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Variability Assessment at Morphological Level in Taro (*Colocasia esculenta* L. Schott)

Surbhi Prithiani[1]*, Virendra Singh[1], R.A. Kaushik[1], Kapil Dev Ameta[1], Devendra Jain[2], H.L. Bairwa[1] and Mahendra Kumar Gora[1]

[1]Department of Horticulture, R.C.A., MPUAT, Udaipur, Rajasthan
[2]Department of Molecular Biology Biotechnology, RCA, MPUAT, Udaipur, Rajasthan, India

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ABSTRACT

The present investigation entitled "Variability Assessment at Morphological Level in Taro (*Colocasia esculenta* L. Schott)" was conducted in *kharif* (2021-22), at Horticulture Farm, Department of Horticulture, Rajasthan College of Agriculture, Udaipur to evaluate the correlation coefficient and path analysis for 18 genotypes. The overall evaluation of genotypic and phenotypic characters was conducted. The results obtained for total yield (t/ha) exhibited highly significant positive genotypic and phenotypic correlations and path analysis with cormel yield per plant, cormel weight, number of cormels per plant, corm weight and corm yield per plant. It also showed significant positive phenotypic correlations with dry matter of corms, and total phenol. Dry matter of cormels showed a positive direct effect, as did calcium oxalate of leaf. Total phenol demonstrated a positive direct effect, along with calcium oxalate of cormel and total sugar percentage.

Key words: *Genotypic, Phenotypic, Path analysis, Correlation*

Introduction

An important tuber crop, taro is primarily grown for subsistence in the tropics and sub-tropics, as well as in many of the tropical regions. It is the fourteenth most consumed vegetable globally and a staple food for people all over the world (Rao *et al.*, 2010). It is a root crop that is widely grown in 50 countries across the globe.

One of the major vegetable crops in the Southern Rajasthan in tribal region and in several Indian states. The crop's low productivity and production can be attributed to several factors, including the scarcity of reliable, high-yielding varieties and the lack of improved varieties specific to the region. As a result, breeding programs that aid in locating parents with a variety of genotypes and high yielding genotypes must be designed.

There is little information available about taro's variability. As, morphological traits are the most effective means of taxonomically classifying plants, morphological studies on the genotypes of taro are necessary. In cultivar collections kept for breeding and conservation, morphological analysis can also assist in identifying genotypes and minimizing duplication (Bammite *et al.*, 2018).

Materials and Methods

The experiment was conducted during *kharif* (2021-22), at Horticulture Farm, Department of Horticulture, Rajasthan College of Agriculture, Udaipur (Rajasthan) with 18 genotypes TTr-17-1, TTr-17-2, TTr-17-3, TTr-17-5, TTr-17-6, TTr-17-8, TTr-17-11, TTr-17-12, TTr-17-13, TTr-17-14, Muktakeshi, Indira arbi I, Jabalpur Local, Dantiwada Local, Bilaspur

Local, Jadol Local, C.G. Arbi II and Local which is situated at 74° 42' E longitude and 24° 35' N latitude with an altitude of 581.13 m above mean sea level. The region falls under NARP agro-climatic zone IV-a of Rajasthan, *i.e.*, Sub- Humid Southern Plains and Aravalli Hills.Observations were recorded on five randomly selected plants in each replication for quantitative and qualitative traits. Data was analyzed to estimate

1. Correlation coefficient: Method suggested by Al-Jibouri *et al.* (1958).
2. Path analysis: Method suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

Results and Discussion

Correlation coefficient

The data presented in the Table 1 showed that plant height at 90 DAP showed highly significant positive genotypic and phenotypic correlations with plant height at 120 DAP (rg = 0.93**, rp = 0.89**), stolon length at 90 DAP (rg = 0.46*, rp = 0.48*), stolon length at 120 DAP (rg = 0.71**, rp = 0.73**), leaf area index at 120 DAP (rg = 0.63**, rp = 0.68**) and total phenol content (rg = 0.43*, rp = 0.41*).Plant height at 120 DAP exhibited significant positive genotypic and phenotypic correlations with stolon length at 120 DAP (rg = 0.56**, rp = 0.72**), leaf area index at 90 DAP (rg = 0.50*, rp = 0.71**), leaf lamina length (rg = 0.78**, rp = 0.39*), leaf area index at 120 DAP (rg = 0.63**, rp = 0.65**) and total phenol content (rg = 0.50*, rp = 0.44*).

