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Correlation between Physiological and Yield Attributes of Orange Flesh Sweet Potato (*Ipomoea batatas* (L.) Lam.) Genotypes

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ABSTRACT

Understanding interrelationships among various traits is vital to plan an effective breeding programme in orange flesh sweet potato (Ipomoea batatas (L.) Lam.). This study was undertaken to determine associations among yield and yield related traits in crop plant so as to identify the major traits of importance that could be used as a basis for clonal selection. A replicated field experiment was carried out using 25 OFSP genotypes. Thus studies on correlation enable the breeder to know the mutual relationship between various characters and determine the component characters on which selection can be used for genetic improvement (Grafuis, 1959). knowledge of associations between the yield and yield components is essential for planning a sound selection programme (Falconer, 1964). Observations were made on different traits. Phenotypic as well as genotypic correlation coefficient analysis revealed that root tuber yield per hectare is positively and significantly correlated with Petiole length, leaf area, total leaf dry weight, chlorophyll a, chlorophyll b, total chlorophyll, number of branches per plant, fresh weight of whole plant, dry weight of whole plant, fresh weight of root, dry weight of root, leaf area index, specific leaf area, crop growth rate, net assimilation rate, number of root tubers per plant , root tuber length, root tuber girth and root tuber yield per plant.

Key words: *Traits, Correlation, Root yield, OFSP*

INTRODUCTION

Sweet potato [*Ipomoea batatas* (L.) Lam.] is a highly heterozygous cross pollinated crop in which many of the traits show continuous variation. Jones *et al*.[4] suggested that mass selection with few cycles of recurrent slection could be practiced for its improvement. As root tuber yield is a polygenic trait, knowledge of the relationship that exists between root tuber yield and other characters and also interrelationships among various traits is necessary to be able to design appropriate selection criteria in sweet potato breeding programme. Yield component characters show associations among themselves and also with yield. Unfavourable associations between the desirable attributes under selection may limit genetic advance.

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Hence, knowledge of associations between the yield and yield components and also among the yield components is essential for planning a sound selection programme[2]. Increasing total yield would be made easier by selecting for components because the components are more simply inherited than the total yield itself. Thus studies on correlation enable the breeder to know the mutual relationship between various characters and determine the component characters on which selection can be used for genetic improvement[3]. However information is lacking on the nature and interrelationships among yield and yield related traits of the available germplasm accessions. Consequently no selection criteria have been set to date. Thus, this study was undertaken to determine the interrelationships among yield and yield related traits so as to identify component traits whose selection lead to improvement in root tuber yield per hectare.

MATERIAL AND METHODS

The experiment was conducted at experimental farm of the Department of Vegetable Science, Horticultural College & Research Institute working under Dr. YSR Horticultural University, Andhra Pradesh, India during the kharif season of 2015 using randomized block design with three replications. Thirty two healthy cuttings of each genotype were planted in each plot in each replication. Randomization was followed in each replication. Recommended cultural practices were followed as per the package of practices standardized by CTCRI. Five randomly selected plants from each genotype were subjected for observations on dry matter production and its partitioning. Three plants of each genotype in each replication were uprooted and partitioned in to their component parts viz., leaves, stem and root tubers. These were air dried and then transferred to hot air oven at 80^0C for 72 hours (until constant weight obtained) and their dry weight was recorded. Phenotypic and genotypic correlations were worked out by using formula suggested by Falconer[2].

RESULTS AND DISCUSSION

The genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients for most of the traits indicating inherent association among most traits (Table 1, 2 and 3). The low phenotypic correlation could arise due to the modifying effect of environment on the association of traits at genetic levels.

Leaf characters

1. Length of leaf lobe (cm)

Length of leaf lobe recorded significant positive correlation with petiole length (0.324 r_p, 0.484 r_g) and root tuber girth (0.341 r_g) at both 5% and 1% LOS. This trait also recorded significant positive correlation with width of leaf lobe (0.244 r_g), total leaf dry weight (0.229 r_g), root tuber girth (0.285 r_p), and root tuber yield per plant (0.233 r_g) at 5% LOS only.

