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RESEARCH PAPER

Correlation and regression analysis for rhizome yield and component characters in tikhur (*Curcuma angustifolia* Roxb.)

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Abstract : An investigation was conducted to analyze the correlation and regression in tikhur for rhizome yield and component characters. The experiment was conducted during *Kharif* seasons 2010-11 and 2011-12 at S.G. College of Agriculture and Research Station (IGKV), Jagdalpur, Bastar (C.G.). The experiment was laid out in Randomized Complete Block Design (RCBD) with 20 genotypes of tikhur with 3 replications. The genotypes were grown randomly in each replication in a total of 60 plots of 3.0 m × 2.4 m each containing 60 plants per plot. Observations were recorded from ten randomly selected sample plants in each treatment and observed mean value used for statistical analysis. The results clearly indicated that the correlation co-efficients were influenced by environmental factors. However, some of the characters exhibited some extent of association and not much affected by environment. The improvement of total rhizome yield t/ha and weight of mother rhizome per plant can be possible by practicing individual selection for weight of primary finger rhizome per plant, number of primary finger rhizome per plant, harvest index and thickness of secondary finger rhizome per plant. Hence, these characters must be given importance for further improvement of their population.

Key Words : Tikhur, Correlation, Regression, Rhizome yield

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INTRODUCTION

Tikhur (*Curcuma angustifolia* Roxb.) is an important annual herb of family Zingiberaceae. It is an important starchy plant. Simultaneously it is used as a medicine by tribal people of Chhattisgarh. In Chhattisgarh, it is found abundantly in the hilly tracts and forests of Bastar, Dantewada, Bijapur, Narayanpur, Kanker, Rajnandgaon, Kawardha, Dhamtari, Bilaspur, Raipur, Korba, Korea and Surguja districts. Bastar and Bilashpur divisions are the major potential area of the state for tikhur (Anonymous, 2005). Two types of tikhur are found in the Bastar division; one with creamy white flowers and another having light pink coloured flowers (Singh *et al.*, 1999). It is found that over exploitation of the species that resulted in bringing it in valuable category of IUCN. Thus, it has necessitated the cultivation of this species in the farmer's field. Growing demand for various pharmaceutical and food industries for a quality raw material rich in starch contents, require thorough studies for selection of best genotype and varieties which have high starch content, thus can only be met by selection of better natural source and then attempt for breeding better variety. Tikhur rhizomes are used as appetizer reducing burning sensations and stomach pains, removal of stone from kidney, useful for ulcer patient (Sharma, 2003) and rhizome pulp is used for treatment of headache as well as it

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gives cooling effect (Nag *et al.*, 2006). The rhizome pulp is a remedy for fever, joint pains and leucorrhoea. The starch obtained from the rhizomes is highly nutritious and easily digestible, therefore, it is recommended for infants, weak children and invalids. The starch of tikhur is used for the preparation of many sweet meals and herbal dishes like *halwa, barfi, jalebi* etc. It is used specially during fast (*Vrata, Upwas*). Farmers also prepare herbal drink "*sarbat*" through tikhur starch during summer due to its cooling effect (Singh and Palta, 2004). In the past, tikhur was occurring to a large extent throughout the *Sal* forest of Chhattisgarh. But at present the unscientific manner of harvesting and over exploitation have brought its occurrence to the restricted patches. Inspite of being an important medicinal herb, information on its superior genotypes, special characteristics correlation and regression with component characters is lacking. No research work has been carried out to screen superior genotypes for correlation and regression analysis in tikhur. Yield is an important economic character and it is ultimate effect of interaction between several metric traits and it is highly susceptible to change in environments. A few yield contributing characters may be directly and positively associated with yield, often provide useful indication in selection. Looking to the importance of the crop for people of the Chhattisgarh an investigation on correlation and regression analysis for rhizome yield and component characters in tikhur (*Curcuma angustifolia* Roxb.) was undertaken during the year of *Kharif* seasons 2010-11 and 2011-12 at Shaheed Gundadhoor College of Agriculture and Research Station (IGKV) Kumhrawand, Jagdalpur, Bastar, Chhattisgarh.

