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Study on Genetic Variability for Yield and Attributing Traits of Lesser Yam (*Dioscorea esculenta*)

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ABSTRACT

The present experiments were carried out at the Research Farm Tirhut College of Agriculture, Dholi, Mzaffarpur in two respective years under Randomized Block Design with four replication. The experimental materials comprised five genotypes including two checks Sree Kala and Sree Latha of lesser yam. Mean Sum of square due to genotypes were found highly significant for traits viz ; days to 50% plant emergence, tuber length, marketable tuber/plant, non-marketable tuber/plant and tuber yield in both the years. High GCV was observed for traits viz ; days to 50% plant emergence, tuber length (cm), no of marketable tuber yield/plant and No. of non-marketable tuber yield/plant in both the years, while for traits viz; vine length (cm), dry matter (%) and tuber yield (kg)/plot in first year. High heritability coupled with high genetic advance were observed for characters viz ; days to 50% plant emergence, tuber length (cm) and no of non-marketable tuber yield/plant in both the years. Tuber length (cm), tuber girth (cm) and dry matter (%) had shown the significant and positive correlation with marketable tuber yield (t/ha) having high positive direct effect in both the year.

Keywords Lesser yam, Heritability, Genetic advance, Correlation coefficient.

INTRODUCTION

Lesser yam is an annual herbaceous tuber crops which having chromosome number (2n = 40) and belongs to the family Dioscoreaceae. The cultivated yam plays an essential role in ensuring food security and improving the livelihoods of millions of people in Africa (Sanginga and Mbabu 2015). According to FAOSTAT (2021), ~92% of global yam production came from the West African yam belt, while Nigeria alone accounted for 65.5% of the total production. It is cultivated in Africa, Asia, parts of South America, as well as Caribbean and the South Pacific islands for its storage tubers (Asiedu and Alieu 2010, Tsadiku *et al.* 2024). In Bihar lesser yam used as a prasad in Chhathpuja festival and eaten after cooking. The genus comprises over 600 species (Dansi *et al.* 2013, Marcos *et al.* 2014), and only 10 of them are cultivated for human food and

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have real economic significance in Africa (Lebot 2009, Asiedu and Alieu 2010, Norman *et al.* 2012). *Ethiopia* is considered to be the center of origin and diversity of most yam species (Coursey 1967, Terauchi *et al.* 1992, Tamiru *et al.* 2011). In the country a large number of yam genotypes are cultivated for food, medicine and economical uses (Hildebrand *et al.* 2003, Girma *et al.* 2012). The tuber of Dioscorea esculenta are rich source of carbohydrates so they are very suitable to be used as a substitute for rice or alternative sources of carbohydrates about 22.44%, crude fat, crude fiber, starch and sugar Anwar *et al.* (2019), Bahlawan *et al.* (2020). Besides being used as a substitute for rice, it turns out that *D. esculenta* flour is also very potential to be used as a substitute for wheat flour because it has the swelling ability of Wheat and is in accordance with American Wheat standards Bahlawan *et al.* (2020). The objective of experiment was to find out the nature of gene action and relationship between some yield attributing traits for selection of superior lines and used as a parents in further breeding programs.

MATERIALS AND METHODS

The present experiments were carried out at the Research Farm Tirhut College of Agriculture, Dholi, Mzaffarpur in two respective years under Randomized Block Design with four replication. The experimental materials comprised five genotypes including two checks Sree Kala and Sree Latha of lesser yam. Data were recorded based on five randomly selected plants of each traits viz ; days to 50% plant emergence (days), vine length (cm), petiole length (cm), leaf length (cm), leaf width (cm), tuber length (cm), tuber girth (cm), dry matter (%), no of marketable tuber yield/plant, no of non-marketable tuber yield/plant and Tuber yield (kg)/plot. The data were analyzed following the methods given by Panse and Sukhatme for ANOVA and correlation coefficient. The path analysis was also analyzed following the methods given by Wright, Duwey and Lu (1959).

RESULTS AND DISCUSSION

Mean sum of square due to genotypes were found highly significant for traits viz ; days to 50% plant emergence, tuber length, marketable tuber/plant, non-marketable tuber/plant and tuber yield in two respective years (Table 1). High GCV was observed for traits viz ; days to 50% plant emergence, tuber length (cm), no of marketable tuber yield/plant and

Table. 1. Range, Mean, co-efficient of variation and critical differences for eleven characters of Lesser Yam during First and Second Year.