2. Width of leaf lobe (cm)

Lack of correlation observed between width of leaf lobe (0.172 r_p, 0.175 r_g) and root tuber yield.

3. Petiole length (cm)

Petiole length recorded significant positive correlation with chlorophyll b (0.331 r_g) and total chlorophyll (0.306 r_g) at both 5% and 1% LOS, leaf area (0.258 r_g), chlorophyll a (0.239 r_p, 0.288 r_g), chlorophyll b (0.292 r_p), exhibited significant positive correlation at 5% level of significance only.

4. Leaf area (cm^2)

This trait exhibited significant positive correlation with total leaf dry weight (0.336 r_g), chlorophyll a (0.364r_p, 0.455r_g), chlorophyll b (0.422r_p, 0.438r_g), total chlorophyll (0.405 r_p, 0.444 r_g), number of root tubers per plant (0.608r_p, 0.669 r_g), root tuber length (0.419 r_p, 0.477 r_g), root tuber yield per plant (0.595 r_p, 0.627 r_g) and root tuber yield per hectare (0.593 r_p, 0.613 r_g) at both 5% and 1% LOS. This character also recorded significant positive correlation with total leaf dry weight (0.252 r_p) and root tuber girth (0.247 r_g) at 5% LOS only. The vegetative characters *viz.* length of leaf lobe, width of leaf lobe and leaf area showed significant positive correlation with yield attributing characters. It

revealed that, the genotypes which were possessing high source capacity, might have grater sinks.

5. Total leaf dry weight (g)

Total leaf dry weight recorded significant positive correlation with total number of root tubers (0.389 r_p, 0.556 r_g), root tuber length (0.434 r_g), root tuber girth (0.339 r_p, 0.461 r_g), root tuber yield per plant (0.474 r_p, 0.564 r_g) and root tuber yield per hectare (0.416 r_p, 0.536 r_g) at both 5% and 1% LOS and root tuber length (0.285 r_p) at 5% LOS only.

6. Chlorophyll a (mg/g)

This trait was significantly and positively correlated with chlorophyll b (0.856 r_p, 0.926 r_g), total chlorophyll (0.970 r_p, 0.996 r_g), root tuber length (0.302 r_p, 0.421 r_g), root tuber yield per plant (0.300 r_g) and root tuber yield per hectare (0.295 r_p, 0.341 r_g)at both 5% and 1% LOS. This character also recorded significant positive correlation with number of root tubers per plant (0.261 r_p, 0.288 r_g) and root tuber yield per plant (0.227 r_p) at 5% LOS only.

7. Chlorophyll b (mg/g)

Chlorophyll b recorded positive and significant correlation with total chlorophyll (0.955 r_p , 0.997 r_g), root tuber length (0.312 r_g) and root tuber yield per hectare (0.319r_p , 0.331r_g) at both 5% and 1% LOS and with number of root tubers per plant (0.255 r_p, 0.287 r_g), root tuber length (0.266 r_p) and root tuber yield per plant (0.262 r_p,0.277 r_g) at 5% LOS.

8. Total chlorophyll (mg/g)

Total chlorophyll recorded positive and significant correlation with root tuber length (0.297 r_p, 0.366 r_g) and root tuber yield (0.317 r_p, 0.334 r_g) at both 5% and 1% LOS and with number of root tubers per plant (0.268 r_p, 0.286 r_g) and root tuber yield per plant (0.252 r_p, 0.287 r_g) at 5% LOS.The positive correlation between chlorophyll a, chlorophyll b and total chlorophyll with yield attributing characters revealed that, high yielders might have high chlorophyll content.

Vine characters

1. Length of vine (cm)

Length of vine exhibited significant negative correlation with number of root tubers per plant (-0.356 r_p, -0.440 r_g) and root tuber yield per plant (-0.300 r_p, -0.303 r_g) at both 5% and 1% LOS and with root tuber length (-0.245 r_g), root tuber yield per hectare (-0.242 r_p, -0.264 r_g) at 5% LOS. This result is in conformity with the results obtained by Warid *et al.*[11] in sweet potato.