MATERIAL AND METHODS

The investigation was conducted at IGKV, Shaheed Gundadhoor College of Agriculture and Research Station, Kumhrawand, Jagdalpur, Bastar, Chhattisgarh during *Kharif* seasons of 2010-11 and 2011-12. Twenty indigenous genotypes [(1) IGBT-10-1, (2) IGKOT-10-1, (3) IGDMT-10-1, (4) IGDMT-10-2, (5) IGMOT-10-1, (6) IGSJT-10-1, (7) IGJT-10-1, (8) IGSJT-10-2, (9) IGSJT-10-3, (10) IGKT-10-1, (11) IGSJT-10-4, (12) IGBLT-10-1, (13) IGBT-10-2, (14) IGBT-10-3 (Local Check), (15) IGNT-10-1, (16) IGBT-10-4, (17) IGBLT-10-2, (18) IGKNT-10-1, (19) IGDNT-10-1and (20) IGBJT-10-1] of tikhur (*Curcuma angustifolia* Roxb.) collected from different districts of Chhattisgarh during March 2010 to June 2010. The experiment was laid out in Randomized Complete Block Design (RCBD) with 20 genotypes of tikhur with 3 replications. The genotypes were grown randomly in each replication in a total of 60 plots of 3.0 m × 2.4 m each containing 60 plants per plot and spacing was 60 x20 cm. Applied manure and fertilizers FYM: 20 tones/ ha, N: 60 kg/ha, P_2O_5: 40 kg/ha, K_2O: 60 kg/ha during the crop season. Full dose of FYM mixed in plots during field preparation. Half dose of N and full dose of P and K was mixed in the plots before planting (basal dose) and remaining half dose was applied 45 days after planting during intercultural operation and earthing-up. The crop was grown under rainfed condition. The data were recorded on 10 randomly selected plants for each genotype for each replication. The 19 growth and component characters of yield like plant height (cm), number of leaves per plant, leaf length (cm), leaf breadth (cm), leaf area index (LAI), days to maturity, harvest index (%), weight of mother rhizome plant^{-1} (g), weight of primary finger rhizome plant^{-1} (g), weight of secondary finger rhizome plant^{-1} (g), number of mother rhizome plant^{-1}, number of primary finger rhizome plant^{-1}, number of secondary finger rhizome plant^{-1}, thickness of mother rhizome plant^{-1} (cm), thickness of primary finger rhizome plant^{-1} (cm), thickness of secondary finger rhizome plant^{-1} (cm), dry matter per cent of rhizome plant^{-1}, starch recovery (%) and total rhizome yield t ha^{-1} were recorded in experimental field. The harvested rhizomes were cleaned up and mother rhizomes and finger rhizomes were separated and taken observations of rhizome characters. All the observations were taken from sprouting of rhizomes and up to maturity for estimation correlation and regression. It measures group distance based on multiple characters. Correlation co-efficients were calculated for all possible combinations among the characters at genotypic, phenotypic and environmental levels were estimated as given by Searle *et al.* (1961).

RESULTS AND DISCUSSION

Correlation co-efficient have been worked out in all possible combination and presented in Table 1, 2 and 3. Correlation and regression means association between two or more than two variables. It measures the mutual relationship between various plant characters and determines the component characters on which selection can be based for genetic improvement of dependent characters. Galton (1988) was the first to suggest the use of correlation index to describe the degree of association also affects the effectiveness of selection process. Correlation may be true or spurious. Genetic causes of true correlation are mostly due to linkage, pleiotropy and physiological associations necessitated by developmental biochemical pathways. Linkage is responsible for realizing transient correlation. The degree of correlation arising from pleiotropy expresses the extent to which the characters are influenced by the same gene. Correlation co-efficients between any two metric traits results from genetic and environmental causes. Environmental correlation is of little interest to breeders but it provides information on the extent of environmental influences on the two characters irrespective of their genetic differences and therefore genetic correlation usually reflects correlation of breeding values. In the pooled analysis (Table 1) plant height had positive and significant correlation with leaf length and thickness of mother rhizome per plant at genotypic and phenotypic levels significant and

Table 1: Correlation co-efficient analysis (phenotypic, genotypic and environmental) among total rhizome yield and its components of tikhur (*Curcuma angustifolia* Roxb.): Year-2010-11

