ANALYSIS OF THE DIFFERENT PARAMETERS FOR FRUIT YIELD AND YIELD CONTRIBUTING CHARACTERS IN STRAWBERRY

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ABSTRACT

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The experiment was conducted at Akafuzi Agrotechnologis, Namo Bhadra, Rajshahi, Bangladesh winter season of 2007 to estimate the genetic parameters and character association in seven exotic genotypes of strawberry. Highest genotypic and phenotypic coefficients of variations were observed for number of stolons/plant followed by number of fruits/plant and number of nodes/stolon. High heritability coupled with high genetic advance as percentage of mean was observed for fruit yield, plant height, number of flowers /plant and canopy size. Plant height, number of leaves /plant, number of stolons/plant, number of flowers/plant and number of fruits/plant showed highly significant positive association with fruit yield. Most of the characters exerted negative direct effect on fruit yield and highest direct effect was for number of nodes/stolon.

Keywords: Correlation coefficient, Stolon, canopy size, path analysis, yield, strawberry

INTRODUCTION

Strawberry (*Fragaria* × *ananassa* Duch.) is a popular fruit all over the world where suitable soil and moisture are available. It is a fruit of winter leading country. It is one of most popular, nutritious and lovely looking fruits in the world. The production and consumption of strawberry is increasing day by day because of its food value and other importance. The winter season preferably November to March can be favorable for strawberry cultivation in Bangladesh. It is cultivated in an area of 0.2 million hectares producing 0.3 million metric tons. America is the place of 1st position (27%) for the production of strawberry (Hossain, 2007). It has been commercially cultivated in Canada, USA, Japan, Spain, Germany, Korea, Italy, Poland, Thailand and so many other countries in the world (Biswas *et al*., 2007).

Strawberry has traditionally been a popular delicious fruit for its flavor, taste, fresh use, freezing and prosing. It contains relatively high quantities of ellagic acid, which has a wide range of biological activity. It is produced in 71 countries worldwide on 1249820 hectares. Strawberries are now getting popularity in Bangladesh (Sakila *et al.,* 2007). Due to its popularity and increasing demand in Bangladesh, a research study has been undertaken at Department of Botany, University of Rajshahi, Bangladesh to establish a rapid *in vitro* clonal propagation of different strawberry genotypes and evaluate their field performance in Bangladesh condition.

MATERIALS AND METHODS

Runner tips/nodal segments were collected from 40-45 days old field grown strawberry mature plants. Fresh nodal segments/runner tips were collected from strawberry mature plants during the last week of October 2007 from Plant Breeding and Gene Engineering Lab, Department of Botany, University of Rajshahi, Bangladesh. In the present study seven strawberry genotypes RABI-3, JP-2, JP-3, Camarosa, Sweet Charly, Giant Mountain and Festival were used as plant materials. Plantlets of seven strawberries were planted at Akafuzi Agrotechnologis, Namo Bhadra, Rajshahi, Bangladesh in a Randomized Block Design with ten replications during winter season of 2007 and 25 explants per replication. The fertilizers (Nitrogen 55 kg, P 70 kg, K 65 kg/hectares) and 25 explants were used to ensure optimum plant population (Hossain, 2007). Irrigation and intercultural operations were done for raising good crops.

The time of harvest is very important in strawberry. After sowing of strawberry plantlets fruits were collected from the field within 90-100 days. Berries were harvested every day to maintain the quality of the berries. When 2/3 of the berries were become red color then berries was ready to collect. The other standard agronomic practices were followed. Data were recorded under winter field condition on plant height (cm), no. of leaves/plant, no. of stolons/plant, no. of nodes/stolon, canopy size (cm^2), days to flowering, no. of flowers/plant, no. of fruits/plant and fruit yield/plant (gm/p).