Table 1: Phenotypic (P) and genotypic (G) correlation matrix among yield and leaf characters in orange flesh sweet potato genotypes

Characters		Length of leaf lobe (cm)	Width of leaf lobe (cm)	Petiole length (cm	leaf area (cm^2)	Total leaf dry weight (g)	Chlorophyll a (mg/g)	Chlorophyll b (mg/g)	Total chlorophyll (mg/g)
Length of leaf lobe (cm)	G	**1.000**							
	P	**1.000**							
Width of leaf lobe (cm)	G	0.244*	**1.000**						
	P	0.213	**1.000**						
Petiole length (cm)	G	0.484**	0.131	**1.000**					
	P	0.324**	0.115	**1.000**					
leaf area (cm^2)	G	0.019	0.024	0.258*	**1.000**				
	P	0.079	0.035	0.216	**1.000**				
Total leaf dry weight (g)	G	0.229*	0.136	0.028	0.336**	**1.000**			
	P	0.152	0.096	0.019	0.252*	**1.000**			
Chlorophyll a (mg/g)	G	-0.028	-0.105	0.288*	0.455**	0.137	**1.000**		
	P	-0.027	-0.101	0.239*	0.364**	0.168	**1.000**		
Chlorophyll b (mg/g)	G	0.028	-0.112	0.331**	0.438**	0.201	0.926**	**1.000**	
	P	0.044	-0.111	0.292*	0.422**	0.168	0.856**	**1.000**	
Total chlorophyll (mg/g)	G	-0.001	-0.108	0.306**	0.444**	0.167	0.996**	0.997**	**1.000**
	P	0.005	-0.109	0.273*	0.405**	0.175	0.970**	0.955**	**1.000**
No. of root tubers per plant	G	0.187	0.189	0.174	0.669**	0.556**	0.288*	0.287*	0.286*
	P	0.155	0.176	0.136	0.608**	0.389**	0.261*	0.255*	0.268*
Root tuber length (cm)	G	0.128	0.172	0.226*	0.477**	0.434**	0.421**	0.312**	0.366**
	P	0.100	0.144	0.177	0.419**	0.285*	0.302**	0.266*	0.297**
Root tuber girth (cm)	G	0.341**	0.014	0.104	0.247*	0.461**	0.047	0.116	0.080
	P	0.285*	0.005	0.106	0.222	0.339**	0.023	0.109	0.064
Root tuber yield per plant (g)	G	0.233*	0.170	0.202	0.627**	0.564**	0.300**	0.277*	0.287*
	P	0.158	0.162	0.170	0.595**	0.474**	0.227*	0.262*	0.252*
Root tuber yield (t/ha)	G	0.160	0.175	0.264*	0.613**	0.536**	0.341**	0.331**	0.334**
	P	0.125	0.172	0.237*	0.593**	0.416**	0.295**	0.319**	0.317**

***significant at 5% level ** significant at 1 % level**

2. Internodal length (cm)

This trait was significantly and negatively correlated with root tuber length (-0.478 r_p, -0.540 r_g), root tuber girth (-0.372 r_p, -0.404 r_g) and root tuber yield per plant (-0.297 r_p, -0.305 r_g) at both 5% and 1% LOS and with number root tubers per plant (-0.233 r_g) and root tuber yield per hectare (-0.275 r_p, -0.281 r_g) at 5% LOS. This result is in conformity with the results obtained by Thamburaj and Muthukrishnan[9] in sweet potato.

3. Number of branches per plant

This trait exhibited significant positive correlation with number of root tubers per plant (0.470 r_p, 0.560 r_g), root tuber girth (0.338 r_g), root tuber yield per plant (0.481 r_p, 0.557 r_g) and root tuber yield per hectare (0.493 r_p, 0.564 r_g) at both 5% and 1% LOS and with root tuber girth (0.280 r_p) at 5% LOS. Significant positive correlation for number of branches per plant is in agreement with the results of Thamburaj and Muthukrishnan[9], Lin[5], Naskar *et al.*[7], Teshome *et al.*[8] and Li Yun Song *et al.*[6] at genotypic level only.

