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To Study Association Among Fruit Yield And Yield Contributing Traits Of Okra (Abelmoschus Esculentus L. Moench)

A. I. Khan[1], K. S. Baig[2], H. V. Kalpande[3], R. R. Dhutmal[4], D.K. Patil[5], A. R. Gaikwad[6], S. G. Shinde*[7], A. D. Pandagale[8], A. W. More[9], D. K. Zate[10], S. M. Umate[11], M. P. Wankhade[12], A. K. Choudhari[13], V. R. Ghuge[14], J. D. Deshmukh[15]

[1]M.Sc. student, [6, *7,12,1314&15] Assistant Professor, [4,9,10 &11], Associate Professor, [3] Head, Department of Genetics and Plant Breeding, [2]Director of Research, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India.

[5]Associate Dean & Principal, College of Agriculture, Badnapur, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India.

[8]Associate Professor (Agronomy), Cotton Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India.

Corresponding Author: S. G. Shinde, sandeepshinde@vnmkv.ac.in

Abstract

The experimental material comprising 30 genotypes including two checks were evaluated in Randomized Block Design during two crop seasons i.e., Kharif -2022 and Rabi-2022-23 at two locations i.e., Parbhani and Nanded comprising three different environments viz., E1 (Parbhani Kharif-2022), E2 (Nanded Kharif-2022) and E3 (Nanded Rabi-2022-23). Data were recorded on twelve quantitative characters viz., days to 50% flowering, days to first harvest, number of ridges per fruit, number of fruits per plant, fruit length, fruit girth, fruit weight, plant height, number of nodes per plant, internodal length and fruit yield per plant. The character association studies indicated that fruit yield per plant was strongly associated with all the character except days to 50% flowering, days to first maturity suggested the importance of improvement in characters like number of fruits per plant, number of ridges per fruit, fruit length, fruit weight, plant height, number of branches per plant and internodal length through selection is expected to results in improvement of fruit yield per plant.

Keywords: *Okra, stability, G x E interaction, character association*

INTRODUCTION

Vegetables are prime importance in human diet, as they provide cheaper source of nutrients like carbohydrates, minerals, vitamins, proteins and dietary fibres. The fruits of okra are rich source of vitamin A, C and minerals *viz.*; Ca, Mg and Fe. The seeds of okra are good source of protein (20%) and vegetable oil (14%). The average nutritive value (ANV) of okra is 3.21 per cent, which is higher than tomato, brinjal and cucurbitaceous vegetables (Sharma and Arora, 1993).

Okra is one of the economically important vegetables grown across the world including tropical and subtropical regions. Most popular terms for okra are lady's finger (England), gumbo (United States of America), guino-gombo (Spanish), guibeiro (Portuguese) and bhindi (India). Earlier known as *Hibiscus esculentus*, presently okra is accepted as Abelmoschus *esculentus,* Family Malvacae, due to presence of distinguished characteristics of the calyx, corolla and staminal column which are fused at the base and fall together after the anthesis (Dhankhar and Mishra, 2004).

Okra is basically self-pollinated crop. However, occurrence of out crossing ranges from 0.34-27.30 per cent (Akenova and Fatokun, 1984) with maximum 42.20 per cent is noticed in insect assisted pollination (Kumar, 2006). This renders considerable amount of genetic diversity. The extent of cross pollination in a particular place will depends upon the cultivar, competitive flora, insect population and season etc. (Bose *et al.*, 1993). Okra plant is a robust erect annual herb of 0.5 to 2 meter tall; stem green or tinged red; leaves simple and alternate; flower solitary and auxiliary, calyx completely fused; petals five, separate and yellow with crimson spot-on claw; staminal column united to base of petals, with Monadelphous staminal tube; ovary superior; stigma small, 5-8 fids, fruit pyramidal capsule; seeds dark green to dark brown rounded and about 5 mm in diameter. India leads the globe in okra production, accounting for 62.07 per cent of world okra production and producing okra on an area of 544 thousand ha with a production of 6494 thousand tons and a productivity of 11.90 tons per hectare. It is cultivated in states of Gujarat, West Bengal, Bihar, Madhya Pradesh, Orissa, Chhattisgarh, Uttar Pradesh and Haryana. In Maharashtra okra is grown in the districts viz., *Solapur*, Satara, Pune, Jalgaon, Thane with an area of about 1147.95 thousand ha. and production 7896.27 thousand MT. Okra contributes about 60 percent to the total fresh vegetable export, excluding potato, garlic and onion. The okra occupies an area of 13.98 thousand hectare in Maharashtra state with an annual production of 139.28 thousand tons and 2.17 % share with an average productivity of 9.97 tonnes per hectare (NHB 2021-22).

