Association studies for yield and quality traits in ginger (*Zingiber officinale* Rosc.)

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ABSTRACT

Genotypic and phenotypic correlation coefficients were estimated for yield, yield attributing and quality traits in 28 ginger genotypes. The genotypic correlation coefficients were higher in magnitude than phenotypic correlation coefficients. The characters *viz.,* plant height, number of leaves on main shoot, shoot diameter, rhizome thickness and dry recovery which showed highly significant positive correlation with rhizome yield. Essential oil showed highly significant and positive correlation with oleoresin and crude fibre.

Keywords: Genotypic, phenotypic, correlation, ginger, association

INTRODUCTION

Ginger (*Zingiber officinale* Rose.) belongs to the family Zingiberaceae and is one of the important and widely used spice throughout the world, for its universal appeal and lemon flavour (Nybe and Miniraj, 2005). It is one of the oldest and most important spices, being cultivated in Tropical Asia for over 3000 years (Purseglove *et al.*, 1981). Ginger plays an important role in Indian Ayurvedic medicine.

Scope to improve any crop depends on the magnitude of genetic variability present in the germplasm collections. Greater the variability in the germplasm, better would be the chances of selecting superior genotypes (Simmonds, 1962). Breeding of ginger through selection and hybridization is seriously handicapped by lack of variability, absence of natural seed set and exclusive vegetative propagation. The understanding regarding the nature and magnitude of association among plant traits is essential to improve the crop yield. Knowledge of genetic and phenotypic association among economic traits helps in development of high yielding cultivars through different strategies. To understand the association of plant characters with yield and to get clear picture of genetic variability, correlation studies are helpful. In this regard the present study was conducted to understand the association between different yield, yield attributing and quality traits in ginger.

MATERIAL AND METHODS

Experimental details

The present study was carried out at ICAR-Indian Institute of Spices Research, Experimental Farm, Peruvannamuzhi, Kozhikode, Kerala for two consecutive years 2016-17 and 2017-18 with 28 ginger genotypes *viz.,* IISR Varada, IISR Mahima, IISR Rejatha, Suprabha, Suravi, Suruchi, Sourabh, Athira, Karthika, Aswathy, KAU Chandra, Mohini, Rio de Janeiro, Nadia, Maran, Himachal, Bhaise, Gorubathane, Mahim, Zaheerabad local, Arunachal Pradesh local, Acc. 247, Acc. 65, Acc. 578, Acc. 219, Acc. 833, RG 3 and red ginger. Fourteen different yield, yield attributing and quality traits such as plant height, number of tillers, number of leaves on main shoot, total number of leaves, leaf length, leaf width, leaf area, shoot diameter, rhizome thickness, yield per plant, dry recovery, essential oil, oleoresin and crude fibre were studied.

Statistical analysis

The estimates of genotypic and phenotypic correlation coefficients were estimated by using the SPSS 16.0 software.

RESULTS AND DISCUSSION

To understand the association of plant characters with yield and to get clear picture of genetic variability, correlation studies are helpful. The correlation coefficients among the different characters were worked out at phenotypic (Table 1) and genotypic levels (Table 2). In general, the genotypic correlation coefficients were higher in magnitude than phenotypic correlation coefficients.

Table 1: Estimates of phenotypic correlation coefficients among different traits in ginger

	Plant ht. (cm)	No. of tillers	No. of leaveson mainshoot	Total no. of leaves	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Shoot diameter (cm)	Rhizome thickness (cm)	Yield/ plant (g)	Dry recovery (%)	Essential oil (%)	Oleores in (%)
No. of tillers	-0.237*	1											
No. of leaves on main shoot	0.324**	-0.364**	1										
Total no. of leaves	-0.055^{NS}	0.836**	0.001^{NS}	1									
Leaf length (cm)	0.237*	-0.120^{NS}	-0.025^{NS}	-0.152^{NS}	1								
Leaf width (cm)	0.045^{NS}	0.134^{NS}	-0.159^{NS}	-0.007^{NS}	0.560**	1							
Leaf area	0.139^{NS}	0.043^{NS}	-0.122^{NS}	-0.071^{NS}	0.823**	0.926**	1						
Shoot diameter (cm)	0.270**	-0.178^{NS}	0.390**	0.015^{NS}	0.167^{NS}	0.151^{NS}	0.174^{NS}	1					
Rhizome thickness (cm)	0.297**	-0.419**	0.224*	-0.330**	0.076^{NS}	0.017^{NS}	0.156^{NS}	-0.019^{NS}	1				
Yield/plant (g)	0.201*	0.372**	0.293**	-0.180^{NS}	0.112^{NS}	-0.039^{NS}	0.113^{NS}	-0.190*	-0.331**	1			
Dry recovery (%)	0.167^{NS}	-0.201*	0.019^{NS}	-0.080^{NS}	0.033^{NS}	-0.152^{NS}					1		
Essential oil (%)	-0.198*	0.150^{NS}	0.030^{NS}	0.030^{NS}	0.161^{NS}*	0.143^{NS}					-0.526**	1	
Oleoresin (%)	-0.300**	0.346**	-0.123^{NS}	0.147^{NS}	0.061^{NS}	0.184^{NS}					-0.605**	0.864**	1
Crude fibre (%)	-0.197*	0.201*	-0.047^{NS}	0.054^{NS}	0.024^{NS}	0.159^{NS}					-0.447**	0.433**	0.599**

*Significant @ 5% level of significance; **Significant @ 1% level of significance

Table 2: Estimates of genotypic correlation coefficients among different traits in ginger