Growth indices

1. Leaf area index

This trait exhibited significant positive correlation with specific leaf area (0.922 r_p.0.954 r_g), crop growth rate (0.650 r_p, 0.705 r_g), net assimilation rate (0.865 r_p, 0.892 r_g), number root tubers per plant (0.642 r_p.0.710 r_g), root tuber length (0.494 r_p, 0.542 r_g), root tuber girth (0.344 r_p, 0.376 r_g), root tuber yield per plant (0.654 r_p, 0.687 r_g) and root tuber yield per hectare (0.651 r_p, 0.674 r_g) at both 5% and 1% LOS and with specific leaf weight (0.246 r_p, 0.264 r_g) at 5% LOS. Number of roots and root weight are in conformity with the results of Bacusmo *et al.*[1] and tuber yield with the results of Tiwari *et al.*[10] in sweet potato.Leaf area index exhibited significant negative correlation with relative growth rate (-0.245 r_g) at 5% LOS.

2. Specific leaf area (cm^2/g)

This trait exhibited significant positive correlation with specific leaf weight (0.384 r_p.0.390 r_g), crop growth rate (0.686 r_p, 0.745 r_g), net assimilation rate (0.928 r_p, 0.936 r_g), number of root tubers per plant (0.693 r_p, 0.755 r_g), root tuber length (0.514 r_p,0.583 r_g), root tuber girth (0.405 r_p, 0.421 r_g), root tuber yield per plant (0.696 r_p, 0.715 r_g) and root tuber yield per hectare (0.668 r_p, 0.681 r_g) at both 5% and 1% LOS.

Table 2: Phenotypic (P) and genotypic (G) correlation matrix among yield and vine characters in orange flesh sweet potato genotypes

Characters		length of vine (cm)	Internodal length (cm)	No. of branches per plant
Length of vine (cm)	G	**1.000**		
	P	**1.000**		
Internodal length (cm)	G	0.048	**1.000**	
	P	0.035	**1.000**	
No. of branches per plant	G	-0.041	-0.055	**1.000**
	P	-0.064	-0.029	**1.000**
No. of root tubers per plant	G	-0.440**	-0.233*	0.560**
	P	-0.356**	-0.222	0.470**
Root tuber length (cm)	G	-0.245*	-0.540**	0.214
	P	-0.211	-0.478**	0.194
Root tuber girth (cm)	G	0.025	-0.404**	0.338**
	P	0.016	-0.372**	0.280*
Root tuber yield per plant (g)	G	-0.303**	-0.305**	0.557**
	P	-0.300**	-0.297**	0.481**
Root tuber yield (t/ha)	G	-0.264*	-0.281*	0.564**
	P	-0.242*	-0.275*	0.493**

significant at 5% level** * significant at 1 % level**

3. Specific leaf weight (g/cm^2)

This trait exhibited significant positive correlation with net assimilation rate (0.475 r_p, 0.483 r_g) at both 5% and 1% LOS and with number of root tubers per plant (0.238 r_g) at 5% LOS.

4. Crop growth rate ($g/m^2/d$)

This trait exhibited significant positive correlation with net assimilation rate (0.674 r_p, 0.720 r_g), number of root tubers per plant (0.837 r_p, 0.999 r_g), root tuber length (0.527 r_p, 0.584 r_g), root tuber girth (0.535 r_p, 0.593 r_g), root tuber yield per plant (0.930 r_p, 0.993 r_g) and root tuber yield per hectare (0.881 r_p,

0.951 r_g) at both 5% and 1% LOS. The above results are in conformity with the results of Tiwari *et al*.[10] in sweet potato. This trait was significantly and negatively correlated with relative growth rate (-0.313 r_p, -0.548 r_g) at both 5% and 1% LOS.