Characters		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19$
Plant height (cm)	G	0.141	0.902	0.013	-0.376	0.470	-0.530	-0.032	0.066	-0.312	-0.157	-0.034	-0.057	0.494	0.273	0.457	-0.055	0.166	-0.200
	P	0.124	0.882**	0.026	-0.370*	0.443**	-0.426**	-0.032	0.061	-0.281*	-0.131	-0.24	-0.047	0.414*	0.156	0.366*	-0.047	0.142	-0.186
	E	-0.107	0.351*	0.312*	-0.086	-0.273*	0.053	-0.054	-0.028	0.445**	0.254	0.105	0.179	0.080	-0.159	-0.063	0.127	-0.119	-0.014
No. of leaves per	G	1.000	0.136	-0.168	-0.346	0.261	-0.091	0.179	-0.208	-0.489	-0.092	0.237	-0.305	-0.046	-0.160	0.256	0.401	0.025	-0.417
plant)	P	1.000	0.141	-0.151	-0.324*	0.240	-0.117	0.169	-0.191	-0.453	-0.115	0.168	-0.271*	-0.037	-0.145	0.225	0.372*	0.049	-0.399*
	E	1.000	0.239	0.035	0.002	-0.006	-0.245	0.067	-0.035	-0.061	-0.302	-0.349	0.093	-0.006	-0.180	0.133	0.085	0.201	-0.263
Leaf length (cm)	G		1.000	0.182	-0.153	0.652	-0.582	-0.119	-0.100	-0.389	-0.189	-0.030	-0.149	0.337	0.070	0.595	0.058	-0.028	-0.371
	P		1.000	0.186	-0.150	0.613**	-0.482**	-0.111	-0.083	-0.364*	-0.159	-0.033	-0.124	0.263*	0.020	0.493**	0.063	-0.038	-0.352
	E		1.000	0.260*	-0.075	-0.301*	-0.091	0.044	0.188	0.131	0.250	-0.077	0.352*	-0.117	-0.170	0.093	0.157	-0.156	-0.143
Leaf breadth (cm)	G			1.000	0.820	0.115	0.155	0.103	0.068	-0.020	0.071	0.094	0.075	0.006	-0.051	0.009	-0.124	0.078	0.108
	P			1.000	0.792**	0.099	0.141	0.091	0.073	-0.011	0.085	0.101	0.080	0.037	-0.031	0.037	-0.112	0.061	0.124
	E			1.000	0.011	-0.200	0.121	-0.098	0.149	0.141	0.250	0.185	0.152	-0.419**	0.010	0.211	0.029	-0.079	0.307
Leaf area index	G				1.000	-0.122	0.176	0.062	0.032	0.111	0.291	0.113	0.221	-0.339	-0.210	-0.269	-0.0002	-0.058	0.136
(LAI)	P				1.000	-0.121	0.151	0.067	0.036	0.104	0.274*	0.111	0.208	-0.275*	-0.125	-0.227	-0.002	0.065	0.136
	E				1.000	-0.125	0.141	0.370**	0.270	-0.258*	0.0163	0.226	-0.241	0.169	0.233	-0.108	-0.078	0.382*	0.298*
Days to maturity	G					1.000	-0.465	0.0065	-0.262	-0.531	-0.272	-0.310	-0.440	0.271	-0.150	0.516	0.453	-0.157	-0.574
	P					1.000	-0.409**	0.004	-0.254	-0.517**	-0.251	-0.302	-0.438**	0.243	-0.092	0.423**	0.430**	-0.117	-0.539**
	E					1.000	-0.285*	-0.058	-0.135	-0.234	0.024	-0.243	-0.410*	0.191	0.036	0.041	0.013	0.292*	-0.143
Harvest index (%)	G						1.000	0.014	0.167	0.524	0.062	0.250	0.260	-0.255	-0.072	-0.401	-0.165	0.062	0.541
	P						1.000	0.041	0.151	0.431**	0.042	0.245	0.183	-0.130	0.022	-0.329*	-0.134	0.007	0.478**
	E						1.000	0.227	0.115	0.068	-0.035	0.261*	-0.190	0.149	0.147	-0.181	-0.006	-0.168	0.298*
Moth. rhiz.Wt./	G							1.000	0.623	0.096	0.539	0.407	0.319	0.116	0.582	-0.213	-0.074	0.236	0.454
plant (g)	P							1.000	0.630**	0.081	0.483**	0.367*	0.309*	0.136	0.378*	-0.174	-0.051	0.207	0.419
	E							1.000	0.330*	-0.171	-0.184	-0.053	0.145	0.330*	0.022	-0.021	0.335*	-0.042	0.030
Prim. rhiz.Wt./	G								1.000	0.155	0.605	0.563	0.256	-0.059	0.874	-0.419	-0.192	0.513	0.787
plant (g)	P								1.000	0.144	0.555**	0.501**	0.235	-0.052	0.547**	-0.295*	-0.194	0.454**	0.724**
	E								1.000	-0.020	0.073	-0.048	-0.041	-0.030	-0.029	0.231	-0.231	0.036	0.145
Seco. Rhiz. Wt./	G									1.000	0.033	0.135	0.687	0.228	0.346	-0.435	-0.617	-0.016	0.677
plant (g)	P									1.000	0.027	0.122	0.650**	0.142	0.204	-0.358*	-0.579**	-0.022	0.624**
	E									1.000	-0.037	-0.018	0.003	-0.359*	-0.109	-0.052	0.048	-0.091	0.031
No. of moth. rhiz.	G										1.000	0.420	0.372	-0.544	0.266	-0.242	-0.137	0.437	0.467
/plant	P										1.000	0.381*	0.347*	-0.448**	0.114	-0.174	-0.132	0.402*	0.434**
	E										1.000	0.078	0.070	-0.102	-0.216	0.089	-0.078	0.182	0.161
No. of prim. rhiz./	G											1.000	0.105	-0.361	0.469	-0.079	-0.084	0.264	0.441
plant	P											1.000	0.099	-0.306*	0.308*	-0.089	-0.080	0.222	0.412*
	E											1.000	0.052	-0.121	0.067	-0.144	-0.047	-0.032	0.194

Table 1 : contd……

Table 1 : Contd.....

No. of seco.	G											1.000	0.119	0.295	-0.489	-0.366	0.122	0.543
rhiz./plant	P											1.000	0.079	0.127	-0.371*	-0.334*	0.094	0.487**
	E											1.000	-0.130	-0.169	0.164	0.158	-0.145	-0.118
Moth. rhiz. thick.	G												1.000	0.411	0.118	-0.281	-0.091	0.092
(cm)	P												1.000	0.238	0.037	-0.246	-0.086	0.041
	E												1.000	0.027	-0.145	-0.134	-0.078	-0.171
Prim. rhiz. thick.	G													1.000	-0.230	-0.434	0.764	0.799
(cm)	P													1.000	-0.119	-0.252	0.504**	0.455**
	E													1.000	0.016	0.140	0.137	-0.167
Second. rhiz. thick.	G														1.000	0.041	-0.232	-0.534
(cm)	P														1.000	0.015	-0.199	-0.437**
	E														1.000	-0.346*	-0.101	-0.109
DM % of rhiz.	G															1.000	-0.120	-0.527
/plant	P															1.000	-0.094	-0.494**
	E															1.000	0.135	-0.145
Starch recovery	G																1.000	0.433
(%)	P																1.000	0.372*
	E																1.000	-0.018

$ Total rhizome yield t/ha, * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2 : Correlation co-efficient analysis (phenotypic, genotypic and environmental) among total rhizome yield and its components of tikhur (*Curcuma angustifolia* Roxb.): Year 2011-12

