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Research Article

Variability and association analysis of curcumin content with yield components in turmeric (*Curcuma longa* L.)

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Abstract
Variability, correlation and path analysis of 24 yield and quality characters were assessed in turmeric using 15 genotypes. Wide genetic variability was observed among the genotypes for most of the characters studied. High GCV and PCV was observed for 17 characters except for plant height, leaf length, leaf width, primary rhizome length, secondary rhizome girth, diameter of inner core of primary rhizome and diameter of primary rhizome. High heritability coupled with high genetic advance as per cent of mean was observed for 23 characters except secondary rhizome girth. Simple correlation analysis revealed that fresh rhizome yield per plant showed positive and significant correlation with collar girth, length of mother rhizome, girth of mother rhizome, weight of mother rhizome, number of primary rhizome, weight of primary rhizome and number of secondary rhizome. From path analysis, it is understood that fresh rhizome yield exhibited high direct positive effect on girth of mother rhizome, weight of mother rhizome, weight of primary rhizome, number of secondary rhizome and curcumin content.

Key words
Turmeric, variability, correlation, path analysis, rhizome yield

Introduction

Turmeric (C*urcuma longa* L.), a perennial rhizomatous crop with India as its origin, is a potential spice crop, natural dye and gaining momentum for its medicinal use since ancient times. India contributes production of around 10, 51,160 tonnes from 1,93,395 ha area contributing to export value of 1, 24,189 lakhs (Spices Board, 2017). The major constituents of turmeric being curcuminoids, which has worldwide importance, to cure many ailments. The natural variability in turmeric is more and for genetic improvement, germplasm collections represent main source of variability till date. In recent times, the seed set and variability by artificial sexual mating system is seen in turmeric which contributes to variability. Rhizome yield and curcumin is a complex trait depending on a number of yield components and their associations (Anandaraj *et al.*, 2014). Quality parameters such as curcumin content, essential oil and oleoresin content are a function of various characters and their interaction with the environment. Hence, complete understanding of the strength and type of association between quality traits and yield component traits is a prerequisite for the formulation of a successful breeding programme. Taking this into consideration, the present study was performed to assess the genetic variability and association among various yield attributes on curcumin content in turmeric.

Material and Methods

The material of the present study comprised of 15 turmeric genotypes representing germplasm collections from all turmeric growing states of India. The genotypes were grown in a randomized block design with three replications at ICAR-Indian Institute of Spices Research, Experimental Farm, Peruvannamuzhi, Kerala during June 2016 to January 2017. Recommended package of practices was followed (Jayashree *et al.,* 2015). Agro morphological observations on 23 morphological and yield traits were recorded on five plants in each replication. Curcumin estimation was done using ASTA (2004). Variability parameters like phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (h^2) and genetic advance as per cent mean (GAM) were calculated by adopting the formulae given by Johnson *et al.* (1955). PCV and GCV were categorized as low, moderate or high following Sivasubramanian and Menon (1973). Heritability percentage was classified as suggested by Robinson *et al. (*1949). Genetic advance as per cent of mean (GAM) was categorized according to Johnson *et al.* (1955). Statistical scrutiny by simple correlation coefficient analysis was carried out as proposed by Goulden (1952) whereas path coefficient analysis was assessed as given by Dewey and Lu (1959) to assess the association between yield, curcumin and other yield component traits. Curcumin was estimated using ASTA 2004

Results and Discussion

The present study was conducted to assess variability and association among 15 genotypes for desired traits. Analysis of variance revealed significant differences among the genotypes for all

the traits studied (Table 1). *Per se* performance of 15 genotypes for 24 different traits revealed that significantly higher yield was recorded by Narendra Haldi 98 and IISR Pragati. Significantly high curcumin content was expressed in IISR Prathiba, IISR Pragati, SLP-389/1, Duggirala Red, Rajendra Sonia and Punjab Haldi 1. Maximum internodal length was recorded in SC-61 and Punjab Haldi 1. Significantly more number of mother rhizomes was observed in IISR Prathiba, IISR Pragati, SC-61, Varna and Rajendra Sonia. Weight of primary rhizome was maximum in IISR Pragati and SLP-389/1whereas maximum number of primary rhizomes was recorded in Varna. Range for each trait expresses the variability level for all traits among the genotypes which are presented in Table 2. This indicated the presence of wide spectrum of variation for all the characters except girth of secondary rhizome. Prasath *et al.* (2016) also indicated the presence of wide variability in turmeric.