The recorded data were statistically analyzed according to Steel and Torrie (1980). Mean values were used for different statistical analysis. Analysis of variance and genotypic and phenotypic variation were calculated following Singh and Chaudhury (1985). The phenotypic coefficient of variability (PCV) and genotypic coefficient of variability (GCV) were computed as suggested by Johnson *et al*. (1966). Estimates of broad sense heritability and genetic advance as percentage of mean (genetic gain=GA %) were computed as suggested by Allard (1960). Genotypic (rg), phenotypic (rp) correlations were calculated from variance and covariance component given by Jibouri *et al. (*1958). Path coefficient analysis was done according to Dewey and Lu (1978).

RESULTS AND DISCUSSION

Mean squares for all the characters were highly significant (P≤0.01) except plant height and days to flowering in field conditions, which indicated the presence of sufficient genetic variability in the experimental materials for fruit yield and other characters (Table1). The estimates of mean with standard error (SE), genotypic (GCV) and phenotypic (PCV) coefficients of variation, heritability (h^2b), genetic advance (GA) and genetic advance as percentage of mean (GA%) for eight characters are given in Table 1. The values of phenotypic and genotypic coefficient of variability's indicated that there were considerable environmental effect upon the phenotypic expression for most of the characters except plant height, canopy size and days to flowering. Higher values of genotypic coefficient of variability for number of stolons/plant, number of fruits/plant and number of nodes/stolon indicated higher degree of genetic variability in these characters. Similar results have observed by Ara (2009). The narrow difference between phenotypic and genotypic coefficient of variability supported the idea that environment had less effect on plant height, canopy size and number of flowers/plant characters under present study. The highest and the lowest genotypic coefficient of variability's were found in fruits yield /plant and plant height, respectively.

Table 1. Analysis of Variance for fruit yield and other characters in strawberry

Characters	Genotypic MS	F-value
Plant height (cm)	60.56	1.97 NS
No. of leaves/plant	190.42	6.073**
No. of stolons/plant	43.28	8.29**
No. of nodes/stolon	3.98	11.04**
Canopy size(cm2)	29505.92	19.77**
Days to flowering	18.776	3.774 NS
No. of flowers/plant	75.15	20.75**
No. of fruits/plant	15.46	15.12**
Fruit yield/plant (gm/p)	1.17(*19.6)	9.073**

PH =Plant height (cm), NLP= No. of leaves/plant, NSP= No. of stolons/plant, NNS =No. of nodes/stolon, CS= Canopy size (cm^2), DF= Days to flowering, NFP= No. of flowers/plant, NFrP= No. of fruits/plant and FrYP=Fruit yield/plant (gm/p)

High heritability estimates for all the characters were found high which indicated that it was under the control of genetic rather than the environment (Table 2). Breeder should consider heritability estimates along with the genetic advance because heritability alone is not a good indicator of the usable of genetic variability as reported by Masood (1986). High heritability coupled with high genetic advance for number of flowers and number of fruit in each year indicated that these characters were controlled by additive genes and effective selection could be made for these parameters. Heritability estimates in broad sense were relatively high for almost all the characters studied except leaves number and number of stolons/plant.

Table 2. Estimates of genetic parameters for fruit yield and yield contributing traits in strawberry

Characters	Mean±SE	GCV%	PCV%	h^2b%	GA	GA%
PH	18.8±1.622	9.19	9.76	88.52	334.61	1779.84
NLP	19.27±1.718	20.69	35.68	33.66	476.36	2472.03
NSP	4.71±0.675	41.42	63.75	42.21	260.86	5538.43
NNS	2.61±0.177	23.05	32.56	50.14	87.69	3359.77
CS	371.24±10.928	14.26	17.65	65.25	8770.58	2362.51
DF	31.04±	6.91	9.97	48.05	306.27	986.70
NFP	16.01±0.574	16.7	20.5	66.42	448.79	2803.19
NFrP	3.43±0.317	35.03	65.78	58.8	190.17	5544.31
FrYP	6.77±0.192	7.89	9.31	71.79	93.18	1376.37

PH =Plant height (cm), NLP= No. of leaves/plant, NSP= No. of stolons/plant, NNS =No. of nodes/stolon, CS= Canopy size (cm^2), DF= Days to flowering, NFP= No. of flowers/plant, NFrP= No. of fruits/plant and FrYP=Fruit yield/plant (gm/p).