Sl. No.	Traits	Range		Mean		Sem(±)		CD at 0.05	
		First Year	Second Year	First Year	Second Year	First Year	Second Year	First Year	Second Year
1	Days to 50% plant emergence (days)	12.00-19.00	16.00-25.00	15.20	19.40	0.89	3.35	2.16	2.88
2	Vine length (cm)	141.08-164.43	98.41-164.84	150.62	125.33	7.71	22.05	13.94	17.02
3	Petiole length (cm)	5.5-7.01	5.07-6.37	6.26	5.76	0.61	0.52	1.67	0.86
4	Leaf length (cm)	7.00-10.62	5.92-6.70	8.70	6.35	1.20	0.25	1.80	0.49
5	Leaf width (cm)	7.16-9.06	5.74-6.54	7.77	6.07	0.71	0.25	1.65	0.56
6	Tuber length (cm)	7.00-12.33	7.00-14.68	9.69	11.22	1.94	2.21	1.54	1.75
7	Tuber girth (cm)	11.16-14.00	13.66-15.59	13.10	14.59	1.01	0.63	1.36	1.76
8	Dry matter (%)	23.25-26.69	21.80-29.90	25.11	26.28	1.33	3.07	1.69	1.80
9	No. of marketable tuber yield/plant	6.33-9.30	7.61-19.33	7.54	12.73	1.01	4.07	0.83	1.70
10	No. of non-marketable tuber yield/plant	1.35-2.91	2.16-5.16	2.38	3.19	0.56	1.03	0.55	0.56
11	Tuber yield (kg)/plot	13.74-15.86	3.75-6.38	14.82	4.70	0.72	1.03	1.11	0.88

Table 2. Genetical parameters for eleven characters of Lesser Yam during First and Second Year.

Traits	First Year				Second Year			
	GCV (%)	PCV (%)	h^2 (%)	GA (%)	GCV (%)	PCV (%)	h^2 (%)	GA (%)
Days to 50% plant emergence	36.75	40.32	83.00	69.00	37.65	41.45	82.52	70.47
Vine length (cm)	10.08	14.78	46.56	14.17	3922	39.76	97.29	79.69
Petiole length (cm)	15.50	34.81	19.84	14.23	17.95	26.15	47.13	25.39
Leaf length (cm)	28.42	34.3	58.04	44.6	7.83	11.96	42.85	10.56
Leaf width (cm)	16.33	29.71	30.2	18.48	7.72	13.38	33.33	9.19
Tuber length (cm)	43.99	47.74	84.9	83.5	43.27	46.98	84.81	82.09
Tuber girth (cm)	16.16	20.21	63.91	26.61	6.77	15.67	18.69	6.03
Dry matter (%)	11.40	13.71	67.19	18.98	25.9	27.06	91.6	51.08
No. of marketable tuber yield/plant	29.38	32.02	84.21	55.55	71.23	72.91	0.83	65.73
No. of non-marketable tuber yield/plant	51.20	57.99	77.95	93.12	71.7	74.59	92.40	61.33
Tuber yield (kg)/plot	10.01	13.33	56.46	15.51	47.48	52.22	82.67	88.94

Table 3. Genotypic (upper value) and Phenotypic (lower value) correlation coefficients between different character combinations among eleven characters of Lesser Yam in First Year.

Characters		Ch-1	Ch-2	Ch-3	Ch-4	Ch-5	Ch-6	Ch-7	Ch-8	Ch-9	Ch-10	Ch-11
First Year												
Days to 50% plant emergence (days)	G	1.000	-0.571	0.278	0.075	0.329	-0.167	-0.042	0.090	0.228	-0.290	-0.364
	P	1.000	-0.257	0.061	0.027	0.131	-0.330	-0.478*	0.430	0.196	-0.113	-0.390
Vine length (cm)	G		1.000	0.274	-0.013	-0.347	-0.242	-0.240	-0.026	-0.845	-0.630	-0.082
	P		1.000	0.158	-0.041	-0.013	-0.227	0.009	-0.212	-0.365	-0.060	-0.157
Petiole length (cm)	G			1.000	-0.418	-0.696	-0.807	-0.032	0.395	-0.003	-0.049	-0.799
	P			1.000	0.125	0.709**	-0.172	0.212	-0.083	-0.052	-0.216	0.020
Leaf length (cm)	G				1.000	0.993	0.000	-0.177	0.183	0.128	0.538	-0.215
	P				1.000	0.516*	0.404	0.455*	0.098	0.540*	0.194	0.361
Leaf width (cm)	G					1.000	0.479	-0.891	0.919	0.896	0.325	-0.263
	P					1.000	0.272	0.441	0.054	0.578**	0.199	-0.135
Tuber length (cm)	G						1.000	0.836	0.177	0.746	0.317	0.151
	P						1.000	0.702**	-0.081	0.640**	0.247	0.162
Tuber girth (cm)	G							1.000	-0.579	0.077	0.072	0.492
	P							1.000	-0.240	0.276	-0.063	0.173
Dry matter (%)	G								1.000	0.882	-0.108	-0.931
	P								1.000	0.224	-0.130	0.057
No. of marketable tuber yield/plant	G									1.000	0.662	0.095
	P									1.000	0.495*	0.260
No. of non-marketable tuber yield/plant	G										1.000	-0.015
	P										1.000	-0.110
Tuber yield(kg)/plot	G											1.000
	P											1.000

