ORIGINAL RESEARCH PAPER

Engineering

YIELD AND QUALITY COMPONENT ANALYSIS OF GINGER (*ZINGIBER OFFICINALE ROSCOE*) IN EASTERN GHAT HIGH LAND ZONE OF ODISHA.

KEY WORDS: Ginger, genetic variability, correlation, component analysis

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ABSTRACT

A biometrical investigation on genetic variability, genetic advance, heritability, character association and path coefficient analysis was conducted taking fifteen ginger genotypes and five yield attributing traits for making clonal selections. Significant genotypic differences existed among the genotypes for all the characters studied. High value of phenotypic coefficient of variability(PCV), genotypic coefficient of variability(GCV), heritability and genetic advance as per cent of mean values indicated scope for improvement in rotting percent, dry recovery per cent, oleoresin per cent and fresh rhizome yield. Both at phenotypic and genotypic level, fresh rhizome yield was found positively and strongly correlated with dry recovery per cent and oleoresin per cent and negatively significantly correlated with rotting per cent. Path analysis revealed that the significantly positive associations of fresh rhizome yield in ginger with dry recovery per cent and oleoresin were due to high positive indirect effect via rotting per cent. Correlated response to selection revealed that, low rotting per cent in genotypes was increased the dry recovery per cent and fresh rhizome yield in ginger. So, due emphasis may be given to low rotting and high dry recovered genotypes in yield improvement.

Ginger (*Zingiber officinale Roscoe*) is an important delicacy, medicine, spice and monocotyledonous perennial herb belonging to the family Zingiberaceae. It is a valuable cash crop and widely used due to its pleasant pungent and spicy aroma required in the manufacture of a number of by products. Ginger plays an important role in Indian Ayurvedic medicine as a folk remedy to promote cleaning of the body through perspiration and stimulate cold treatments whereas ginger oil obtained from dry ginger powder is primarily used as a flavouring agent in confectionary, preservation as well as medicine. It is the basic need to develop high yielding varieties with better quality to increase the production and productivity of ginger in India. The available germplasm serves as most valuable natural reservoir for providing donor parent to improve the particular traits by genetic reconstruction of plant . Therefore, collection, conservation and evaluation of germplasm are essential for present as well as future crop improvement programmes. It is urgent need to exploit the existing ginger germplasm for assessing genetic variability, heritability and component analysis in ginger. Rhizome yield is a complex trait depends upon a number of yield component and their association. Magnitude and direction of association between two or more component result correlation coefficient. Correlation coefficient analysis reveals better understanding of yield component and assists in effective clonal selection and hybridization programmes as similar reported by Johnson et al. (1955) and Singh et al. (1985). Keeping this in background, the present investigation is an attempt to find out the existing genetic variability, associations among characters and to identify the strongest characters affecting yield in ginger.