Although high heritability estimates have been found to be helpful in making selection of superior genotypes on the basis of phenotypic performance. Johnson (1955) suggested that heritability estimates along with genetic advance as percentage of mean were more useful in predicting the response of selection. High values of heritability (h^2b) together with genetic advance as percentage of mean were obtained for plant height, number of stolons/plant, canopy size, number of flowers/plant, number of fruits/plant and fruit yield suggesting selection for these characters would give better response (Table 2). Similar results have also been reported by Karim (2007).

Correlation coefficient of fruit yield/plant and yield contributing characters revealed that the genotypic correlation coefficients in most of the cases were higher than their phenotypic correlation coefficients indicating the effects of environment suppressed the phenotypic relationship between these characters. In few cases, moreover, phenotypic correlation co-efficient were same with or higher than their genotypic correlation coefficients suggesting that both environmental and genotypic correlations in these cases acted in the same direction and finally maximize their expression at phenotypic level. Fruit yield was significantly and positively associated with most of the characters except canopy size and days to flowering. Similar result has also been observed by Biswas *et al*. (2007). Most of the characters were strong positively correlated among themselves. Positive correlation of number of flowers/plant with number of fruits/plant at genotypic and phenotypic level suggested that selection for higher number of strong may be done by selecting higher number of fruits. Sakila *et al*. (2007) and Ara (2009) have also reported positive correlation between number stolons with number of fruits.

Table 3. Estimate of genotypic and phenotypic correlation between yield and yield components in strawberry

Character	NL	NSP	NNS	CS	DF	NFP	NFrP	FrYP
PH	0.619	0.678	0.746	1.213	-0.963	0.471	0.978	0.605*
	0.964	0.884	0.604	0.983	-0.588	0.565	0.877	0.645*
NL		0.990	0.404	0.789	-0.123	0.184	0.904	0.995***
		0.357	0.078	0.943	0.031	0.335	0.276	0.807***
NSP			0.581	-0.997	-0.056	0.546	0.682	0.956***
			0.339	0.983	-0.093	0.527	0.822	0.559*
NNS				0.472	-0.233	0.564	0.521	0.790**
				0.368	-0.104	0.375	0.360	-0.088
CS					0.234	0.395	0.973	0.252
					0.103	-1.028	0.661	0.027
DF						-0.412	-0.212	0.570
						-0.175	-0.108	0.445
NFP							0.877	0.734***
							0.714	0.953***
NFrP								0.991***
								0.728***

PH =Plant height (cm), NLP= No. of leaves/plant, NSP= No. of stolons/plant, NNS =No. of nodes/stolon, CS= Canopy size (cm^2), DF= Days to flowering, NFP= No. of flowers/plant, NFrP= No. of fruits/plant and FrYP=Fruit yield/plant (gm/p).

Path coefficients values based on genotypic correlations are given in Table 3. Number of nodes/stolon had high positive direct effect towards yield and their correlation with fruit yield was positive at genotypic level. Number of leaves/plant showed high negative direct effect. Plant height, having highest positive indirect effect on fruit yield, also showed high indirect positive effect through number of leaves/plant, confirming the importance of days to flowering, number of fruits/plant and number leaves /plant by way of indirect contribution in enhancing the fruit yield in strawberry.

The results of the present study indicated high heritability together with genetic advance as percentage of mean for fruit yield, number of fruits/plant, canopy size, number of nodes/stolon and number of stolons/plant. Therefore, selection through the above characters will be effective for the improvement of strawberry.

Correlation and path coefficient analysis suggested that during selection more emphasis should be given on number of leaves, number of stolons /plant, number of nodes/stolon and number of fruits/plant, since these characters have high positive correlation and high direct effect on fruit yield.

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