *Inter. J. Plant Res*., **25**(2): 62-65.

Kumar, S., Dewan, N., Choupoo, A.S., Marak, B.S. andDobonroy, D. 2018. Genetic variability and correlation in chrysanthemum (*Chrysanthemum morifolium* Ramat) genotypes. *Hort. Flora. Res. Spectrum*, **7**(1): 33-40.

Misra, S., Mandal, T.,Vanlalruati. and Das, S.K. 2013. Correlation and path coefficient analysis for yield contributing parameters in spray chrysanthemum. *J. Hort. Letters*, **3**(1): 14-16.

Prakash, A., Kumar, M., Singh, C., Kumar, A., Badal, D.S. and Singh, S. 2018. correlation and path analysis studies in chrysanthemum (*Dendranthema grandiflora* Tzvelev). *J. Pharma. and Phyto*., **7**(2): 3890-3893.

Sahu, M. and Sharma, G. 2014. Genetic variability, correlation and path analysis for yield and its attributing traits in small flowered chrysanthemum. *J.Orna. Hort*.,**17**(1-2): 32-37.

Sirohi, P.S. and Behera, T.K. 1999. Correlation and path analysis studies in chrysanthemum. *J.Orna. Hort*., **2**(2): 80-83.

Suvija, N.V., Kumar, S.R., Suresh, J. and Jawaharlal, M. 2016. Studies on correlation and Path coefficient analysis in chrysanthemum (*Chrysanthemum morifolium* Ramat). *Inter. J. Innovative Res. and Advanced Studies*, **3**(7) :259-262.