The number of cormels per plant exhibited significant positive genotypic and phenotypic correlations with corm weight (rg = 0.60**, rp = 0.55**). Cormel weight exhibited significant positive genotypic and phenotypic correlations with plant height at 120 DAP (rg = 0.54*, rp = 0.59**), leaf area index at 90 DAP (rg = 0.50**, rp = 0.46**).

Cormel yield per plant exhibited significant positive phenotypic correlations withcormel weight (rg = 0.89**, rp = 0.83**) and number of cormel(rg = 0.74**, rp = 0.67**).These findings are in agreement with findings of Yadav *et al.*, (2018).Total yield showed significant positive phenotypic correlations with number of cormels per plant (rg = 0.68**, rp = 0.77**), corm weight (rg = 0.55**, rp = 0.49**), cormel weight (rg = 0.81**, rp = 0.78**) corm yield per plant (rg = 0.70*, rp = 0.37**) and cormel yield per plant (rg = 0.98**, rp = 0.96**) which is highest.

Chlorophyll content showed significant positive phenotypic correlations with leaf area index at 120 DAP (rg = 0.62**, rp = 0.65**). Dry matter of cormel exhibited significant positive phenotypic correlations with cormel yield /plant (rg = 0.61*, rp = 0.33*). Total sugar showed significant positive phenotypic correlations starch content (rg = 0.685**, rp = 0.85**). Total phenol content exhibited significant positive genotypic and phenotypic correlations with Total yield (rg = 0.64**, rp = 0.41**)

Similar, results were also reported by Mohanty *et al.*, (2016) in sweet potato, Devi *et al.* (2019), Paul and Bari (2015). The findings clearly exhibited a higher magnitude of genotypic correlation corresponding to phenotypic correlations, which might be due to modifying or masking effects of environment. It establishes a strong inherent relationship among the characters studied as reported by Johnson *et al.* (1955).

Path analysis

According to the data in Table 2, at the genotypic level, the highest positive direct effect was observed for cormel yield per plant (0.8502), followed by corm yield per plant (0.2422), dry matter of cormels (0.0064), and calcium oxalate of cormel (0.0058). The number of cormels per plant had a very minor positive effect (0.001), with cormel weight (0.0009). The highest negative direct effect was observed for corm weight (-0.0002).

According to the data in table 3 it is represented that at the phenotypic level, cormel yield per plant showed the highest positive direct effect (0.9343), followed by corm yield per plant (0.2965).

All the above results are confirmed by the finding of Vimal *et al.* (2019) for elephant foot yam, and Paul and Bari (2015) for taro.

Conclusion

The present investigation concluded that cormel yield per plant exhibited significant positive phenotypic correlations with corm weight, and total yield. Total yield showed significant positive phenotypic correlations with plant height at 90 DAP, plant height at 120 DAP, number of stolons, number of cormels per plant, corm weight, and cormel yield per plant.At the genotypic and phenotypic level, the highest positive direct effect was observed for cormel yield per plant followed by corm yield per plant.

Table 1. Phenotypic (below diagonal)& Genotypic (above diagonal) correlation matrix

