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Correlation studies in avocado (*Persea americana*) accessions for morphological and biochemical characters

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ABSTRACT

The correlation coefficients were estimated for different morphological and biochemical traits in 83 avocado (*Persea americana* Mill.) accessions of South India. The fruit weight, fruit length, fruit width, pulp weight and seed weight showed highly significant positive correlations with fruit yield, while peel per cent showed negative correlation with fruit yield. These traits can be utilized for selection of high-yielding genotypes. The total phenols content has positive correlation with DPPH antioxidant activity. The dry-matter content of pulp showed highly significant positive correlation with oil content of fresh and dry pulp, while moisture content in pulp showed negative correlation with oil content of fresh pulp. The dry-matter content and moisture content of pulp can be utilized for selection of high oil-yielding accessions.

Key Words: Oil content, Selection, Correlation, Dry-matter, FRAP

Avocado (*Persea americana* Mill.) belonging to Lauraceae family commercially grown in more than 80 countries (FAO STAT, 2019). It is a rich source of several bioactive compounds (Gomez-Caravaca *et al*., 2015 and Salazar-Lopez *et al*., 2020). The broader genetic base for leaf shape, fruit shape, peel colour, pulp colour, peel thickness and seed shapes is available in India due to seeds propagation from many decades (Tripathi *et al*., 2022). To build up a viable breeding programme, knowledge of interrelationships between yield and yield contributing characteristics is required. Hence, selection of genotypes directly based on yield may not be realistic and it depends on several other contributing components. Simple correlation analysis enables indirect selection of required trait (Robinson *et al*., 1951). Hence present study was formulated to know direct and indirect relationship between different morphological and biochemical characters of avocado.

MATERIALS AND METHODS

The study was carried out at ICAR-Indian Institute of Horticultural Research, Bengaluru, during 2018-19 and 2019-20. Eight-three accessions collected from different parts of South India were characterized for quantitative characters, viz. fruit length (cm), fruit width (cm), fruit weight (g), pulp weight (g), pulp per cent, seed weight (g), seed per cent, peel weight (g), peel per cent, length of seed cavity (cm), width of seed cavity (cm), seed length (cm), seed width (cm), leaf length (cm), leaf width (cm), pedicel diameter (cm), peel thickness (mm) and yield per tree. The biochemical characters, such as CUPRAC (Cupric Reducing Antioxidant Capacity) activity, FRAP (ferric reducing antioxidant power) activity, DPPH (2,2-diphenyl- 1-picrylhydrazyl) activity, total phenols, total carotenoids (mg /100g), TSS (total soluble solids) (° Brix), moisture content (%), dry-matter content (%), oil content in dry pulp (%), oil content in fresh pulp (%) and crude fiber (%) were also studied. The mean values were used for correlation studies. Correlations between morphological and biochemical traits were analyzed using the Pearson correlation coefficients by SPSS 16.0 software.

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RESULTS AND DISCUSSION

The fruit length showed highly significant positive correlation with fruit width (0.38), fruit weight (0.72), pulp weight (0.75), pulp per cent (0.56), peel weight (0.48), length of seed cavity (0.78), seed length (0.67) and yield (0.36/tree), showiing negative correlation with seed percent (-0.42) and peel percent (-0.46) (Table 1.). The accessions having more fruit

Table 1: Correlation coefficients for morphological characters of avocado accessions

Trait	FL	FW	FWT	PLW	PLP	SWT	SP	PEWT	PEP	LSC	WSC	SL	SW	LL	LW	PDD	PET	YEL
FL	1																	
FW	0.38***	1																
FWT	0.72***	0.83***	1															
PLW	0.75***	0.79***	0.98***	1														
PPT	0.56***	0.35**	0.52***	0.64***	1													
SWT	0.31**	0.65***	0.64***	0.51***	-0.23*	1												
SPT	-0.42***	-0.22*	-0.36***	-0.50***	-0.92***	0.44***	1											
PEWT	0.48***	0.73***	0.77***	0.72***	0.25*	0.48***	-0.32**	1										
PEPT	-0.46***	-0.40***	-0.50***	-0.52***	-0.46***	-0.41***	0.08	0.08	1									
LSC	0.78***	0.29**	0.60***	0.59***	0.24*	0.45***	-0.06	0.32**	-0.46***	1								
WSC	0.20	0.72***	0.61***	0.48***	-0.20	0.91***	0.38***	0.50***	-0.35**	0.42***	1							
SL	0.67***	0.35**	0.57***	0.51***	0.07	0.61***	0.11	0.33**	-0.44***	0.76***	0.51***	1						
SW	0.17	0.65***	0.55***	0.42***	-0.28*	0.96***	0.45***	0.48***	-0.32**	0.34**	0.93***	0.51***	1					
LL	0.10	-0.07	-0.01	-0.03	-0.08	0.08	0.10	-0.03	-0.007	0.154	0.08	0.01	0.02	1				
LW	0.20	-0.05	0.09	0.05	-0.12	0.20	0.16	0.05	-0.06	0.26*	0.15	0.25*	0.15	0.65***	1			
PDD	0.15	0.43***	0.38***	0.38***	0.20	0.14	-0.25*	0.50***	0.05	-0.05	0.13	0.01	0.11	-0.05	-0.17	1		
PET	-0.26*	0.13	-0.04	-0.10	-0.19	0.11	0.09	0.24*	0.28**	-0.37***	0.09	-0.21	0.11	-0.09	-0.20	0.36***	1	
YEL	0.36***	0.35**	0.38***	0.35**	0.12	0.33**	-0.03	0.26*	-0.25*	0.28*	0.25*	0.30**	0.20	0.10	0.01	0.16	-0.01	1