The term *Abelmoschus* is probably derived from Arabian word "abul-l-mosk" which means "source of musk," indicating musky smell of seeds (Charrler, 1984). Maximum cultivation (99%) of okra is being done in the Asian and African countries but productivity is very poor in African countries (2.25 MT ha−1) in comparison to other okra growing regions. Global average yield of okra is 5.26 MT ha-1 from an area of 1.83 M ha with annual productivity of 9.62 MT. 72% of total world production occurs in India, ranking first with 6.3 million MT productivity in 0.5 million ha area (NHB-2022, FAOSTAT, 2022).

The top 3 exporters of Fresh okra are India with 40,568 shipments followed by Honduras with 3,489 and Philippines at the 3rd spot with 1,444 shipments (16-May-2023, APEDA). Okra has tremendous export potential as fresh vegetable. It accounts for 70 percent of the 30 percent exchange earnings, other than onion from export of vegetables. Major targets have been our neighbouring countries in the gulf and south east Asia, particularly Singapore, Mauritius, Malaysia, Sri Lanka, Bangladesh and middle east countries which are upcoming potential market for export of vegetables from India. For fresh fruit export, bhindi fruits should be green, tender, 6-9 cm long. Among them the suitable varieties for export are Pusa sawani, Parbhani Kranti, Varsha Uphar and Pusa A-4. Although bhindi is grown for export in different parts of the country, the major exporting area are Nasik, Ozar, Saikheda, Kolhar, Dindori, and Solapur in Maharashtra.

Correlation analysis are prerequisites for improvement of any crop including okra for selection of superior genotypes and improvement of any trait. In plant breeding, correlation analysis provides information about yield components and thus helps in selection of superior genotypes from diverse genetic populations. The correlation studies simply measure the associations between yield and other traits. Usefulness of the information obtained from the correlation coefficients can be enhanced by partitioning into direct and indirect effects for a set of a pair-wise cause-effect inter relationships (Kang *et al.*, 1983). Furthermore, it is necessary to understand correlation among the component traits to ascertain their rational significance.

MATERIALS AND METHOD

The experimental material comprising 30 genotypes including two checks were evaluated in Randomized Block Design during two crop seasons i.e. *Kharif* 2022 and *Rabi* 2022-23 at two locations i.e. Parbhani and Nanded comprising total of three different environment viz., E1-Parbhani *Kharif 2022*, E2- Nanded *Kharif 2022* and E3- Nanded *Rabi 2022-23*. The sowing was carried out at the spacing of 60 cm and 30 cm between the rows and plants respectively. The method of sowing followed was dibbling. One plant per hill was maintained by thinning 15 days after sowing. All other cultural practices were undertaken as and when required to maintain healthy crop.

RESULT AND DISCUSSION

The correlation coefficient is the most important statistical concept used as a measure of degree of association between two characters worked at the same time. Correlation studies help the breeder to compute the required genetic makeup of the ideal variety. The character association studies indicated that fruit yield per plant was strongly associated with all the character except days to 50% flowering, days to first maturity suggested the importance of improvement in characters like number of fruits per plant, number of ridges per fruit, fruit length, fruit weight, plant height, number of branches per plant and internodal length through selection is expected to results in improvement of fruit yield per plant.

The genotypic and phenotypic correlation coefficients for different characters in E1, E2, E3 and pooled environment are presented in Table 4.1, 4.2, 4.3 and 4.4 respectively.