SN	Character	Plant height (cm) (90 DAP)	Plant height (cm) (120 DAP)	Number of stolons	Stolon length (cm) (90 DAP)	Stolon length (cm) (120 DAP)	Number of Leaves (120 DAP)	Leaf lamina Length (cm)	Leaf lamina Width (cm)	Leaf Area Index (90 DAP)	Leaf Area Index (120 DAP)	Corm weight (g)	Number of cormels/ plant	Cormel weight (g)	Corm yield/ plant (kg)	Cormel yield/ plant (kg)	Total yield (t/ha)	Chorophyll content (mg/ 100 g) (90 DAP)	Dry matter of corms (%)	Dry matter of cormels (%)	Starch content (%)	Total Sugar (%)	Total Phenol (mg/ 100g)	Calcium oxalate of leaf (mg/ 100g)	Calcium oxalate of cormel (mg/ 100g)
1	Plant height (cm) (90 DAP)	0.93**	-0.12	0.46*	0.71**	0.31	0.63*	-0.03	0.46	0.63**	0.11	-0.09	0.28	0.52	0.19	0.28	0.06	-0.05	0.18	-0.02	0.02	0.50*	-0.04	-0.22	
2	Plant height (cm) (120 DAP)	0.89**		-0.20	0.35	0.56**	0.05	0.78**	-0.01	0.50*	0.63**	-0.03	0.01	0.54*	0.37	0.48	0.50	-0.01	0.10	0.25	0.14	0.19	0.63**	-0.33	-0.50*
3	Number of stolons	0.30	0.32*		0.29	0.24	0.30	0.24	0.78**	0.51*	0.47*	0.01	-0.21	0.14	0.17	-0.04	0.01	0.43	-0.18	-0.24	-0.33	-0.17	-0.46	-0.04	-0.06
4	Stolon length (cm) (90 DAP)	0.48**	0.36*	0.29		0.79**	0.45*	0.51	0.40	0.27	0.34	0.17	-0.10	-0.04	0.21	-0.08	-0.01	0.11	-0.07	0.11	0.18	0.09	0.08	-0.06	0.01
5	Stolon length (cm) (120 DAP)	0.73**	0.62**	0.35*	0.76**		0.48*	0.61*	0.34	0.38	0.56**	0.18	-0.08	0.13	0.47	0.09	0.19	0.42	-0.16	0.00	-0.13	-0.04	0.18	-0.02	0.00
6	Number of Leaves (120 DAP)	0.57**	0.47**	0.51**	0.47**	0.59**		0.09	0.14	0.10	0.20	0.08	-0.52	-0.11	0.10	-0.38	-0.30	0.08	-0.24	-0.07	-0.31	-0.18	-0.16	0.20	0.15
7	Leaf lamina Length (cm)	0.23	0.32*	0.10	0.20	0.27	-0.07		0.54	0.95**	0.59*	-0.08	-0.02	0.19	0.43	0.07	0.16	0.49	0.27	0.27	0.19	0.29	0.01	-0.42	-0.19
8	Leaf lamina Width (cm)	0.32*	0.39*	0.67**	0.43**	0.48**	0.45**	0.18		0.14	0.13	0.13	0.06	0.09	0.32	0.19	0.24	0.09	-0.17	-0.22	-0.26	-0.12	-0.17	-0.01	-0.08
9	Leaf Area Index (90 DAP)	0.65**	0.71**	0.58**	0.33*	0.52**	0.58**	0.19	0.53**		0.83**	0.07	-0.14	0.43	0.53	0.34	0.41	0.32	0.14	0.10	-0.16	0.11	0.30	-0.57*	-0.57*
10	Leaf Area Index (120 DAP)	0.68**	0.65**	0.54**	0.38*	0.61**	0.40*	0.27	0.32	0.72**		-0.03	-0.18	0.48*	0.37	0.26	0.31	0.62**	-0.11	-0.08	-0.11	-0.13	0.20	-0.29	-0.32
11	Corm weight (g)	0.23	0.13	0.12	0.21	0.25	0.22	-0.08	0.23	0.23	0.07		0.60**	-0.04	1.20**	0.31	0.55*	-0.01	0.20	-0.08	-0.18	0.00	0.08	-0.23	-0.40*
12	Number of cormels/plant	0.39*	0.46**	0.28	0.14	0.22	0.20	-0.09	0.43**	0.47**	0.18	0.55**		0.06	0.56	0.74**	0.77**	-0.07	0.43	0.25	0.08	0.36	0.54*	-0.58**	-0.85**
13	Cormel weight (g)	0.45**	0.59**	0.37*	0.06	0.27	0.25	0.07	0.27	0.55**	0.51**	0.12	0.37*		0.22	0.89**	0.81**	0.18	0.36	0.30	0.25	0.39	0.47*	-0.48*	-0.60**
14	Corm yield/plant (kg)	0.14	0.10	-0.06	0.12	0.21	0.05	-0.17	0.10	0.14	0.16	0.56**	0.20	0.02		0.54	0.70*	0.08	-0.24	-0.64*	-0.67*	-0.54	0.10	-0.13	-0.26
15	Cormel yield/ plant (kg)	0.43**	0.56**	0.37**	0.08	0.24	0.22	0.03	0.32*	0.48**	0.39**	0.34*	0.67**	0.83**	0.07		0.98**	0.18	0.61*	0.44	0.30	0.59*	0.73**	-0.77**	-1.01**
16	Total yield (t/ha)	0.44**	0.55**	0.33*	0.11	0.29	0.22	-0.02	0.33*	0.49**	0.41**	0.49**	0.68**	0.78**	0.37**	0.96**		0.17	0.46	0.22	0.09	0.37	0.64**	-0.68**	-0.92**
17	Chorophyll content (mg/100 g)(90 DAP)	0.46**	0.45**	0.53**	0.25	0.56**	0.51**	0.07	0.47**	0.69**	0.65**	0.17	0.46**	0.42**	0.01	0.42**	0.40**		0.02	0.05	-0.25	0.06	0.25	-0.37	-0.34
18	Dry matter of corms (%)	-0.07	0.04	-0.11	-0.07	-0.16	-0.19	0.17	-0.17	0.05	-0.10	0.17	0.27	0.28	-0.09	0.33*	0.28	-0.01		0.88**	0.77**	0.92**	0.22	-0.65**	-0.66**
19	Dry matter of cormels (%)	0.09	0.13	-0.18	0.09	-0.02	-0.07	0.17	-0.22	0.02	-0.08	-0.09	0.14	0.22	-0.27	0.22	0.13	-0.00	0.88**		0.85**	0.95**	0.35	-0.46*	-0.43*
20	Starch content (%)	-0.04	0.07	-0.21	0.16	-0.13	-0.24	0.12	-0.23	-0.12	-0.10	-0.18	0.04	0.20	-0.30*	0.17	0.07	-0.19	0.78**	0.85**		0.85**	0.28	-0.50**	-0.49**
21	Total Sugar (%)	-0.00	0.11	-0.11	0.07	-0.05	-0.14	0.18	-0.13	0.04	-0.11	-0.01	0.22	0.30	-0.24	0.32*	0.23	0.01	0.92**	0.95**	0.86**		0.31	-0.60**	-0.54**
22	Total Phenol (mg/100g)	0.36*	0.42**	-0.28	0.08	0.15	-0.11	0.01	-0.15	0.17	0.19	0.07	0.37*	0.38*	0.10	0.41**	0.41**	0.17	0.26	0.38*	0.31	0.33		-0.44*	-0.48*
23	Calcium oxalate of leaf (mg/100g)	-0.05	-0.24	-0.03	-0.06	-0.03	0.13	-0.23	-0.05	-0.35*	-0.25	-0.22	-0.39*	-0.34*	-0.03	-0.40**	-0.39**	-0.27	-0.57**	-0.37	-0.43*	-0.53**	-0.37		0.95**
24	Calcium oxalate of cormel (mg/100g)	-0.01	-0.16	0.09	0.08	0.10	0.27	-0.15	0.08	-0.13	-0.18	-0.31	-0.38*	-0.32	-0.15	-0.41**	-0.43**	-0.04	-0.63**	-0.42*	-0.47**	-0.52**	-0.45*	0.87**	