Table 4. Genotypic (upper value) and Phenotypic (lower value) correlation coefficients between different character combinations among eleven characters of Lesser Yam Lesser Yam in Second Year.

Characters		Ch-1	Ch-2	Ch-3	Ch-4	Ch-5	Ch-6	Ch-7	Ch-8	Ch-9	Ch-10	Ch-11
Second Year												
Days to 50% plant emergence (days)	G	1.000	0.371	-0.216	0.184	0.883	-0.948	-0.104	0.765	-0.272	-0.475	-0.652
	P	1.000	0.158	-0.435	0.030	0.131	-0.326	0.324	0.263	-0.241	-0.267	-0.238
Vine length (cm)	G		1.000	-0.576	-0.142	-0.369	0.194	-0.467	0.442	0.204	-0.054	-0.278
	P		1.000	-0.415	-0.226	-0.149	0.168	-0.292	0.356	0.195	-0.109	-0.170
Petiole length (cm)	G			1.000	-0.997	-0.090	0.245	0.442	-0.669	-0.653	0.238	0.255
	P			1.000	0.089	-0.154	-0.219	0.093	-0.396	-0.331	0.322	-0.132
Leaf length (cm)	G				1.000	0.410	-0.191	0.156	0.136	0.872	-0.080	0.580
	P				1.000	0.539*	-0.417	-0.178	0.343	0.107	-0.241	0.072
Leaf width (cm)	G					1.000	-0.863	0.793	0.836	-0.203	-0.354	-0.065
	P					1.000	-0.320	-0.166	0.367	0.130	-0.218	0.020
Tuber length (cm)	G						1.000	0.452	0.165	0.908	-0.108	0.913
	P						1.000	0.324	-0.104	0.610**	-0.304	0.566**
Tuber girth (cm)	G							1.000	0.381	0.670	-0.298	0.871
	P							1.000	-0.167	0.107	-0.186	0.274
Dry matter (%)	G								1.000	0.353	-0.682	0.128
	P								1.000	0.434	-0.444*	0.124
No. of marketable tuber yield/plant	G									1.000	-0.760	0.009
	P									1.000	0.623**	0.696
No. of non-marketable tuber yield/plant	G										1.000	-0.679
	P										1.000	-0.460*
Tuber yield (kg)/plot	G											1.000
	P											1.000

Table 5. Phenotypic direct and indirect effect of eleven characters of Lesser Yam Lesser Yam in both Years.

First Year											
Characters	Ch-1	Ch-2	Ch-3	Ch-4	Ch-5	Ch-6	Ch-7	Ch-8	Ch-9	Ch-10	Ch-11
Days to 50% plant emergence(days)	**-0.347**	0.089	-0.021	-0.009	-0.046	0.115	0.166	-0.149	-0.068	0.039	-0.390
Vine length (cm)	0.097	**-0.377**	-0.059	0.016	0.005	0.086	-0.003	0.080	0.138	0.023	-0.157
Petiole length(cm)	-0.016	-0.041	**-0.258**	-0.032	-0.183	0.045	-0.055	0.021	0.013	0.056	0.020
Leaf length(cm)	-0.010	0.016	-0.048	**-0.382**	-0.197	-0.154	-0.174	-0.037	-0.206	-0.074	-0.361
Leaf width(cm)	0.110	-0.011	0.592	0.431	**0.836**	0.227	0.369	0.045	0.483	0.166	-0.135
Tuber length(cm)	-0.264	-0.182	-0.138	0.323	0.217	**0.800**	0.562	-0.064	0.512	0.198	0.162
Tuber girth(cm)	0.125	-0.002	-0.056	-0.119	-0.116	-0.184	**0.262**	0.063	-0.072	0.016	0.173
Dry matter (%)	0.164	-0.081	-0.032	0.037	0.020	-0.031	-0.092	**0.382**	0.085	-0.050	0.057

Table 5. Continued.