Table 4.8: Estimates of genotypic (G) and phenotypic (P) correlations for fruit yield contributing traits in E1 environment

Genotypic Correlation	Days to 50 % flowering	Number of Ridges /fruit	Days to Maturity	No. of Fruits/plant	Fruit Weight	Fruit Length	Fruit Girth	No of Nodes/plant	Plant Height	No of Branches/plant	Internodal length	Fruit yield/plant
Days to 50 % flowering	1											
Number of Ridges /fruit	0.074	1										
Days to Maturity	0.009	-0.091	1									
No. of Fruits/plant	0.100	0.388**	-0.117	1								
Fruit Weight	-0.851**	0.077	0.217	0.166	1							
Fruit Length	-0.527**	-0.039	-0.054	0.207	0.780**	1						
Fruit Girth	-0.043	0.050	0.018	0.171	0.313*	0.014	1					
No of Nodes/plant	-0.002	0.396**	-0.152	1.101	0.153	0.280*	0.235	1				
Plant Height	-0.147	0.738**	-0.268*	0.603**	0.132	0.018	-0.031	0.533**	1			
No of Branches/plant	0.467**	0.577**	-0.024	0.316*	0.329*	0.344**	-0.019	0.313*	0.354**	1		
Internodal length	0.074	1.000**	-0.091	0.388**	0.077	-0.039	0.050	0.396**	0.738**	0.577**	1	
Fruit yield	-0.344**	0.360**	-0.003	0.868**	0.698**	0.616**	0.283*	0.902**	0.521**	0.443**	0.360**	1
Phenotypic Correlation	**Days to 50 % flowering**	**Number of Ridges /fruit**	**Days to Maturity**	**No. of Fruits/plant**	**Fruit Weight**	**Fruit Length**	**Fruit Girth**	**No of Nodes/plant**	**Plant Height**	**No of Branches/plant**	**Internodal length**	**Fruit yield/plant**
Days to 50 % flowering	1											
Number of Ridges /fruit	0.076	1										
Days to Maturity	-0.050	-0.103	1									
No. of Fruits/plant	0.163	0.327**	-0.090	1								
Fruit Weight	-0.284*	0.109	0.208	0.059	1							
Fruit Length	-0.379**	-0.008	0.060	0.093	0.601	1						
Fruit Girth	-0.007	0.049	0.011	0.153	0.258*	0.012	1					
No of Nodes/plant	0.175	0.279*	-0.074	0.870**	0.089	0.105	0.189	1				
Plant Height	0.010	0.652	-0.245*	0.551**	0.095	0.016	-0.033	0.423**	1			
No of Branches/plant	0.064	0.344**	-0.004	0.242	0.226	0.257*	-0.020	0.197	0.316*	1		
Internodal length	0.076	1.000	-0.103	0.327*	0.109	-0.008	0.049	0.279*	0.652**	0.344**	1	
Fruit yield	-0.032	0.278*	-0.014	0.811**	0.520**	0.392**	0.257**	0.766**	0.486**	0.363**	0.278*	1

* Indicates significance at 5% level ** Indicates significance at 1% level. E_1 = *Kharif* Parbhani (2022)

Table 4.9: Estimates of genotypic (G) and phenotypic (P) correlations for fruit yield contributing traits in E2 environment