Table 2. Genotypic path analysis for Total yield (t/ha)

SN	Character	Corm weight (g)	Number of cormels/ plant	Cormel weight (g)	Corm yield/ plant (kg)	Cormel yield/ plant (kg)	Chorophyll content (mg/100 g) (90 DAP)	Dry matter of corms (%)	Dry matter of cormels (%)	Total Sugar (%)	Total Phenol (mg/ 100g)	Calcium oxalate of leaf (mg/ 100g)	Calcium oxalate of cormel (mg/100g)	r
1	Corm weight (g)	-0.0002	0.0006	-0.0000	0.2902	0.2613	0.0000	-0.0016	-0.0005	-0.0000	-0.0002	0.0017	-0.0023	0.5490*
2	Number of cormels/plant	-0.0001	0.0010	0.0001	0.1368	0.6332	0.0001	-0.0034	0.0016	-0.0001	-0.0014	0.0044	-0.0049	0.7673**
3	Cormel weight (g)	0.0000	0.0001	0.0009	0.0545	0.7537	-0.0003	-0.0028	0.0019	-0.0001	-0.0012	0.0037	-0.0035	0.8069**
4	Corm yield/plant(kg)	-0.0002	0.0006	0.0002	0.2422	0.4630	-0.0001	0.0018	-0.0040	0.0002	-0.0003	0.0010	-0.0015	0.7028**
5	Cormel yield/plant (kg)	-0.0001	0.0007	0.0008	0.1319	0.8502	-0.0003	-0.0047	0.0028	-0.0002	-0.0019	0.0058	-0.0059	0.9794**
6	Chorophyll content (mg/100 g)(90 DAP)	0.0000	-0.0001	0.0002	0.0198	0.1518	-0.0018	-0.0002	0.0003	-0.0000	-0.0006	0.0028	-0.0020	0.1701
7	Dry matter of corms (%)	-0.0000	0.0004	0.0003	-0.0571	0.5159	-0.0000	-0.0077	0.0056	-0.0003	-0.0006	0.0049	-0.0038	0.4576
8	Dry matter of cormels (%)	0.0000	0.0002	0.0003	-0.1540	0.3754	-0.0001	-0.0068	0.0064	-0.0003	-0.0009	0.0035	-0.0025	0.2213
9	Total Sugar (%)	-0.0000	0.0004	0.0004	-0.1309	0.4986	-0.0001	-0.0071	0.0060	-0.0003	-0.0008	0.0045	-0.0031	0.3676
10	Total Phenol (mg/100g)	-0.0000	0.0005	0.0004	0.0241	0.6168	-0.0005	-0.0017	0.0022	-0.0001	-0.0026	0.0033	-0.0028	0.6398**
11	Calcium oxalate of leaf (mg/100g)	0.0000	-0.0006	-0.0005	-0.0324	-0.6534	0.0007	0.0051	-0.0029	0.0002	0.0011	-0.0076	0.0055	-0.6848**
12	Calcium oxalate of cormel (mg/100g)	0.0001	-0.0008	-0.0006	-0.0638	-0.8624	0.0006	0.0051	-0.0027	0.0002	0.0012	-0.0072	0.0058	-0.9246**

