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Genetic Variability Studies In Ginger (*Zingiber officinale*rosc.) Germplasm Under Gangetic Alluvial Plains Of West Bengal

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ABSTRACT
The genetic variability, heritability and genetic advance over mean were estimated for yield and quality traits in sixteen ginger germplasm. Wide genetic variation was observed for all genotypes like fresh yield per plant, plant height, projected yield per hectare and number of fingers per clump. Considering genetic parameters, high GCV was found for oleoresin content (33.07%) followed by fresh yield per plant (32.72), projected yield per hectare (32.60) and Yield per plot (30.66) respectively. In all cases, phenotypic variances were higher than the genotypic variances. Based on high heritability (h^2 b.s.) oleoresin content (98.76%), fresh yield per plant (97.02), projected yield per hectare (94.21), plant height (93.40) and yield per plot (92.25) were found superior and high GAM was observed for oleoresin content (67.71%), fresh yield per plant (66.40) and projected yield per hectare (65.18) found superior traits and representing additive genetic variance. Effective selection would be made considering these traits.
Key words: *Genetic variability, Heritability, Genetic advance and Co-efficient of variation.*

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INTRODUCTION

Ginger *(Zingiber officinale*Rosc.) is one of the earliest known oriental spices and is being cultivated in India for underground modified stem called rhizomes which is used both as fresh vegetable and as a dried spice, since time immemorial. It belongs to the family *Zingiberaceae*.India is the largest producer in the world and the annual production is about 8.55 lakh tonnes from an area of about 1.33 lakh hectares, contributing approximately 25 to 30 per cent of the world production [1]. In West Bengal, it is grown in an area of about 11,500 hectares with an annual production of 25,000 tonnes of fresh rhizome [1]. It is mainly grown in Darjeeling, Kalimpong, Nadia, Bhagwanpur areas of West Bengal. Ginger is used as carminative, diuretic and expectorant. It is effective against migraine headache [2] and diarrhea [3]. The available germplasm serves as most valuable natural reservoir for providing donor parent to improve the particular traits by genetic reconstruction of plant [4]. The progress in breeding for the economic characters that are mostly environmentally influenced is determined by the magnitude and nature of their genetic variability.Hence, it is essential to partition the overall variability into its heritable and non heritable components with the help of genetic parameters like genetic co-efficient of variation, heritability and genetic advance over mean. The present study was, therefore, undertaken to determine the genetic variability for various characters to estimate the scope of advance for selection in ginger.

MATERIALS AND METHODS

The field experiment was conducted at Horticultural Research Station, Mondouri, Faculty of Horticulture, Bidhan Chandra KrishiViswavidyalaya, Nadia, West Bengal during 2014-15 and 2015-16 in the month of May to March. The research station is located approximately at 23.5°N latitude, 89°E longitude having an average altitude of 9.75m from the sea level in the Gangetic alluvial plains of West Bengal. The climate of experimental site is sub-humid and situated just south of the tropic of cancer. In summer temperature is high 25^0C to 42.18^0C, but in winter is short and mild having 11^0C to 26^0C. Generally, monsoon breaks in the month of June and continues up to September. The experiment conducted in a sandy loam texture soil

having P^H range of 6.8. The trials were laid out in Randomized Complete Block Design with three replications using sixteen ginger accessions collected from different locations of India were selected for the study respectively (Table-1). The entire experimental field was leveled properly and was divided into three blocks and each block was divided into 16 plots. Raised bed of 3m length and lm width was prepared. The ginger rhizomes were planted on a spacing of 30 cm x 25 cm. Well rotten Farm Yard manure (FYM) @30 tones/hectare and Neem Cake @ 2 tones/hectare were applied by broadcasting and mixed thoroughly at the time of land preparation. The inorganic fertilizers *i.e.*, Nitrogen @ 80 kg/ha in the form of Urea (46% N), Phosphorous @ 50 kg/ha as Single Super Phosphate (16% P_20_5) and Potassium @ 60 kg/ha as muriateof potash (60% K_2O) were also applied following proper package of practices. Observations were recorded on growth and rhizome yield attributes. The data collected were subjected to statistical analysis. For determination of standard error of mean (S.Em.±) and critical difference (C.D) between the treatment means at 5% level of significance, the statistical table formulated was referred [5]. The genotypic and phenotypic variances were calculated according to [6]and [7]. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) were calculated by the method suggested by [8]. Whereas, heritability in broad sense for yield and its components were worked out by using formula suggested by [9]. Genetic advance as per cent of mean (GAM) was calculated by the method suggested [6].