Genotypic Correlation	Days to 50 % flowering	Number of Ridges /fruit	Days to Maturity	No. of Fruits/plant	Fruit Weight	Fruit Length	Fruit Girth	No of Nodes/plant	Plant Height	No of Branches/plant	Internodal length	Fruit yield/plant
Days to 50 % flowering	1											
Number of Ridges /fruit	0.302**	1										
Days to Maturity	0.079	0.071	1									
No. of Fruits/plant	-0.134	-0.121	-0.482**	1								
Fruit Weight	0.133	-0.293	0.154	-0.029	1							
Fruit Length	0.177	0.074	-0.806**	0.438**	-0.026	1						
Fruit Girth	0.011	-0.070	-0.150	0.314**	0.322*	0.120	1					
No of Nodes/plant	-0.225	-0.219	-0.508**	0.792**	0.326*	0.266*	0.409**	1				
Plant Height	-0.036	0.195	-0.266*	0.440**	0.074	0.463**	0.364**	0.110	1			
No of Branches/plant	-0.036	0.397	0.032	0.523**	-0.164	0.328*	-0.205	0.175	0.468**	1		
Internodal length	-0.261*	0.364	0.087	0.073	0.160	0.124	0.218	-0.079	0.817	0.454**	1	
Fruit yield	-0.079	-0.262**	-0.396**	0.869**	0.459**	0.415**	0.361**	0.862**	0.419**	0.386**	0.116	1
Phenotypic Correlation	**Days to 50 % flowering**	**Number of Ridges /fruit**	**Days to Maturity**	**No. of Fruits/plant**	**Fruit Weight**	**Fruit Length**	**Fruit Girth**	**No of Nodes/plant**	**Plant Height**	**No of Branches/plant**	**Internodal length**	**Fruit yield/plant**
Days to 50 % flowering	1											
Number of Ridges /fruit	0.243*	1										
Days to Maturity	0.083	0.133	1									
No. of Fruits/plant	-0.150	-0.080	-0.434**	1								
Fruit Weight	0.077	-0.154	0.002	0.004	1							
Fruit Length	0.164	0.074	-0.678**	0.425**	-0.014	1						
Fruit Girth	0.029	-0.030	-0.129	0.294*	0.300*	0.129	1					
No of Nodes/plant	-0.177	-0.026	-0.333**	0.707**	0.216	0.229	0.355**	1				
Plant Height	-0.024	0.108	-0.226	0.398**	0.070	0.427**	0.341**	0.105	1			
No of Branches/plant	-0.015	0.207	-0.01	0.42	-0.12	0.266**	-0.18	0.13	0.27	1		
Internodal length	-0.099	0.410**	0.081	0.063	0.118	0.105	0.198	-0.027	0.646**	0.188	1	
Fruit yield	-0.099	-0.123	-0.394**	0.845**	0.480**	0.397**	0.332**	0.727**	0.378**	0.326*	0.082	1

* Indicates significance at 5% level ** Indicates significance at 1% level E_2= Kharif Nanded (2022)

Table 4.10: Estimates of genotypic (G) and phenotypic (P) correlations for fruit yield and yield contributing traits in E3 environment

Genotypic Correlation	Days to 50 % flowering	Number of Ridges /fruit	Days to Maturity	No. of Fruits/ plant	Fruit Weight	Fruit Length	Fruit Girth	No of Nodes/plant	Plant Height	No of Branches/plant	Internodal length	Fruit yield/plant
Days to 50 % flowering	1											
Number of Ridges /fruit	-0.129	1										
Days to Maturity	-0.022	-0.448*	1									
No. of Fruits/plant	0.018	0.266*	-0.101	1								
Fruit Weight	0.054	0.095	-0.006	-0.022	1							
Fruit Length	0.255*	0.219	-0.234	0.165	0.577**	1						
Fruit Girth	-0.075	-0.033	0.049	0.068	0.475**	0.111	1					
No of Nodes/plant	-0.025	0.146	-0.077	0.993**	-0.084	0.097	0.063	1				
Plant Height	0.232	0.384**	0.075	0.605**	0.008	0.154	0.038	0.496**	1			
No of Branches/plant	0.155	0.003	-0.202	0.854**	0.306*	0.258*	0.277*	0.884**	0.303*	1		
Internodal length	0.092	-0.029	-0.130	0.332**	0.118	0.260*	0.141	0.322*	0.562**	0.442**	1	
Fruit yield	-0.009	0.292*	-0.061	0.735**	0.654**	0.480*	0.455**	0.671**	0.428**	0.825**	0.257*	1
Phenotypic Correlation	**Days to 50 % flowering**	**Number of Ridges /fruit**	**Days to Maturity**	**No. of Fruits/ plant**	**Fruit Weight**	**Fruit Length**	**Fruit Girth**	**No of Nodes/ plant**	**Plant Height**	**No of Branches/ plant**	**Internodal length**	**Fruit yield/plant**
Days to 50 % flowering	1											
Number of Ridges /fruit	-0.084	1										
Days to Maturity	0.003	-0.341**	1									
No. of Fruits/plant	-0.002	0.215	-0.076	1								
Fruit Weight	0.029	0.087	-0.016	-0.006	1							
Fruit Length	0.202	0.190	-0.152	0.138	0.548**	1						
Fruit Girth	-0.086	-0.042	0.016	0.057	0.460	0.109	1					
No of Nodes/plant	-0.022	0.142	-0.070	0.885**	-0.077	0.091	0.061	1				
Plant Height	0.206	0.329*	0.070	0.549**	0.009	0.157	0.028	0.471**	1			
No of Branches/plant	0.156	-0.083	-0.131	0.628**	0.252	0.233	0.223	0.666**	0.244	1		
Internodal length	0.088	0.023	-0.102	0.262*	0.110	0.244*	0.132	0.311*	0.515	0.264*	1	
Fruit yield	-0.011	0.272*	-0.068	0.671**	0.648**	0.449**	0.446**	0.657**	0.397**	0.641**	0.244**	1