Characters		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19$
Plant height (cm)	G	0.055	0.633	0.069	-0.065	0.075	0.357	0.073	0.057	0.087	0.131	-0.060	0.209	0.392	0.404	0.729	0.084	-0.379	0.005
	P	0.047	0.587**	0.055	-0.065	0.077	0.223	0.048	0.030	0.082	0.094	-0.066	0.163	0.306*	0.278*	0.600*	0.085	-0.202	0.010
	E	-0.054	0.088	-0.220	-0.094	0.106	0.083	-0.185	-0.247	0.016	-0.173	-0.153	-0.336*	0.1849	-0.172	0.289*	0.099	0.062	0.121
No. of leaves per	G	1.000	0.208	-0.152	-0.362	0.101	0.229	0.013	-0.022	-0.210	0.118	0.101	-0.041	0.167	-0.253	0.343	0.308	-0.009	-0.147
plant)	P	1.000	0.162	-0.137	-0.339*	0.129	0.169	0.014	0.005	-0.180	0.043	0.058	-0.043	0.109	-0.214	0.262*	0.279*	0.028	-0.138
	E	1.000	-0.166	0.011	-0.0771	0.399*	0.147	0.019	0.161	0.062	-0.302*	-0.183	-0.051	-0.022	-0.150	0.038	-0.003	0.112	-0.052
Leaf length (cm	G		1.000	0.190	-0.158	0.335	0.388	0.201	0.187	0.258	0.348	0.014	0.187	0.646	0.283	0.536	0.071	-0.279	0.131
	P		1.000	0.176	-0.149	0.306*	0.187	0.141	0.144	0.247	0.256*	-0.004	0.174	0.457**	0.271*	0.439*	0.076	-0.148	0.111
	E		1.000	0.029	-0.086	0.028	-0.108	-0.191	-0.112	0.152	-0.159	-0.105	0.090	0.062	0.304*	0.194	0.138	0.005	-0.122
Leaf breadth (cm)	G			1.000	0.828	0.251	0.092	0.318	0.085	0.243	0.026	0.057	0.116	0.242	0.318	0.035	-0.107	-0.179	0.226
	P			1.000	0.805**	0.231	0.088	0.278*	0.100	0.217	0.008	0.086	0.108	0.169	0.271*	0.022	-0.114	-0.077	0.222
	E			1.000	0.014	-0.061	0.189	0.0004	0.258*	-0.099	-0.122	0.372*	0.038	-0.022	0.233	-0.033	-0.247	0.116	0.149
Leaf area index	G				1.000	0.163	-0.163	0.090	-0.146	0.101	0.074	-0.048	-0.008	-0.125	0.106	-0.248	-0.011	-0.079	0.012
(LAI)	P				1.000	0.153	-0.099	0.082	-0.134	0.095	0.064	-0.046	-0.004	-0.087	0.078	-0.194	-0.010	-0.054	0.012
	E				1.000	-0.335*	-0.053	0.064	-0.033	-0.073	0.022	-0.163	0.250	0.168	-0.082	0.086	0.045	-0.297*	0.123

Table 2 : Contd.....

Table 2 : Contd.....

Days to maturity	G	1.000	-0.2318	-0.414	-0.448	0.0200	0.211	-0.355	-0.146	0.261	0.313	0.403	0.379	-0.215	-0.396
	P	1.000	-0.0827	-0.382*	-0.397*	0.004	0.169	-0.326*	-0.145	0.180	0.210	0.319*	0.351*	-0.059	-0.367*
	E	1.000	0.2355	-0.2016	-0.034	-0.171	-0.056	-0.144	-0.146	-0.019	-0.111	0.072	-0.054	0.268*	0.096
Harvest index (%)	G		1.000	0.611	0.463	0.542	0.369	0.390	0.384	0.4123	0.176	-0.031	0.190	-0.281	0.5857
	P		1.000	0.351*	0.296*	0.316*	0.141	0.239	0.270*	0.268*	0.217	0.097	0.064	0.149	0.407*
	E		1.000	0.063	0.134	0.030	-0.128	0.081	0.190	0.1603	0.263*	0.227	-0.241	0.373*	0.379*
Moth. rhiz.Wt.	G			1.000	0.896	0.663	0.343	0.751	0.428	0.234	0.378	0.076	-0.459	0.267	0.939
/plant (g)	P			1.000	0.832**	0.604**	0.304*	0.696**	0.410*	0.198	0.245	0.060	-0.390*	0.095	0.822**
	E			1.000	0.540**	0.272*	0.166	0.455**	0.330*	0.149	-0.046	0.024	0.100	-0.118	-0.032
Prim. rhiz.Wt.	G				1.000	0.599	0.256	0.745	0.429	0.377	0.486	0.125	-0.578	0.497	0.943
/plant (g)	P				1.000	0.528**	0.186	0.664**	0.416**	0.277*	0.318*	0.061	-0.529**	0.284*	0.837**
	E				1.000	0.065	-0.083	0.280*	0.350**	0.091	-0.071	-0.117	-0.177	0.075	-0.031
Seco.Rhiz. Wt.	G					1.000	0.388	0.534	0.704	0.072	0.319	0.181	-0.213	0.287	0.787
/plant (g)	P					1.000	0.317*	0.470**	0.665**	0.044	0.243	0.131	-0.194	0.153	0.732**
	E					1.000	-0.021	0.082	0.388*	-0.025	0.064	-0.024	0.041	-0.012	0.0088
No. of moth. rhiz.	G						1.000	0.166	0.017	0.243	0.308	-0.109	-0.007	0.560	0.185
/plant	P						1.000	0.153	0.0226	0.122	0.231	-0.069	-0.0006	0.193	0.179
	E						1.000	0.104	0.0489	-0.094	0.086	0.018	0.040	-0.206	0.211
No. of prim. rhiz./	G							1.000	0.6177	0.012	0.006	0.135	-0.588	0.249	0.823
plant	P							1.000	0.542*	0.022	0.068	0.113	-0.521	0.133	0.733**
	E							1.000	0.149	0.047	0.229	0.061	-0.044	0.012	0.050
No. of seco.	G								1.000	-0.189	-0.127	0.396	-0.436	-0.189	0.619
rhiz./plant	P								1.000	-0.209	-0.051	0.285*	-0.404*	-0.119	0.565**
	E								1.000	-0.315*	0.157	-0.018	-0.133	-0.061	0.066
Moth. rhiz. thick.	G									1.000	0.844	0.236	-0.137	0.117	0.225
(cm)	P									1.000	0.534**	0.156	-0.091	0.079	0.176
	E									1.000	0.147	0.047	0.039	0.054	0.109
Prim. rhiz. thick.	G										1.000	0.357	-0.196	0.183	0.353
(cm)	P										1.000	0.178	-0.159	0.228	0.297*
	E										1.000	-0.092	-0.094	0.280	0.251
Second. rhiz.	G											1.000	0.035	-0.561	0.074
thick. (cm)	P											1.000	0.045	-0.267*	0.077
	E											1.000	0.126	-0.029	0.154
DM % of rhiz.	G												1.000	-0.186	-0.533
/plant	P												1.000	-0.162	-0.522**
	E												1.000	-0.299*	-0.317*
Starch recovery	G													1.000	0.302
(%)	P													1.000	0.189
	E													1.000	0.114