	Plant ht. (cm)	No. of tillers	No. of leaves on main shoot	Total no. of leaves	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Shoot diameter (cm)	Rhizome thickness (cm)	Yield/ plant (g)	Dry recovery (%)	Essential oil (%)	Oleores in (%)
No. of tillers	-0.557**	1											
No. of leaves on main shoot	0.862**	-0.553**	1										
Total no. of leaves	-0.085^{NS}	0.869**	-0.120^{NS}	1									
Leaf length (cm)	0.092^{NS}	-0.468**	0.450**	-0.538**	1								
Leaf width (cm)	-0.319**	0.200*	-0.070^{NS}	-0.022^{NS}	0.742**	1							
Leaf area	-0.188*	-0.028^{NS}	0.114^{NS}	-0.207*	0.908**	0.956**	1						
Shoot diameter (cm)	0.390**	-0.290**	0.877**	-0.003^{NS}	0.558**	0.095^{NS}	0.282**	1					
Rhizome thickness (cm)	0.289**	-0.546**	0.335**	-0.362**	0.377**	0.331**	0.378**	0.748**	1				
Yield /plant (g)	0.408**	0.443**	0.403**	-0.267**	0.206*	0.030^{NS}	0.140^{NS}	0.353**	0.589**	1			
Dry recovery (%)	0.526**	-0.329**	0.166^{NS}	-0.124^{NS}	0.034^{NS}	-0.655**	-0.455**	0.135^{NS}	0.208*	0.276**	1		
Essential oil (%)	-0.365**	0.145^{NS}	0.089^{NS}	0.030^{NS}	0.672**	0.427**	0.531**	0.259**	-0.289**	-0.444**	-0.715**	1	
Oleoresin (%)	-0.566**	0.378**	-0.209*	0.153^{NS}	0.323**	0.420**	0.410**	-0.111^{NS}	-0.421**	-0.561**	-0.885**	0.915**	1
Crude fibre (%)	-0.401**	0.277**	-0.029^{NS}	0.112^{NS}	-0.037^{NS}	0.283**	0.180^{NS}	-0.339**	-0.482**	-0.301**	-0.632**	0.478**	0.662**

*Significant @ 5% level of significance; **Significant @ 1% level of significance

Phenotypic correlation

Phenotypic correlation coefficients showed that, yield per plant had significant and positive correlation with plant height (0.201), number of leaves on main shoot (0.293), shoot diameter (0.221), rhizome thickness (0.383) and dry recovery (0.201). Plant height showed highly significant positive correlation with the number of leaves on main shoot (0.324), shoot diameter (0.270), rhizome thickness (0.297) and significant correlation with leaf length (0.237). Number of tillers showed highly significant and positive correlation with total number of leaves. Number of leaves on main shoot had highly significant correlation with shoot diameter (0.390). Leaf area has highly significant and positive correlation with leaf length (0.823) and leaf width (0.926). These findings are supported by Saikia and Shadeque (1992), Sasikumar *et al.* (1992), Pandey and Dobhal (1993), Abraham and Latha (2003) where the vegetative parameters *viz.,* plant height, number of leaves, shoot diameter and rhizome character like rhizome thickness showed positive correlation with yield. Nandkangre *et al.* (2016) also reported high significant correlations among rhizome yield, rhizome weight per plant, numbers of leaves, leaf length and plant height.

Essential oil has shown highly significant and positive correlation with oleoresin (0.864) and crude fibre (0.433) and crude fibre exhibited highly significant positive correlation with oleoresin (0.599). Whereas, rhizome thickness exhibited significant and negative correlation with essential oil (-0.192), oleoresin (-0.312) and crude fibre (-0.331). This might be due to less number of total oil cells when the thickness of the rhizome increases. Also, bold rhizomes recorded less crude fibre content and are suitable for vegetable purpose.

Genotypic correlation

The genotypic correlation coefficients between different characters revealed that yield per plant had highly significant and positive correlation with plant height (0.408), number of leaves on main shoot (0.403), shoot diameter (0.353), rhizome thickness (0.589), dry recovery (0.276) and leaf length (0.206). Similarly like phenotypic correlation, genotypic correlation for plant height showed positive association with number of leaves on main shoot (0.862), shoot diameter (0.390) and rhizome thickness (0.289). Number of tillers had highly significant positive correlation with total number of leaves (0.869). Number of leaves on main shoot exhibited positive correlation with leaf length (0.450), shoot diameter (0.877) and rhizome thickness (0.335).

Leaf area had highly significant and positive correlation with leaf length (0.908) and leaf width (0.956). Leaf length showed positive association with leaf width (0.742), shoot diameter (0.558), rhizome thickness (0.337), essential oil (0.672) and oleoresin (0.323).

Similar findings have been reported by Ravishanker *et al.* (2013), where the rhizome yield had significant positive correlation with plant height, length of primary rhizome and rhizome thickness in ginger. The characters that displayed consistency in trait association over the years could be the potential traits that need to be addressed for the improvement of gingers. Plant height appeared to display significant and positive correlation with yield contributing traits. The same trait was also concluded to be of prime importance in the selection program on the basis of its positive and significant correlation with rhizome yield (Sasikumar *et al.*, 1992).

Essential oil showed highly significant and positive correlation with oleoresin (0.915) and crude fibre (0.478). Crude fibre had highly significant and positive correlation with oleoresin (0.662). Genotypic correlation also exhibited high negative correlation of rhizome thickness with essential oil (-0.289), oleoresin (-0.421) and crude fibre (-0.482).

CONCLUSION

The characters *viz.,* plant height, number of leaves on main shoot, shoot diameter, rhizome thickness and dry recovery which showed highly significant positive correlation with rhizome yield can be used for selection of high yielding genotypes.

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