Phenotypic coefficient of variation (PCV) was slightly higher than genotypic coefficient of variation (GCV) for all the traits. This emphasizes on wide scope of improvement through selection. High PCV and GCV was observed in most of the traits except for plant height, number of leaves, leaf length, leaf width, length of primary rhizome, length of secondary rhizome, girth of secondary rhizome, diameter of primary rhizome and primary inner core diameter. All the traits studied showed high heritability (h^2) and genetic advance expressed in percentage of mean (GAM); except girth of secondary rhizome which showed low heritability (Table 3). High heritability and high genetic advance as percent of mean indicates the presence of additive gene action with lesser environmental influence on these traits. Hence selection for these traits would be effective. The obtained result is in accordance with the result of Singh *et al.* (2012), Gupta *et al.* (2015) and Mishra *et al.* (2015) in different traits studied.

The economic value of turmeric is determined by fresh rhizome yield per plant and curcumin content. The genetic relationship between these two characters and their relationship with the yield components are important consideration in turmeric. Simple correlation analysis revealed that fresh rhizome yield per plant showed positive correlation with collar girth, length of mother rhizome, girth of mother rhizome, weight of mother rhizome, number of primary rhizome, weight of primary rhizome and number of secondary rhizome (Table 4). Similarly, earlier studies reported positive correlation of yield with weight of primary, number of primary rhizome and weight of mother rhizome (Aravind *et al.*, 2011, Prajapati *et al.*, 2014 and Verma *et al.*, 2014). Traits having positive correlation were also reinforced with high values of heritability. Thus, selection for these traits would in turn improve yield of turmeric. Curcumin content showed positive correlation with number of shoots, number of leaves, number of mother rhizomes, weight of primary rhizomes, intermodal length, diameter of primary rhizome, inner core of primary rhizome and outer core thickness of primary rhizome. Thus, selection for these traits may result in identification of genotypes with high curcumin content.

Path co-efficient analysis gave an insight into the direct and indirect effects of different characters on yield and also the degree of relationship among the traits under study. Fresh rhizome yield exhibited high direct positive effect on girth of mother rhizome, weigh of mother rhizome, weight of primary rhizome, number of secondary rhizome and curcumin content (Table 5). Similar findings were also reported by Aravind *et al.* (2011) and Prajapati *et al.* (2014). Weight of mother and primary rhizome had direct positive effect on fresh rhizome yield. Internodal length had moderate direct effect on fresh rhizome yield. Curcumin content had moderate positive indirect effect on yield *via* internodal length, diameter of primary rhizome, primary inner core diameter and primary outer thickness. The choice of economic trait for selection criteria based on path analysis are rhizome characters like weight of mother rhizome, girth of mother rhizome, weight of primary rhizome, number of primary rhizome and curcumin content.

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Table 1. Analysis of variance for different traits in turmeric genotypes