5. Relative growth rate (mg/g/d)

This trait was significantly and negatively correlated with number of root tubers per plant (-0.336 r_g), root tuber length (-0.299 r_g), root tuber girth (-0.332 r_p, -0.486 r_g), root tuber yield per plant (-0.457 r_g) and root yield per hectare (-0.337 r_g) at both 5% and 1% LOS and with net assimilation (-0.250 r_g), number of root tubers per plant (-0.275 r_p), root tuber yield per plant (-0.290 r_p) and root yield per hectare (-0.233 r_p) at 5% LOS. The above results are in conformity with the results of Tiwari *et al*.[10] in sweet potato.

6. Net assimilation rate (mg/cm^2/d)

This trait exhibited significant positive correlation with number of root tubers per plant (0.680 r_p,0.741 r_g), root tuber length (0.528 r_p, 0.596 r_g), root tuber girth (0.384 r_p, 0.412 r_g), root tuber yield per plant (0.679 r_p,0.692 r_g) and root tuber yield per hectare (0.621 r_p, 0.626 r_g) at both 5% and 1% LOS. The above results are in conformity with the results of Tiwari *et al*.[10] in sweet potato.

Table 3: Phenotypic (P) and genotypic (G) correlation matrix among yield and growth indices in orange flesh sweet potato genotypes

Characters		Leaf area index	Specific leaf area (cm^2/g)	Specific leaf weight (g/cm^2)	Crop growth rate (g/m^2/d)	Relative growth rate (mg/g/d)	Net assimilation rate (mg/cm^2/d)
Leaf area index	G	**1.000**					
	P	**1.000**					
Specific leaf area (cm^2/g)	G	0.954**	**1.000**				
	P	0.922**	**1.000**				
Specific leaf weight (g/cm^2)	G	0.264*	0.390**	**1.000**			
	P	0.246*	0.384**	**1.000**			
Crop growth rate (g/m^2/d)	G	0.705**	0.745**	0.167	**1.000**		
	P	0.650**	0.686**	0.160	**1.000**		
Relative growth rate (mg/g/d)	G	-0.245*	-0.211	-0.069	-0.548**	**1.000**	
	P	-0.142	-0.148	-0.059	-0.313**	**1.000**	
Net assimilation rate (mg/cm^2/d)	G	0.892**	0.936**	0.483**	0.720**	-0.250*	**1.000**
	P	0.865**	0.928**	0.475**	0.674**	-0.187	**1.000**
No. of root tubers per plant	G	0.710**	0.755**	0.238*	0.999**	-0.336**	0.741**
	P	0.642**	0.693**	0.210	0.837**	-0.275*	0.680**
Root tuber length (cm)	G	0.542**	0.583**	0.185	0.584**	-0.299**	0.596**
	P	0.494**	0.514**	0.166	0.527**	-0.174	0.528**
Root tuber girth (cm)	G	0.376**	0.421**	-0.004	0.593**	-0.486**	0.412**
	P	0.344**	0.405**	-0.005	0.535**	-0.332**	0.384**
Root tuber yield per plant (g)	G	0.687**	0.715**	0.129	0.993**	-0.457**	0.692**
	P	0.654**	0.696**	0.126	0.930**	-0.290*	0.679**
Root tuber yield (t/ha)	G	0.674**	0.681**	-0.005	0.951**	-0.337**	0.626**
	P	0.651**	0.668**	-0.001	0.881**	-0.233*	0.621**

significant at 5% level** * significant at 1 % level**

CONCLUSION

Correlation study indicated that genotypic correlation coefficients were higher than phenotypic correlation coefficients indicating lesser phenotypic expression under the influence of environment. Petiole length, leaf area, total leaf dry weight, chlorophyll a, chlorophyll b, total chlorophyll, number of branches per plant, leaf area index, specific leaf area, crop growth rate, net assimilation rate.registered a positive significant correlation at both phenotypic and genotypic levels with root tuber yield per hectare indicating the importance of these traits in selection for yield and are identified as yield attributing characters on which selection can be relied upon for the genetic improvement of yield of OFSP. Yield contributing characters like petiole length, leaf area, total leaf dry weight, chlorophyll a, chlorophyll b, total chlorophyll, number of branches per plant, leaf area index, specific leaf area, crop growth rate, net assimilation rate are the most dependable characters and could be effectively used in breeding for improvement in yield.

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