METERIALS AND METHODS

The present experiment was conducted at High Altitude Research Station (Orissa University of Agriculture and Technology), Pottangi, Koraput, Odisha, India during Kharif season in years from 2007- 08 to 2011-12 to characterize fifteen ginger accessions selected from preserved Germplasm of this centre in Randomized Block Design (RBD) with three replications. This research station is located at an altitude of 914.4 M above mean sea level, latitude 18° 34' N and longitude 82°52' E besides NH-43 , 105 Km away from Vizianagaram (AP) Railway station and 175 km from Vishakhapatnam (AP) Airport in the district Koraput in Southern Odisha of Eastern Ghats High Land Zone. The experimental field had sandy loam, slightly acidic soil (pH 6.5), low in organic carbon and nitrogen, medium in phosphorus and potassium. The experimental field was prepared by deep ploughing by MB followed by harrowing twice whereas well decomposed manure F.Y.M @ 20 tonnes per hectare were applied during last harrowing before sowing. Selected rhizomes of large shiny and healthy were cut into pieces of 3-5cm in the length, 15- 20gm in weight with 2-3 buds. Rhizome treatment was done for 30 seconds with 1g carbendazim , 3g mancozeb, 1g plantomycin and 2ml quinalphous by dissolving in one litre water as a safeguard against soft rot and to induce early sprouting as similar reported by Ravishanker et al., 2013. Single bed size of 1m x 3m with spacing of 30cm x 25cm and 15cm bed height per replication per entry was maintained. The each germplasm pieces were sown on 10-15th may in each year and irrigation was done at weekly interval during summer as per requirement. Recommended package and protective measures were followed as and when to raise healthy ginger crop. The data were recorded from each treatment in each replication and replication wise mean data was used for statistical analysis for five diverse traits viz. dry recovery (%), essential oil (%), oleoresin (%), rotting (%) and fresh rhizome yield (t/ha). The analysis of variance (ANOVA) for RBD was estimated according to Panse and Sukhtame (1989) (Table 1). The genotypic and phenotypic variances were calculated according to Johnson et al. (1955) and Comstock and Robinson (1952). Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were calculated by the method suggested by Singh and Chaudhary (1985) whereas heritability in broad sense for yield and its components were worked out by using formula suggested by Hanson et al. (1956). Genetic advance (GA) was calculated by the method suggested by Johnson et al. (1955). Genotypic and phenotypic correlations were partitioned using the technique outlined by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Extreme significant treatment variance was found for all 5 diverse traits (Table 1). Data of fifteen entries with five diverse traits from Kharif 2007-08 to 2011-12 were analyzed and mean performance was shown (Table 2). Based on genetic variability analysis, eleven genotypes out of fifteen genotypes viz. V_2E_5-2, V_1E_4-5, V_3S_1-8, V_1S_1-2, Singhjhara, V_1C, S-692, Suprabha,V_1S_1-8,Acc-117,Acc-35 and S-646 were found to be most promising for rhizome yield and quality traits. In general, PCV estimates were higher than GCV estimates for all studied traits (Table 3). The GCV was found highest for rotting per cent (30.67%) followed by oleoresin content (12.03%) and fresh rhizome yield (12.37%), respectively. It indicates that the presence of maximum amount of genetic variability which emphasized the wide scope of selection for the improvement of these characters (Ravishanker et al., 2013). The influence of environment was expected to be minimum when difference between GCV and PCV was less in magnitude for all studied characters as similar reported by Pandey and Dobhal

(1993); Tiwari (2003) and Singh and Mittal (2003). Genotypic variance was highest for rhizome rotting per cent(70.517) followed by fresh rhizome yield(15.634) (Table 3). High heritability with low genetic advance in per cent of mean was observed for dry recovery per cent, essential oil per cent, oleoresin per cent and fresh rhizome yield (t/ha) which indicated the involvement of non-additive gene action for the expression of these traits and selection for such trait might not be rewarding. Based on high heritability coefficient (h2 bs) along with high genetic advance as percent of mean, rhizome rotting per cent (99.29, 62.74%) was found superior trait and representing additive genetic variance (Table 3) therefore, effective selection can be made for this trait as similar reported by Baranwal et al., 2012. Architecture of ginger rhizome as well as other tuber crops is basic selection parameter based on overall net effect produced by various yield components directly or indirectly by interacting with each another. Genotypic correlation coefficient revealed that rhizome yield had significant positive correlation with dry recovery per cent (0.772) and oleoresin per cent (0.659) and significant negative correlation with rhizome rotting per cent (-0.844). Among component traits, positive and significant association was observed between dry recovery per cent and rotting per cent(0.527), oleoresin and dry recovery per cent(0.571) and oleoresin per cent and dry recovery per cent(0.109) (Table 6). Among component traits, negative and significant association was observed between essential oil per cent and rotting per cent(-0.238)(Table 6). Continuous selection for yield and quality traits is known for fixing of genetic variability in crop plants (Desclaux, 2005). The present study indicated a broad genetic base in the ginger germplasm of India.

Correlated response to selection is presented in Table 5. The negative significant correlation between rotting per cent and dry recovery per cent(-6.429), rotting per cent and oleoresin per cent(-6.955) and rotting per cent and yield (t/ha) was revealed that the genotypes with low rotting per cent had higher yield with high dry recovery and oleoresin per cent. The positive association between rotting per cent and essential oil(2.270) revealed that susceptible ginger entries might have high oil per cent.

Thus, from these studies it can be inferred that emphasis may be given for the genotypes with lowest rotting per cent , high dry recovery per cent, high oleoresin and high fresh rhizome yield in ginger.