Characters	Replication	Treatment	Error
PH- Plant height (cm)	63.61	146.74**	76.03
NT- Number of tillers	0.34	2.38**	0.17
NL- Number of leaves	11.66	37.20**	4.76
PL - Petiole length (cm)	2.67	135.46**	5.06
LL - Leaf length (cm)	7.36	180.14**	4.74
LW - Leaf width (cm)	1.31	15.91**	1.37
CG - Collar girth (cm)	3.31	30.67**	1.37
LPR - Length of primary rhizome (cm)	0.02	5.72**	0.34
LMR - Length of mother rhizome (cm)	2.96*	16.45**	0.88
LSR - Length of secondary rhizome (cm)	0.37	2.51**	0.31
GMR - Girth of mother rhizome (cm)	0.96	23.07**	0.73
GPR - Girth of primary rhizome (cm)	0.47	8.51**	0.29
GSR - Girth of secondary rhizome (cm)	0.72	1.27	0.66
NMR - Number of mother rhizome	0.04	1.99**	0.03
WMR - Weight of mother rhizome (g)	32.84	10490.45**	140.81
NPR - Number of primary rhizome	1.81	21.78**	3.36
WPR - Weight of primary rhizome (g)	1135.29	6871.27**	673.55
NSR - Number of secondary rhizome	5.75	201.11**	4.29
PIL – Primary internodal length (cm)	0.08*	0.26**	0.02
DPR - Diameter of primary rhizome (cm)	0.01	0.18**	0.02
DIPR - Diameter of inner core of primary rhizome (cm)	0.01	0.13**	0.01
PCOT - Primary core outer thickness (cm)	0.004*	0.03**	0.001
CUR - Curcumin content (%)	0.02	7.33**	0.04
YLD - Fresh rhizome yield (g/ plant)	2483.16	40680.99**	3599.65

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Table 2. *Per se* performance of 15 genotypes for yield and yield attributing traits in turmeric genotypes

Genotypes	PH	NT	NL	PL	LL	LW	CG	LPR	LMR	LSR	GMR	GPR	GSR
Suvarna	156.87*	2.87	15.13	20.00	64.83*	18.47*	13.23	9.53	6.52	6.33*	10.99	6.84	4.97
IISR Prathiba	142.20	3.40	18.20	27.27	57.83	17.00	12.37	7.39	7.25	3.60	13.17	7.33	5.36
IISR Pragati	104.93	3.47	15.87	22.00	49.07	13.13	10.13	8.58	5.51	5.45	9.09	8.05*	6.79
SLP-389/1	90.20	3.07	13.67	18.60	46.80	14.93	10.60	11.27*	5.97	3.07	10.24	8.23*	5.12
SC-61	114.83	3.13	14.53	17.80	52.07	16.20	10.13	10.07*	7.21	5.56	9.96	6.14	4.79
Acc. 849	159.23*	2.53	16.67	17.93	70.07	19.47*	20.80*	8.86	14.60*	4.72	16.35*	7.78	5.64
BSR 2	151.23*	2.93	17.13	37.27*	60.77	15.93	11.63	8.83	7.30	4.73	13.13	7.41	5.67
CO 2	145.13	3.07	17.73	36.60*	65.33*	16.60	11.30	6.70	6.91	3.89	11.00	7.01	5.47
Varna	160.77*	2.93	14.53	17.33	67.57*	18.37*	11.87	10.12*	6.69	5.89	11.70	7.16	4.99
Duggirala Red	139.67	3.13	21.30*	28.10	62.73*	16.00	10.87	8.33	8.59	3.60	14.32	1.40	5.19
Rajendra Sonia	120.73	3.80*	20.47	26.60	54.67	13.30	10.40	8.26	7.29	4.79	9.99	8.05*	5.48
Narendra Haldi 98	126.57	1.17	12.17	16.27	55.03	16.43	17.93*	6.92	11.19*	4.33	16.24*	7.93	5.63
Punjab Haldi 1	108.80	5.27*	22.90*	20.57	46.77	10.63	8.43	8.91	9.87*	4.78	5.59	8.44*	6.93*
Megha Turmeric 1	145.23	3.77	22.27*	28.27*	66.37*	14.30	11.03	8.17	6.95	5.03	11.97	7.12	6.26
Rajapuri	115.13	2.07	11.80	21.67	53.83	16.97	10.63	11.22*	7.27	4.09	12.77	6.80	4.92
Mean	132.10	3.11	16.96	23.75	58.25	15.85	12.09	8.88	7.94	4.66	11.77	7.05	5.55
S.E.	5.03	0.23	1.26	1.30	1.26	0.68	0.67	0.34	0.54	0.32	0.49	0.31	0.47
CD (5%)	14.59	0.68	3.65	3.77	3.64	1.96	1.96	0.98	1.57	0.94	1.43	0.90	1.36
CV (%)	6.60	13.09	12.86	9.47	3.74	7.38	9.66	6.58	11.79	12.05	7.28	7.67	14.65