$ Total rhizome yield t/ha, *and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 3 : Correlation co-efficient analysis (phenotypic, genotypic and environmental) among total rhizome yield and its components of tikhur (*Curcuma angustifolia* Roxb.): Pooled (2010-11 and 2012-13)

Characters		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19$
Plant height (cm)	G	0.093	0.868	0.057	-0.209	0.322	0.187	0.007	0.0884	-0.360	0.151	-0.067	0.024	0.405	0.267*	0.691	0.056	-0.121	-0.152
	P	0.072	0.665**	0.043	-0.167	0.217*	0.123	0.022	0.039	-0.054	0.027	-0.052	0.090	0.334**	0.224	0.510**	0.037	-0.081	-0.052
	E	0.005	-0.041	-0.017	0.0064	-0.051	0.134	0.0452	-0.023	0.254	-0.183	-0.036	0.158	0.264	0.197	0.130	-0.047	-0.015	0.096
No. of leaves per	G	1.000	0.165	-0.157	-0.350	0.216	0.283	0.100	-0.159	-0.580	0.015	0.191	-0.355	0.060	-0.271	0.287	0.351	0.024	-0.367
plant)	P	1.000	0.151	-0.144	-0.332**	0.195*	0.085	0.085	-0.081	-0.328**	-0.027	0.109	-0.154	0.040	-0.178	0.243*	0.327**	0.038	-0.261*
	E	1.000	0.009	0.019	-0.027	0.081	0.005	0.074	0.098	0.015	-0.189	-0.055	0.087	0.008	-0.085	0.078	0.076	0.101	-0.012
Leaf length (cm	G		1.000	0.186	-0.155	0.562	0.111	0.050	0.055	-0.146	0.109	-0.041	0.029	0.572	0.249	0.550	0.066	-0.118	-0.145
	P		1.000	0.181*	-0.150	0.485**	0.021	0.026	0.044	-0.080	0.074	-0.017	0.031	0.365**	0.143	0.464**	0.069	-0.093	-0.105
	E		1.000	0.111	-0.057	0.012	-0.051	-0.048	0.040	0.025	-0.052	0.049	0.070	-0.005	-0.017	0.109	0.111	-0.032	-0.008
Leaf breadth (cm)	G			1.000	0.819	0.178	0.214	0.291	0.116	0.167	0.046	0.123	0.193	0.196	0.178	0.024	-0.117	-0.020	0.234
	P			1.000	0.798**	0.147	0.090	0.193*	0.087	0.096	0.041	0.093	0.094	0.108	0.118	0.029	-0.114	-0.009	0.176
	E			1.000	0.002	-0.083	0.116	-0.095	0.056	-0.016	0.044	0.075	-0.033	-0.120	0.069	0.075	-0.071	0.040	0.042
Leaf area index	G				1.000	-0.010	-0.106	0.099	-0.088	0.169	0.195	0.041	0.189	-0.263	-0.043	-0.246	-0.006	0.002	0.091
(LAI)	P				1.000	-0.014	-0.034	0.075	-0.060	0.100	0.154	0.025	0.097	-0.173	-0.024	-0.209*	-0.006	0.004	0.069
	E				1.000	-0.170	-0.020	0.072	0.001	-0.041	0.019	-0.040	-0.050	0.044	0.046	-0.038	-0.027	0.069	0.047
Days to maturity	G					1.000	-0.088	-0.248	-0.469	-0.308	0.058	-0.457	-0.368	0.282	0.036	0.475	0.452	-0.212	-0.547
	P					1.000	-0.147	-0.158	-0.300**	-0.323**	-0.055	-0.298**	-0.306**	0.207*	0.025	0.365**	0.390**	-0.091	-0.446**
	E					1.000	-0.286	0.010	-0.033	-0.437	-0.343	-0.070	-0.346	0.117	0.014	0.029	-0.004	0.191	-0.275
Harvest index (%)	G						1.000	0.592	0.579	-0.342	0.0007	0.346	-0.043	0.269	0.293	-0.158	0.103	0.316	0.384
	P						1.000	0.267*	0.253*	0.298**	0.114	0.222*	0.228*	0.170	0.150	0.003	0.015	0.105	0.389**
	E						1.000	0.202	0.186	0.480	0.1938	0.212	0.291	0.160	0.125	0.088	-0.067	0.048	0.471
Moth. rhiz. Wt	G							1.000	0.838	0.480	0.5105	0.527	0.353	0.378	0.646	-0.064	-0.364	0.349	0.709
/plant (g)	P							1.000	0.754**	0.350**	0.372**	0.563**	0.367**	0.172	0.303**	-0.038	-0.237*	0.143	0.656**
	E							1.000	0.672	0.255	0.190	0.601	0.397	-0.020	0.030	0.002	0.1100	-0.120	0.595
Prim. rhiz.Wt.	G								1.000	0.736	0.426	0.545	0.517	0.410	0.876	-0.131	-0.546	0.630	0.939
/plant (g)	P								1.000	0.345**	0.321**	0.600**	0.341**	0.148	0.413**	-0.082	-0.382**	0.353**	0.791**
	E								1.000	0.067	0.201	0.648	0.248	-0.073	0.076	-0.015	-0.100	0.039	0.640
Seco.Rhiz. Wt.	G									1.000	0.060	0.518	0.697	0.140	0.556	-0.212	-0.731	0.408	0.862
/plant (g)	P									1.000	0.181*	0.299**	0.654**	0.091	0.222*	-0.112	-0.397**	0.062	0.673**
	E									1.000	0.308	0.151	0.6375	0.0579	0.027	-0.008	0.151	-0.252	0.536
No. of moth. rhiz.	G										1.000	0.279	0.159	-0.075	0.488	-0.166	-0.110	0.557	0.216
/plant	P										1.000	0.241*	0.155	-0.101	0.178	-0.111	-0.057	0.279*	0.279*
	E										1.000	0.204	0.1682	-0.134	-0.113	-0.002	0.1693	-0.144	0.369
No. of prim.	G											1.000	0.255	0.026	0.277	0.067	-0.492	0.363	0.649
Rhiz./ plant	P											1.000	0.351**	-0.114	0.177	0.027	-0.320**	0.172	0.599**
	E											1.000	0.414	-0.226	0.108	-0.029	-0.006	-0.034	0.555