Characters	Ch-1	Ch-2	Ch-3	Ch-4	Ch-5	Ch-6	Ch-7	Ch-8	Ch-9	Ch-10	Ch-11
First Year											
No. of marketable tuber yield/plant	-0.235	0.438	0.062	-0.647	-0.693	-0.768	-0.331	-0.268	**-0.199**	-0.593	-0.260
No. of non-marketable tuber yield/plant	-0.012	-0.006	-0.023	0.021	0.021	0.027	-0.007	-0.014	0.053	**0.108**	-0.110
Second Year											
Days to 50% plant emergence (days)	**0.017**	0.003	-0.008	0.001	0.002	-0.006	0.006	0.005	-0.004	-0.005	-0.238
Vine length (cm)	-0.051	**-0.323**	0.134	0.073	0.048	-0.054	0.094	-0.115	-0.063	0.035	-0.170
Petiole length (cm)	0.010	0.010	**-0.024**	-0.002	0.004	0.005	-0.002	0.010	0.008	-0.008	-0.132
Leaf length (cm)	0.003	-0.019	0.008	**0.085**	0.046	-0.036	-0.015	0.029	0.009	-0.021	0.072
Leaf width (cm)	-0.009	0.010	0.011	-0.038	**-0.070**	0.022	0.012	-0.026	-0.009	0.015	0.020
Tuber length (cm)	-0.086	0.044	-0.058	-0.110	-0.084	**0.264**	0.086	-0.027	0.161	-0.080	0.566
Tuber girth (cm)	0.008	-0.007	0.002	-0.004	-0.004	0.008	**0.023**	-0.004	0.002	-0.004	0.274
Dry matter (%)	-0.004	-0.005	0.005	-0.005	-0.005	0.001	0.002	**0.014**	-0.006	0.006	0.124
No. of marketable tuber yield/plant	-0.137	0.112	-0.189	0.061	0.074	0.348	0.061	0.248	**0.571**	-0.356	0.696
No. of non-marketable tuber yield/plant	0.012	0.005	-0.014	0.010	0.009	0.013	0.008	0.019	0.027	**-0.043**	-0.460

During First Year: RESIDUAL EFFECT = 0.0921, During Second Year: RESIDUAL EFFECT = 0.0304

No of non-marketable tuber yield/plant in both the years, while for traits viz ; vine length (cm), dry matter (%) and tuber yield (kg)/plot in first year (Table 2). PCV bit higher than GCV for all the studied traits in both the years which indicated that these traits influenced by genotypic as well as environmental factors. Similar findings reported by Padhan *et al.* (2019), Mulualem *et al.* (2023) and Athira *et al.* (2017). The high heritability coupled with high genetic advance were observed for characters viz ; days to 50% plant emergence, tuber length (cm) and no. of non-marketable tuber yield/plant which indicating the preponderance of additive gene action. Similar findings were reported by Padhan *et al.* (2019), Mulualem *et al.* (2023), Athira *et al*. (2017) and Vandna *et al.* (2020).

The aim of correlation studies in primarily to know the suitability of various characters responsible for survival of other traits (Searle 1965). The indirect selection is more effective than direct selection procedure, when the attribute in question has low heritability and/or is not easily and precisely measurable. Correlation coefficients among the various component characters and their effects are presented in (Tables 3–4). Genetic as well as phenotypic correlation was worked for all the characters combination. Petiole length (cm) exhibited highly significant and positive correlation with tuber yield (kg)/plot while leaf length (cm) exhibited significant and positive correlation with leaf width (cm), tuber girth (cm), no. of marketable tuber yield/plant and negative tuber yield (kg)/plot similarly leaf length had leaf significant and positive correlation with leaf width (cm), tuber girth (cm) and tuber yield (kg)/plot width (cm). Tuber length (cm) also shown highly significant and positive correlation with No of marketable tuber yield/plant and tuber yield (kg)/plot. Similar findings were corroborated by Nwankwo *et al.* (2019), Mulualem *et al.* (2023), Athira *et al.* (2017) and Vandna *et al.* (2020). Tuber yield (kg)/plot also exhibited significant and positive correlation with No of marketable tuber yield/plant in both the years. Tuber length (cm), tuber girth (cm) and dry matter (%) had shown the significant and positive correlation with marketable tuber yield (t/ha) having high positive direct effect in both the year (Table 5). Similar findings were reported by Padhan *et al.* (2019) and Mulualem *et al.* (2023).

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