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Table 2. Contd……

Genotypes	NMR	WMR	NPR	WPR	NSR	PIL	DPR	DIPR	PCOT	CUR	YLD
Suvarna	1.27	68.93	9.80	217.80	28.47*	1.15	1.89	1.22	0.38	2.24	431.58
IISR Prathiba	3.47*	148.09	12.93	157.21	6.40	0.69	2.16	1.23	0.52*	4.90*	396.30
IISR Pragati	3.00*	84.20	10.53	292.50*	16.53	1.51	2.62*	1.87*	0.46	5.73*	577.93*
SLP-389/1	2.87	86.75	11.47	251.93*	3.13	1.29	2.23	1.24	0.49	4.77*	346.93
SC-61	3.20*	114.33	15.33	167.07	20.73*	1.39*	1.98	1.25	0.32	2.25	431.48
Acc. 849	1.80	266.13*	10.07	210.47	21.33*	0.83	2.31	1.40	0.35	1.57	728.42*
BSR 2	3.80*	173.77*	13.00	210.28	14.73	0.96	2.17	1.13	0.48	3.24	482.40
CO 2	2.47	85.27	6.33	109.80	8.93	1.03	2.07	1.27	0.41	3.23	236.08
Varna	2.73*	109.25	13.53*	223.67	26.67*	1.06	2.06	1.20	0.33	2.18	430.17
Duggirala Red	1.67	72.60	7.47	234.87	4.67	1.33	2.40	1.37	0.52*	4.16*	402.53
Rajendra Sonia	3.13*	86.33	8.60	240.67	10.00	1.31	2.41	1.43	0.51*	5.54*	462.15
Narendra Haldi 98	1.13	204.87*	9.00	164.27	21.20*	0.47	2.40	1.33	0.59*	1.03	416.33
Punjab Haldi 1	2.33	62.08	6.13	167.07	5.33	1.46*	2.50*	1.60*	0.52*	5.35*	301.03
Megha Turmeric 1	1.73	62.87	10.27	164.47	17.80	1.27	1.97	1.27	0.33	2.25	354.67
Rajapuri	2.07	91.13	8.20	152.47	9.67	1.16	1.77	1.00	0.32	2.32	346.47
Mean	2.44	114.44	10.18	197.64	14.37	1.13	2.20	1.32	0.44	3.38	422.97
S.E.	0.10	6.85	1.06	14.98	1.20	0.07	0.08	0.06	0.02	0.11	34.64
CD (5%)	0.28	19.86	3.07	43.44	3.47	0.21	0.25	0.17	0.05	0.33	100.42
CV (%)	6.77	10.37	18.02	13.13	14.42	11.17	6.70	7.59	6.74	5.87	14.18

Table 3. Variability parameters for yield and its attributing traits in turmeric genotypes

Character	Mean	Minimum	Maximum	PCV (%)	GCV (%)	h^2 (%)	GAM %
PH	132.10	90.20	160.77	17.56	16.27	85.87	31.06
NT	3.11	1.17	5.27	30.58	27.64	81.68	51.46
NL	16.96	11.80	22.90	23.27	19.39	69.45	33.29
PL	23.75	16.27	37.27	29.33	27.76	89.57	54.12
LL	58.25	46.77	70.07	13.65	13.13	92.50	26.01
LW	15.85	10.63	19.47	15.73	13.89	77.99	25.27
CG	12.09	8.43	20.80	27.60	25.85	87.73	49.87
LPR	8.88	6.70	11.27	16.46	15.09	84.04	28.50
LMR	7.94	5.51	14.60	31.02	28.70	85.56	54.68
LSR	4.66	3.07	6.33	21.95	18.35	69.88	31.60
GMR	11.77	5.59	16.35	24.30	23.19	91.03	45.58
GPR	7.05	1.40	8.44	24.71	23.49	90.37	46.01
GSR	5.55	4.79	6.93	16.76	8.14	23.58	8.14
NMR	2.44	1.13	3.80	33.77	33.09	95.98	66.78
WMR	114.44	62.08	266.13	52.36	51.32	96.08	103.63
NPR	10.18	6.13	15.33	30.28	24.34	64.60	40.30
WPR	197.64	109.80	292.50	26.48	23.00	75.41	41.14
NSR	14.37	3.13	28.47	58.17	56.35	93.86	112.46
IPL	1.13	0.47	1.51	27.63	25.27	83.66	47.61
DPR	2.20	1.77	2.62	12.39	10.43	70.81	18.07
DIPR	1.32	1.00	1.87	16.67	14.84	79.25	27.21
PCOT	0.44	0.32	0.59	21.78	20.71	90.44	40.58
CUR	3.38	1.03	5.73	46.45	46.08	98.40	94.15
YLD	422.97	236.08	728.42	29.87	26.29	77.45	47.65