Table 3 : Contd.....

Table 3 : Contd……….

No. of seco. rhiz./plant	G	1.000	0.133	0.189	-0.046	-0.748	0.120	0.535
	P	1.000	-0.084	0.049	-0.008	-0.371**	-0.020	0.531**
	E	1.000	-0.207	-0.018	0.028	0.057	-0.128	0.564
Moth. rhiz. thick. (cm)	G		1.000	0.719	0.193	-0.244	0.092	0.270
	P		1.000	0.395**	0.105	-0.161	0.005	0.119
	E		1.000	0.175	-0.009	-0.023	-0.087	-0.028
Prim. rhiz. thick (cm)	G			1.000	0.048	-0.342	0.650	0.731
	P			1.000	0.037	-0.206*	0.364**	0.370**
	E			1.000	0.029	-0.020	0.114	0.071
Second. rhiz. thick. (cm)	G				1.000	0.035	-0.345	-0.230
	P				1.000	0.017	-0.236*	-0.145
	E				1.000	-0.085	-0.032	-0.002
DM % of rhiz./ plant	G					1.000	-0.130	-0.690
	P					1.000	-0.129	-0.508**
	E					1.000	-0.197	-0.072
Starch recovery (%)	G						1.000	0.543
	P						1.000	0.270*
	E						1.000	-0.096

$ Total rhizome yield t/ha, * and ** indicate significance of values at P=0.05 and 0.01, respectively

negative correlation was showed in number of leaves per plant with weight of secondary finger rhizomes per plant at genotypic levels. Leaf breadth showed highly significant and positive correlation with leaf area index at genotypic and phenotypic levels. Days to maturity showed significant and negative correlation with total rhizome yield per plant at phenotypic level.

Harvest index showed highly significant and positive correlation with weight of primary finger rhizomes per plant and weight of mother rhizome per plant at genotypic level only. Harvest index also showed positive correlation with all combinations except weight of secondary finger rhizomes per plant, number of secondary finger rhizomes per plant, thickness of secondary finger rhizomes per plant and dry matter per cent of rhizomes at all levels.

Weight of mother rhizome per plant showed highly significant and positive correlation with weight of primary finger rhizome per plant and total rhizome yield t/ha at all three levels, while it had significant and positive correlation with weight of secondary finger rhizome per plant at genotypic level, number of mother rhizome per plant at genotypic level number of primary finger rhizome per plant at genotypic, phenotypical and environmental levels and thickness of primary finger rhizomes per plant at genotypic level.