RESULTS AND DISCUSSION

The analysis of variances showed that, the variances due to treatments (genotypes) was highly significant (at P= 0.05) for all thetraits studied except length of fingers (Table-2), indicating thereby the presence of genetic variability in the experimental material. The estimates of mean, range, environmental variance (EV), genotypic variance (GV), phenotypic variance (PV), environmental co- efficient of variance (ECV),genotypic co- efficient of variance (GCV), phenotypic co-efficient of variance (PCV), heritability (h^2b.s.) genetic advance (GA) and genetic advance as per cent of mean (GAM) for different characters are presented in Table-3. High GCV was found for oleoresin content (33.07%) followed by fresh yield per plant (32.72) and projected yield per hectare (32.60) respectively. In general, PCV estimates were higher than GCV estimates for all studied traits. It indicates that the presence of maximum amount of genetic variability which emphasized the wide scope of selection for the improvement of these characters [10]. The influence of environment was minimum when difference between GCV and PCV was less in magnitude for all studied characters. Genotypic variance (GV) was highest for fresh yield per plant (2708.14) followed by plant height (28.44), projected yield per hectare (16.58) and number of fingers per clump (12.02) respectively. Based on high heritability (h2 b.s.) oleoresin content (98.76%), fresh yield per plant (97.02), projected yield per hectare (94.21) and plant height (93.40) were found superior and high GAM was observed for oleoresin content (67.71%), fresh yield per plant (66.40) and projected yield per hectare (65.18) found superior traits and representing additive genetic variance. therefore, effective selection can be made for these traits as similar reported by [11]; [12]; [13] and [14]. Continuous selection for yield and quality traits is known for fixing of genetic variability in crop plants [15]. The present study indicated a broad genetic base in the ginger germplasm of India. This finding is in agreement with the findings of [16] who observed high degree of genetic variation in Asian collection of ginger.

Table-1: Collection of 16 indigenous ginger accessions from selected areas of India

Sl. No.	Accessions	Area of collection
1.	Athira, Karthika and Aswathy	KAU. Kerala.
2.	Acc-65, Acc-219, GCP-49, Acc-91, Acc-701, Acc-723, Acc-239, Acc-87, Acc-713, Acc-278, Acc-702 and Acc-247	IISR, Calicut, Kerala.
3.	Gorubathan (Control.)	RRS, Kalimpong, UBKV, WB.

Table-2: ANOVA for yield and quality contributing traits in ginger

Source	df	Pl. ht. (cm)	No. of leaves/ tiller	Leaf area index	Length of fingers (cm)	Girth of fingers (cm)	No. of fingers/ clump	Yield/ Plant (gm)	Yield/ plot (kg)	Projected yield/ Ha (t/ha)	Essential oil content (%	Oleoresin content (%)
Replications	2	2.51	4.93	30.33	16.66	0.11	45.66	850.49	0.88	5.80	0.09	0.41
Treatments	15	87.33**	17.11**	35.41**	4.33	0.63**	41.74**	8207.44**	5.86**	50.77**	0.16**	12.66**
Error	30	2.00	3.24	5.56	2.20	0.02	5.66	83.00	0.15	1.01	0.01	0.05

Table-3: Mean, genotypic and phenotypic coefficient of variability, heritability (broad sense) and genetic advance of yield and quality contributing traits in ginger

Characters	Mean	EV	GV	PV	ECV	GCV	PCV	h^2	GA	GAM
Plant Height (cm)	40.34	2.00	28.44	30.44	3.511	13.21	13.67	93.40	10.61	26.31
Number of leaves per tiller	17.05	3.24	4.62	7.87	10.57	12.61	16.46	58.72	3.39	19.91
Leaf area index	28.92	5.56	9.95	15.51	8.15	10.90	13.61	64.15	5.20	17.99
Length of fingers (cm)	5.90	2.20	0.71	2.91	25.17	14.29	28.94	24.37	0.85	14.53
Girth of fingers (cm)	2.25	0.02	0.20	0.22	7.20	20.09	21.34	88.61	0.87	38.96
Number of fingers per clump	13.18	5.66	12.02	17.69	18.05	26.30	31.90	67.96	5.88	44.67
Fresh yield per plant (gm)	159.01	83.00	2708.14	2791.14	5.72	32.72	33.22	97.02	105.59	66.40
Yield per plot (Kg)	4.50	0.15	1.90	2.06	8.88	30.66	31.93	92.25	2.72	60.68
Projected yield per hectare (t/ha)	12.49	1.01	16.58	17.60	8.07	32.60	33.58	94.21	8.14	65.18
Essential oil content (%)	1.23	0.01	0.04	0.06	10.79	18.03	21.01	73.60	0.39	31.86
Oleoresin content (%)	6.20	0.05	4.20	4.25	3.70	33.07	33.28	98.76	4.19	67.71

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