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Table 4. Simple correlation coefficients among yield and its attributing traits in turmeric genotypes

Trait	PH	NT	NL	PL	LL	LW	CG	LPR	LMR	LSR	GMR	GPR	GSR	NMR	WMR	NPR	WPR	NSR	PIL	DPR	DIPR	PCOT	CUR	YLD
PH	1.00																							
NT	-0.15	1.00																						
NL	0.20	0.74**	1.00																					
PL	0.31*	0.22	0.46**	1.00																				
LL	0.91**	-0.22	0.15	0.28	1.00																			
LW	0.62**	-0.56**	-0.41**	-0.10	0.64**	1.00																		
CG	0.44**	-0.55**	-0.26	-0.24	0.46**	0.61**	1.00																	
LPR	-0.30*	0.00	-0.35*	-0.45**	-0.25	0.07	-0.25	1.00																
LMR	0.23	-0.20	0.00	-0.28	0.22	0.22	0.68**	-0.21	1.00															
LSR	0.32*	0.12	0.04	-0.25	0.24	0.07	0.02	0.17	-0.16	1.00														
GMR	0.48**	-0.71**	-0.29	0.03	0.53**	0.64**	0.74**	-0.22	0.50**	-0.24	1.00													
GPR	-0.20	0.13	-0.15	-0.20	-0.28	-0.21	0.12	0.09	0.06	0.17	-0.26	1.00												
GSR	-0.13	0.43**	0.35*	0.15	-0.14	-0.40**	-0.04	-0.21	0.18	-0.01	-0.16	0.28	1.00											
NMR	-0.20	0.33*	0.07	0.35*	-0.31*	-0.22	-0.43**	0.12	-0.42**	-0.06	-0.33*	0.24	0.00	1.00										
WMR	0.33*	-0.49**	-0.28	-0.14	0.27	0.47**	0.82**	-0.18	0.69**	-0.08	0.70**	0.23	-0.05	-0.01	1.00									
NPR	0.14	-0.11	-0.28	-0.15	0.04	0.33*	0.05	0.26	-0.16	0.20	0.11	0.11	-0.25	0.45**	0.24	1.00								
WPR	-0.11	0.14	0.01	-0.20	-0.12	-0.07	-0.04	0.31*	-0.10	0.19	-0.07	0.02	0.08	0.16	-0.06	0.29*	1.00							
NSR	0.49**	-0.36*	-0.34*	-0.38**	0.46**	0.45**	0.42**	0.08	0.12	0.74**	0.23	0.14	-0.09	-0.30*	0.28	0.30*	0.06	1.00						
IPL	-0.41**	0.60**	0.31*	-0.03	-0.34*	-0.46**	-0.64**	0.37*	-0.40**	0.19	-0.7**	-0.2	0.13	0.19	-0.7**	-0.07	0.4**	-0.23	1.00					
DPR	-0.31*	0.25	0.22	-0.07	-0.33*	-0.40**	0.05	-0.40**	0.24	-0.22	-0.15	0.03	0.31*	0.07	0.11	-0.18	0.4**	-0.3*	0.13	1.00				
DIPR	-0.31*	0.40**	0.26	-0.14	-0.34*	-0.50*	-0.08	-0.29	0.07	0.15	-0.38*	0.13	0.41**	0.02	-0.08	-0.22	0.4**	-0.07	0.3*	0.8**	1.00			
PCOT	-0.30*	0.08	0.17	0.14	-0.42**	-0.38**	0.01	-0.42**	0.12	-0.42**	0.02	0.01	0.23	0.07	0.08	-0.25	0.15	-0.5**	-0.22	0.6**	0.33*	1.00		
CUR	-0.50**	0.63**	0.40**	0.24	-0.55**	-0.65**	-0.59**	-0.04	-0.37*	-0.25	-0.6**	0.07	0.28	0.52**	-0.5**	-0.14	0.37*	-0.7**	0.5**	0.5**	0.5**	0.48**	1.00	
YLD	0.23	-0.17	-0.12	-0.24	0.20	0.24	0.54**	0.08	0.46**	0.26	0.41**	0.16	0.13	0.03	0.62**	0.32*	0.6**	0.4**	-0.12	0.21	0.25	-0.07	-0.1	1.00