Highly significant and positive correlation recorded in weight of primary finger rhizome per plant with total rhizome yield t/ha at all three levels, and it also showed highly significant and positive correlation with weight of secondary finger rhizome per plant at genotypic level only, number of primary finger rhizome per plant at all three levels, number of secondary finger rhizome per plant at genotypic level only, thickness of primary finger rhizomes per plant at genotypic level only, and starch recovery per cent at genotypic level only. It is also exhibited significant and negative correlation with dry matter per cent of rhizome per plant at genotypic level only.

Highly significant and positive correlation of weight of secondary rhizome per plant was recorded with total rhizome yield t/ha and number of secondary finger rhizome per plant at all three levels (genotypic, phenotypic and environmental), whereas significant positive correlation with number of primary finger rhizome per plant at genotypic level only and thickness of primary finger rhizome per plant at genotypic level only and thickness of primary finger rhizome per plant at genotypic level only. It is also exhibited highly significant and negative correlation with dry matter per cent of rhizome per plant at genotypic level only. Number of mother rhizome per plant had significant and positive correlation with thickness of primary finger rhizome per plant and starch recovery per cent at genotypic level only. Number of mother rhizome showed negative correlation with thickness of mother rhizome per plant and thickness of secondary rhizome per plant at genotypic, phenotypic and

Table 4: Summary of characters association in 20 genotypes of tikhur for rhizome yield and component character

Sr. No.	Character	Significant positive correlation with		
		Year 2010-11	Year 2011-12	Pooled analysis (2010-11 & 2011-12)
1.	Plant height (cm)	Leaf length	Leaf length and thickness of secondary finger rhizomes per plant	Leaf length and thickness of mother rhizome per plant
2.	No of leaves	Days to maturity, thickness of secondary finger rhizome per plant	Thickness of mother rhizome per plant and thickness of secondary finger rhizome per plant.	*
3.	Leaf length (cm)	*	*	*
4.	Leaf breadth (cm)	LAI	LAI	LAI
5.	Days to maturity	Thickness of secondary rhizome per plant, dry mater per cent,	Weight of primary finger rhizomes per plant	Total rhizome yield t/ha
6.	Harvest index (%)	Weight of secondary finger rhizome per plant and total rhizome yield t/ha	Weight of mother rhizome per plant wt. of primary finger riper plant wt. of secondary finger rhizome per plant and total rhizome yield t/ha	Primary finger rhizome per plant, weight of mother rhizome per plant.
7.	Weight of mother rhizome per plant (g)	Weight of primary finger rhizome per plant, thickness of primary finger rhizome per plants number of mother rhizome per plant total rhizome yield t/ha	Wt. of primary finger rhizome per plant wt. of secondary finger rhizome per plant. Number of primary finger rhizome per plant total rhizome yield t/ha	Weight of primary finger rhizome per plant and total rhizome yield t/ha wt. of secondary finger rhizome per plant, no of mother rhizome per plant no of primary finger rhizome per plant and thickness of primary finger rhizomes per plant
8.	Weight of primary finger rhizome per plant (g)	No. of mother rhizome per plant, number of primary finger rhizomes per plant thickness of primary finger rhizomes per plant. Total rhizome yield t/ha no of primary finger rhizome per plant and starch recovery per cent.	Wt. of secondary finger rhizome per plant, number of primary finger rhizome per plant and total rhizome yield t/ha thickness of primary finger rhizome per plant and starch recovery %.	Total rhizome field t/ha wt. of secondary finger rhizome pp no of primary finger rhizome pp. number of second finger rhizome per plant, thickness of primary finger rhizome pp starch recovery.
9.	Weight of secondary finger rhizome per plant (g)	No of secondary finger rhizome per plant, dry matter per cent of rhizome per plant and total rhizome yield t/ha	No of secondary finger rhizome per plant total rhizome yield t/ha number of primary finger rhizome per plant.	Total rhizome yield t/ha no of secondary finger rhizome per plant number of primary finger rhizome p.p. thickness of primary finger rhizome p.p.
10.	No. of mother rhizome per plant	Total rhizome yield t/ha	Starch recovery per cent	Thickness of primary finger rhizome p.p. starch recovery per cent
11.	No. of primary finger rhizomes pr plant	Thickness of primary finger rhizome per plant and total rhizome yield t/ha	No of secondary finger rhizome per plant and total rhizome yield t/ha	Total rhizome yield t/ha and dry mother per cent of rhizome per plant.
12.	No of secondary finger rhizome per plant	Total rhizome yield t/ha	Total rhizome yield t/ha	Total rhizome yield t/ha
13.	Thickness of mother rhizome per plant (cm)	*	Thickness of primary finger rhizome per plant	Thickness of primary finger s\rhizome per plant
14.	Thickness of primary finger rhizome per plant (cm)	Starch recovery (%) and total rhizome yield t/ha	*	Starch recovery per cent and total rhizome yield t/ha
15.	Thickness of secondary finger rhizome per plant	Total rhizome yield t/ha	Starch recovery per cent	*
16.	*	*	Total rhizome yield t/ha	Total rhizome yield t/ha

*Not positively correlated with any of the character

environmental levels. Highly significant and positive correlation of number of primary finger rhizome per plant was recorded with total rhizome yield t/ha at genotypic and phenotypic levels. It also recorded significant and positive correlation with total rhizome yield t/ha at environmental level only and with dry matter per cent of rhizomes per plant at genotypic level only. Number of secondary rhizome per plant had significant and positive correlation with total rhizome yield t/ha at genotypic and phenotypic levels. It is also showed highly significant and negative correlation with dry matter per cent of rhizome per plant at genotypic level only. Thickness of mother rhizome per plant had highly significant and positive correlation with thickness of primary finger rhizome per plant at genotypic level only. Highly significant and positive correlation of thickness of primary finger rhizome per plant was recorded only at genotypic level with starch recovery per cent and total rhizome yield t/ha.