* Indicates significance at 5% level ** Indicates significance at 1% level. E_3= Rabi Nanded (2022-23)

Table 4.11: Estimates of genotypic (G) and phenotypic (P) correlations for fruit yield and yield contributing traits pooled over environment

Genotypic Correlation	Days to 50 % flowering	Number of Ridges /fruit	Days to Maturity	No. of Fruits/ plant	Fruit Weight	Fruit Length	Fruit Girth	No of Nodes/plant	Plant Height	No of Branches/plant	Internodal length	Fruit yield/plant
Days to 50 % flowering	1											
Number of Ridges /fruit	0.341**	1										
Days to Maturity	0.666**	0.343**	1									
No. of Fruits/plant	-0.520**	0.508**	-0.403**	1								
Fruit Weight	-0.850**	-0.369**	-0.720**	0.509**	1							
Fruit Length	-0.715**	-0.480**	-0.893**	0.404**	0.882**	1						
Fruit Girth	-0.276**	0.072**	-0.400**	0.355**	0.180*	0.185*	1					
No of Nodes/plant	-0.234**	0.736**	-0.110	0.911**	0.196**	0.061	0.261**	1				
Plant Height	-0.521**	0.427**	-0.440**	0.914**	0.546**	0.414**	0.412**	0.755**	1			
No of Branches/plant	-0.496**	-0.461**	-0.658**	0.255**	0.718**	0.722**	-0.185*	-0.038	0.285**	1		
Internodal length	0.010	0.722**	0.072**	0.776**	0.061	-0.146*	0.146*	0.817**	0.823**	-0.028	1	
Fruit yield	-0.696**	0.161*	-0.615**	0.876**	0.773**	0.711**	0.274**	0.680**	0.833**	0.559**	0.481**	1
Phenotypic Correlation	**Days to 50 % flowering**	**Number of Ridges /fruit**	**Days to Maturity**	**No. of Fruits/ plant**	**Fruit Weight**	**Fruit Length**	**Fruit Girth**	**No of Nodes/plant**	**Plant Height**	**No of Branches/ plant**	**Internodal length**	**Fruit yield/plant**
Days to 50 % flowering	1											
Number of Ridges /fruit	0.212**	1										
Days to Maturity	0.332**	0.241**	1									
No. of Fruits/plant	-0.204**	0.413**	-0.328**	1								
Fruit Weight	-0.433**	-0.235**	-0.403**	0.300**	1							
Fruit Length	-0.429**	-0.340**	-0.680**	0.293**	0.684**	1						
Fruit Girth	-0.052	0.048	-0.093	0.251**	0.281**	0.141*	1					
No of Nodes/plant	-0.031	0.522**	-0.128	0.854**	0.111	0.040	0.232**	1				
Plant Height	-0.256**	0.408**	-0.343**	0.780**	0.380**	0.335**	0.228**	0.580**	1			
No of Branches/plant	-0.194**	-0.228**	-0.357**	0.247**	0.403**	0.483**	0.002	0.092	0.243**	1		
Internodal length	-0.003	0.637**	-0.008	0.481**	0.109	-0.022	0.189*	0.471**	0.665**	0.067	1	
Fruit yield	-0.272**	0.144*	-0.408**	0.813**	0.636**	0.516**	0.329**	0.696**	0.634**	0.427**	0.316**	1

* Indicates significance at 5% level ** Indicates significance at 1% level.

CONCLUSION

From the results of character association, it was concluded that fruit yield per plant can be increased by improving the traits viz., number of fruits per plant, fruit weight, number of ridges per fruit, fruit length, number of nodes per plant, fruit girth, plant height, number of branches per plant and internodal length.

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