* ,** - Significant at 5% and 1% levels, respectively

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Table 5. Path coefficient analysis showing direct and indirect effects of yield attributing traits on fresh rhizome yield per plant in turmeric genotypes

Character	PH	NT	NL	PL	LL	LW	CG	LPR	LMR	LSR	GMR	GPR	GSR	NMR	WMR	NPR	WPR	NSR	PIL	DPR	DIPR	PCOT	CUR	YLD
PH	**-0.176**	-0.014	-0.015	0.048	0.052	-0.089	0.003	-0.007	0.043	0.052	0.212	0.006	0.001	0.039	0.253	0.013	-0.034	0.178	-0.100	0.061	-0.028	0.064	-0.337	0.226
NT	0.026	**0.093**	-0.057	0.034	-0.013	0.080	-0.004	0.000	-0.037	0.020	-0.312	-0.004	-0.004	-0.065	-0.376	-0.010	0.043	-0.133	0.145	-0.049	0.036	-0.016	0.431	-0.172
NL	-0.035	0.070	**-0.076**	0.070	0.009	0.059	-0.002	-0.008	-0.001	0.006	-0.129	0.005	-0.004	-0.014	-0.213	-0.026	0.002	-0.126	0.074	-0.043	0.024	-0.035	0.272	-0.122
PL	-0.054	0.020	-0.035	**0.154**	0.016	0.014	-0.002	-0.010	-0.052	-0.041	0.013	0.006	-0.002	-0.068	-0.112	-0.014	-0.065	-0.140	-0.008	0.014	-0.012	-0.029	0.163	-0.242
LL	-0.161	-0.021	-0.012	0.043	**0.057**	-0.092	0.004	-0.006	0.041	0.039	0.234	0.009	0.001	0.061	0.208	0.004	-0.039	0.167	-0.082	0.063	-0.031	0.089	-0.375	0.203
LW	-0.109	-0.052	0.031	-0.015	0.036	**-0.143**	0.005	0.002	0.041	0.012	0.284	0.006	0.004	0.043	0.360	0.031	-0.024	0.166	-0.112	0.079	-0.045	0.080	-0.440	0.241
CG	-0.078	-0.051	0.020	-0.037	0.026	-0.087	**0.008**	-0.006	0.126	0.003	0.326	-0.004	0.000	0.084	0.634	0.005	-0.013	0.154	-0.156	-0.009	-0.007	-0.002	-0.399	0.538**
LPR	0.053	0.000	0.027	-0.069	-0.014	-0.011	-0.002	**0.023**	-0.039	0.028	-0.098	-0.003	0.002	-0.023	-0.142	0.025	0.101	0.029	0.091	0.077	-0.027	0.089	-0.030	0.085
LMR	-0.040	-0.019	0.000	-0.043	0.013	-0.031	0.005	-0.005	**0.186**	-0.027	0.222	-0.002	-0.002	0.082	0.534	-0.015	-0.033	0.045	-0.097	-0.047	0.007	-0.026	-0.250	0.458**
LSR	-0.056	0.012	-0.003	-0.039	0.014	-0.011	0.000	0.004	-0.031	**0.163**	-0.107	-0.005	0.000	0.012	-0.065	0.019	0.060	0.272	0.047	0.043	0.013	0.089	-0.166	0.265
GMR	-0.084	-0.066	0.022	0.004	0.030	-0.092	0.006	-0.005	0.094	-0.040	**0.440**	0.008	0.002	0.065	0.539	0.010	-0.022	0.083	-0.166	0.029	-0.034	-0.004	-0.406	0.413**