Thickness of secondary rhizome per plant had negative correlation with starch recovery per cent and total rhizome yield t/ha at all levels. Starch recovery had significant and positive correlation with total rhizome yield t/ha only at genotypic level. The estimation of genetic correlation along with phenotypic ones will give a clear picture of the extent of inherent associations and also indicate as to how much of the phenotypic correlation co-efficient is influenced by the environment. If two characters show high magnitude of positive correlation co-efficient at genotypic level, it will reflect strong linkage at the genetic level but it the correlation values are high at phenotypic level only, it may show weak associations and may be broken up with the change in the said environment of the two correlation values for a pair of threads are high at environmental level, it would indicate that such association are found in that particular environment only and that there will be no such associations if that environment changes. The same principle is applicable to negative correlation values. It the pair of characters possesses low heritability then phenotypic correlation is deterred by the environmental correlation. If they have high heritability genetic correlation is more important. Therefore, in this investigation, an attempt was made to estimate the genotypic and environmental combinations in 20 genotypes of takhur during the year 2010-11, 2011-12 and on pooled basis. The summary of association of characters is given in Table 4. The correlation co-efficients were influenced by environmental factors. However, some of the associations such as plant height with leaf length and thickness of secondary finger rhizome per plant, number of leaves with thickness of secondary finger rhizome per plant, harvest index with weight of secondary finger rhizome per plant and total rhizome yield t/ha, weight of mother rhizome per plant with weight of primary finger rhizome per plant and total rhizome yield t/ha, weight of primary finger rhizome per plant, with number of primary finger rhizome per plant and total rhizome yield t/ha, weight of secondary finger rhizome per plant with number of secondary finger rhizome per plant and total rhizome yield t/ha, number of secondary finger rhizome per plant with total rhizome yield t/ha exhibited some extent of association and not much affected by the environment. The improvement of total rhizome yield t/ha and weight of mother rhizome per plant can be possible by practicing individual selection for weight of primary finger rhizome per plant, number of primary finger rhizome per plant, harvest index and thickness of secondary finger rhizome per plant. Hence, these characters must be given importance for further improvement of their population. Similar correlations were also obtained for some root and tuber crops by Li (1965), Thamburaj and Muthukrishnan (1976) and Naskar *et al.* (1986) in sweet potato and Biradar *et al.* (1978) in cassava.

Conclusion :

The correlation co-efficients were influenced by environmental factors. However, some of the characters exhibited some extent of association and not much affected by environment. The improvement of total rhizome yield t/ha and weight of mother rhizome per plant can be possible by practicing individual selection for weight of primary finger rhizome per plant, number of primary finger rhizome per plant, harvest index and thickness of secondary finger rhizome per plant. Hence, these characters must be given importance for further improvement of their population.

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REFERENCES

Anonymous (2005). Chhattisgarh Rajya Laghu Vanopaj, Bajar Sarvekshan Prativedan, CGMFPFED. pp 16,17 and 42.

Biradar, R.S., Rajendran, P.G. and Hrishi, N. (1978). Genetic variability and correlation studies in cassava (*Mainhot esculenta crants*). *J. Root Crops*, **4**(1) : 7-10.

Galton, F. (1988). Correlation and their measurement chiefly from anthropometric data *Proc. Royal. Soc.*, **45** : 135-145.

Li, L. (1965). Studies on correlation between yield components in sweet potato. Chung- Lua Nunghsueh Hui. *Pas. J. Agri. Ass. China*, **49**: 1-14.

Nag, J.L., Shukla, N., Pararey, P.M., Soni, V.K., Netam, C.R. and Pandey D.K. (2006). Effect of extraction methods on production of edible tikhur (*Curcuma angustifolia* Roxb.). Abstracts book, National Seminar on Medicinal, Aromatic & Spices Plants Perspective and Potential. IGKV, TCB, CARS, Bilaspur, Chhattisgarh. 185 pp.

Naskar, S.K. Ravindran, C.D. and Srinivasan, G. (1986). Correlation and path analysis in sweet potato. *J. Root Crops*, **12**(1): 33-35.

Searle, S.R. (1961). Phenotypic, genotypic and environmental correlations. *Biometrics*, **17** : 474-480.

Sharma, R. (2003). *Medicinal plants of India- An encyclopedia*. Daya Publishing House, Delhi. 75 pp.

Singh, J., Sharma, R.B. and Singh, R. (1999). Improved cultural practices for cultivation of medicinal herb - Tikhur. In : *Health care and development of medicinal plants.* pp. 319-324.

Singh, R. and Palta, A. (2004). Foods and beverages consumed by abujhmarias- A primitive tribe of Bastar in Chhattisgarh. *Tribal Health Bulletin*, **10**(1&2) : 33-40.

Thamburaj, S. and Muthukrishnan, C.R. (1976). Association of metric traits and path analysis in sweet potato (*Ipomea batatas* Lam.). *Madras agric. J.*, **63** : 1-8.