Residual = 0.0017

*, ** Significant correlation with dependent char at 5% and 1% respectively

Table 3. Phenotypic path analysis for Total yield (t/ha)

SN	Character	Corm weight (g)	Number of cormels/ plant	Cormel weight (g)	Corm yield/ plant (kg)	Cormel yield/ plant (kg)	Chorophyll content (mg/100 g) (90 DAP)	Dry matter of corms (%)	Dry matter of cormels(%)	Total Sugar (%)	Total Phenol (mg/100g)	Calcium oxalate of leaf (mg/100g)	Calcium oxalate of cormel (mg/100g)	r
1	Corm weight (g)	0.0005	-0.0006	-0.0000	0.1664	0.3200	-0.0000	-0.0005	0.0001	-0.0000	-0.0000	-0.0000	0.0000	0.4858*
2	Number of cormels/plant	0.0003	-0.0011	-0.0001	0.0584	0.6230	-0.0000	-0.0008	-0.0001	0.0008	-0.0001	-0.0000	0.0000	0.6802**
3	Cormel weight (g)	0.0001	-0.0004	-0.0004	0.0048	0.7751	-0.0000	-0.0008	-0.0002	0.0011	-0.0001	-0.0000	0.0000	0.7791**
4	Corm yield/plant(kg)	0.0003	-0.0002	-0.0000	0.2965	0.0694	-0.0000	0.0002	0.0003	-0.0009	-0.0000	-0.0000	0.0000	0.3657
5	Cormel yield/plant (kg)	0.0002	-0.0007	-0.0003	0.0220	0.9343	-0.0000	-0.0010	-0.0002	0.0011	-0.0001	-0.0000	0.0000	0.9553**
6	Chorophyll content (mg/100 g)(90 DAP)	0.0001	-0.0005	-0.0002	0.0043	0.3925	-0.0001	0.0000	0.0000	0.0000	-0.0000	-0.0000	0.0000	0.3962
7	Dry matter of corms (%)	0.0001	-0.0003	-0.0001	-0.0255	0.3082	0.0000	-0.0029	-0.0009	0.0032	-0.0000	-0.0000	0.0000	0.2819
8	Dry matter of cormels (%)	-0.0000	-0.0002	-0.0001	-0.0796	0.2101	0.0000	-0.0025	-0.0010	0.0033	-0.0001	-0.0000	0.0000	0.1299
9	Total Sugar (%)	-0.0000	-0.0002	-0.0001	-0.0716	0.3004	-0.0000	-0.0026	-0.0009	0.0035	-0.0001	-0.0000	0.0000	0.2283
10	Total Phenol (mg/100g)	0.0000	-0.0004	-0.0001	0.0287	0.3814	-0.0000	-0.0008	-0.0004	0.0012	-0.0002	-0.0000	0.0000	0.4095
11	Calcium oxalate of leaf (mg/100g)	-0.0001	0.0004	0.0001	-0.0095	-0.3782	0.0000	0.0016	0.0004	-0.0019	0.0001	0.0001	-0.0000	-0.3871
12	Calcium oxalate of cormel (mg/100g)	-0.0002	0.0004	0.0001	-0.0454	-0.3805	0.0000	0.0018	0.0004	-0.0018	0.0001	0.0001	-0.0000	-0.4252

Residual = 0.0034

*, ** Significant correlation with dependent char at 5% and 1% respectively

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Conflict of interest statement

The authors declare that there is no conflict of interest.

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