GPR	0.036	0.012	0.012	-0.031	-0.016	0.030	0.001	0.002	0.010	0.028	-0.115	**-0.030**	-0.003	-0.048	0.182	0.011	0.008	0.051	-0.035	-0.006	0.012	-0.003	0.050	0.157
GSR	0.023	0.040	-0.027	0.023	-0.008	0.057	0.000	-0.005	0.033	-0.001	-0.068	-0.008	**-0.010**	-0.001	-0.035	-0.023	0.026	-0.034	0.032	-0.059	0.037	-0.048	0.187	0.129
NMR	0.035	0.031	-0.005	0.054	-0.017	0.032	-0.003	0.003	-0.078	-0.010	-0.146	-0.007	0.000	**-0.197**	-0.009	0.042	0.052	-0.110	0.047	-0.014	0.002	-0.015	0.351	0.035
WMR	-0.057	-0.045	0.021	-0.022	0.015	-0.067	0.006	-0.004	0.129	-0.014	0.307	-0.007	0.001	0.002	**0.774**	0.022	-0.019	0.104	-0.168	-0.022	-0.008	-0.018	-0.314	0.616**
NPR	-0.025	-0.010	0.021	-0.023	0.002	-0.048	0.000	0.006	-0.030	0.033	0.048	-0.004	0.003	-0.089	0.183	**0.093**	0.094	0.111	-0.017	0.035	-0.020	0.053	-0.097	0.324*
WPR	0.019	0.013	0.000	-0.031	-0.007	0.011	0.000	0.007	-0.020	0.031	-0.030	-0.001	-0.001	-0.032	-0.045	0.028	**0.320**	0.022	0.093	-0.076	0.034	-0.033	0.254	0.553**
NSR	-0.085	-0.034	0.026	-0.059	0.026	-0.065	0.003	0.002	0.023	0.121	0.100	-0.004	0.001	0.059	0.220	0.028	0.019	**0.366**	-0.056	0.057	-0.006	0.096	-0.448	0.389**
IPL	0.073	0.056	-0.023	-0.005	-0.019	0.066	-0.005	0.008	-0.075	0.031	-0.302	0.004	-0.001	-0.038	-0.538	-0.007	0.122	-0.085	**0.242**	-0.025	0.028	0.047	0.321	-0.125
DPR	0.055	0.024	-0.017	-0.011	-0.018	0.058	0.000	-0.009	0.045	-0.036	-0.065	-0.001	-0.003	-0.015	0.087	-0.017	0.124	-0.107	0.031	**-0.195**	0.070	-0.129	0.342	0.213
DIPR	0.055	0.037	-0.020	-0.021	-0.019	0.071	-0.001	-0.007	0.014	0.024	-0.166	-0.004	-0.004	-0.004	-0.065	-0.020	0.120	-0.026	0.074	-0.151	**0.090**	-0.070	0.346	0.252
PCOT	0.053	0.007	-0.013	0.021	-0.024	0.054	0.000	-0.010	0.023	-0.069	0.007	0.000	-0.002	-0.014	0.065	-0.024	0.049	-0.167	-0.054	-0.119	0.030	**-0.211**	0.327	-0.069
CUR	0.087	0.059	-0.031	0.037	-0.031	0.093	-0.005	-0.001	-0.069	-0.040	-0.264	-0.002	-0.003	-0.102	-0.358	-0.013	0.120	-0.242	0.115	-0.098	0.046	-0.102	**0.678**	-0.125

* ,** - Significant at 5% and 1% levels, respectively Residual effect: 0.3100