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Table -1: Pooled analysis of variance for five characters of fifteen ginger genotypes in Eastern Ghat High Land zone of Odisha

Sl. No.	Characters	Mean sum of Square		
		Replication(2)	Genotype (14)	Error (28)
1	Dry recovery percent	0.005	5.909**	0.014
2	Essential oil per cent	0.002	0.017**	0.003
3	Oleoresin per cent	0.001	1.367**	0.002
4	Rotting per cent	0.170	70.517**	0.167
5	Fresh rhizome yield per ha	0.456	15.634**	0.474

Table -2: Mean performance of ginger genotypes in Eastern Ghat High Land zone of Odisha from 2007-2011

Entries	Dry Recovery%	Essential oil%	Oleoresin %	Rotting %	Fresh rhizome yield(t/ha)
IG-1	20.067	1.233	4.667	24.700	14.733
IG-2	17.033	1.233	4.200	22.833	15.033
IG-3	18.000	1.133	5.300	21.500	13.667
S-646	21.033	1.300	6.400	18.200	17.700
V2E5-2	21.033	1.167	6.633	11.367	21.367
ACC-35	20.133	1.167	6.400	12.433	18.167
Singhjhara	20.967	1.100	5.367	11.533	19.200
S-692	21.267	1.367	5.267	21.533	18.700
ACC-117	21.133	1.200	5.400	13.233	17.767
V3S1-8	21.267	1.300	6.100	12.500	20.167
V1S1-2	20.833	1.267	6.100	11.633	20.267
V1S1-8	22.167	1.267	6.167	12.233	18.500
V1E4-5	22.300	1.167	5.633	10.333	21.400
V1C-8	20.200	1.167	5.400	17.367	18.167
Suprabha	21.200	1.300	5.367	16.267	17.767
C.D.	0.202	0.092	0.103	0.687	1.158
SE(m)	0.069	0.032	0.035	0.236	0.398
SE(d)	0.098	0.045	0.050	0.334	0.562
C.V.	0.585	4.461	1.092	2.579	3.789

Table -3: Estimates of parameters of Genetic variability, heritability and genetic advance for various characters of fifteen ginger genotypes in Eastern Ghat High Land zone of Odisha

Sl. No.	Characters	Phenotypic range	Mean+SE	PCV (%)	GCV (%)	GCV/PCV	Heritability (h2%)	Genetic Advance	GAM (% mean)
1	Dry recovery percent	16.8-22.6	20.6+0.21	6.83	6.81	0.99	99.28	2.88	13.98
2	Essential oil per cent	1.0-1.5	1.2+0.01	7.13	5.56	0.78	60.83	0.11	8.93
3	Oleoresin per cent	4.1-6.8	5.6+0.10	12.03	11.98	0.99	99.18	1.38	24.58
4	Rotting per cent	9.5-25.8	15.8+0.71	30.67	30.56	0.99	99.29	9.94	62.74
5	Fresh rhizome yield (t/ ha)	11.1-28.5	18.2+0.23	12.94	12.37	0.96	91.42	4.43	24.34

Table-4: Estimate of Genotypic (rg) and Phenotypic (rp) correlation coefficient for five characters of fifteen ginger genotypes in Eastern Ghat High Land zone of Odisha

Characters		Dry recovery per cent	Essential oil per cent	Oleoresin per cent	Rotting per cent	Fresh rhizome yield (t/ ha)
Dry recovery percent	rp	1.000	0.215	0.572**	-0.642**	0.733**
	rg	1.000	0.274	0.576**	-0.647**	0.772**
Essential oil per cent	rp		1.000	0.040	-0.227	0.020
	rg		1.000	0.027	-0.292	0.070
Oleoresin per cent	rp			1.000	-0.695**	0.626**
	rg			1.000	-0.700**	0.659**
Rotting per cent	rp				1.000	-0.798**
	rg				1.000	-0.844**
Fresh rhizome yield (t/ ha)	rp					1.000
	rg					1.000

Table 5: Correlated response to selection of various characters in ginger

Characters	Dry recovery per cent	Essential oil per cent	Oleoresin per cent	Rotting per cent	Fresh rhizome yield (t/ ha)
Dry recovery percent	2.877	0.618	1.656	-1.861	2.131
Essential oil per cent	0.038	0.109	0.004	0.041	0.009
Oleoresin per cent	0.797	0.029	1.383	-0.969	0.876
Rotting per cent	-6.429	2.270	-6.955	9.940	-8.050
Fresh rhizome yield (t/ ha)	3.562	0.253	3.041	-3.895	4.428

Table-6: Direct (diagonal & bold) and indirect effects of Path Coefficients based on genotypic correlation with fresh rhizome yield per ha in ginger

Characters	Dry recovery percent	Essential oil per cent	Oleoresin per cent	Rotting per cent	Genotypic correlation with Fresh rhizome yield per ha
Dry recovery percent	0.190	0.070	-0.016	0.527	0.772**
Essential oil per cent	0.052	0.257	-0.001	-0.238	0.070
Oleoresin per cent	0.109	0.007	-0.028	0.571	0.659**
Rotting per cent	-0.066	0.075	0.020	-0.815	-0.844**
			R =0.165		

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