*** Significant at 0.001 level; ** 0.01 level; * 0.05 level

FL: Fruit length; FW: Fruit width; FWT: Fruit weight; PLW: Pulp weight; PLP: Pulp per cent; SW: Seed weight; SP: Seed per cent; PLWT: Peel weight; PEP: Peel per cent; LSC: Length of seed cavity; WSC: Width of seed cavity; SL: Seed length; SW: Seed width; LL: Leaf length; LW: Leaf width; PDD: Pedicel diameter; PET: Peel thickness; YLD: Yield per tree

length might have more pulp weight, pulp percentage and less seed percentage. The similar findings were reported by Srivastava *et al*. (2023), Rathor (2005), Kumar *et al*. (2006) and Patel *et al*. (2017). Simi (2006) reported positive correlation of fruit length with fruit weight and diameter of mango. Fruit width exhibited positive direct effect on fruit weight (0.83), pulp weight (0.79), seed weight (0.64), peel weight (0.73), width of seed cavity (0.72), seed width (0.65) and pedicel diameter (0.43), showing negative correlation with seed per cent (-0.22) and peel per cent (-0.40).

Fruit weight showed highly positive correlation with pulp weight (0.98), pulp per cent (0.52), seed weight (0.64), peel weight (0.77), seed length, seed width, length and width of seed cavity but had negative correlation with seed per cent (-0.36) and peel per cent (-0.50). Pulp weight expressed significant positive correlation with pulp per cent (0.64) but had negative correlation with seed (-0.50) and peel (-0.52) per cent. Pulp percent showed negative effect on seed per cent and peel per cent of fruit. Seed weight positively correlated with seed percent (0.44), peel weight (0.48) but had negative correlation with peel per cent (-0.41).

Seed per cent and peel weight showed highly significant correlation. Peel per cent reported negative correlation with seed and seed cavity characters. Positive and significant correlation was recorded for seed length and seed cavity characters, seed length and seed width, leaf length and leaf width, pedicel diameter and peel thickness. Positive correlation of seed length and length seed cavity (0.521), seed circumference and length of seed cavity (0.496) was reported by Gopi *et al.* (2021) which is in agreement with the present study. The fruit weight, fruit length, fruit width, pulp weight and seed weight showed highly significant correlation effect on yield of the plant while peel percent showed negative correlation on yield which indicates higher the fruit and seed weight more will be the yield (Table 1).

The CUPPRAC antioxidant activity showed highly and positive relationship with FRAP activity (0.40) and positive relationship with oil content in fresh pulp (0.35) and dry-matter content of pulp (0.33), whereas negatively correlated with moisture content (-0.33) (Table 2.). The similar positive correlation was reported for total phenols and antioxidants activity by Wang *et al*. (2010); Muralidhara *et al*. (2019), Muralidhara *et al*. (2020) and Lal et *al*. (2023). Total phenols had positive correlation with DPPH activity (0.80) and FRAP

Table 2: Correlation matrix for biochemical characters of avocado

Trait	CUPRAC activity	FRAP activity	DPPH activity	Total phenols	TSS	Total carotenoids	Oil content (dry weight)	Moisture content	Oil content (fresh weight)	Dry matter	Crude fibre
CUPRAC activity	1										
FRAP activity	0.40***	1									
DPPH activity	0.17	0.24*	1								
Total phenols	0.02	0.14	0.80***	1							
TSS (ºB)	0.09	0.024	0.22*	0.21	1						
Total carotenoids	0.13	0.45***	0.13	0.07	0.21	1					
Oil content (Dry weight)	0.22*	-0.10	0.093	0.15	0.14	0.18	1				
Moisture content	-0.33**	-0.08	0.051	0.04	-0.30**	-0.27*	-0.65***	1			
Oil content (Fry weight)	0.35**	0.016	-0.004	0.03	0.25*	0.24*	0.85***	-0.95***	1		
Dry matter	0.33**	0.08	-0.05	-0.04	0.30**	0.27*	0.65***	-1***	0.95***	1	
Crude fibre	-0.01	-0.13	-0.11	-0.05	0.01	0.12	0.21	-0.06	0.14	0.06	1

*** Significant at 0.001 level; **0.01 level; *0.05 level

activity expressed highly significant correlation with total carotenoids content. Veena *et al*. (2019) reported that total phenols had a significant positive correlation with total antioxidants (0.68).

Total carotenoids also had positive correlation with oil content in fresh pulp (0.24) and dry-matter content of pulp (0.27) and negatively correlation with moisture content (-0.27). This will help to identify high oil content accessions based on dry-matter content. Dry-matter content of pulp had highly positive correlation with oil content of dry (0.65) and fresh pulp (0.95) (Table 2). Lu *et al*. (2009) and Carvalho *et al*. (2015) reported dry-matter and carotenoids content had positive relationship with fatty acid content. The negative correlation between oil content and moisture content in different varieties of avocado were also reported by Bezuidenhout and Bezuidenhout (2014). Carvalho *et al.* (2015) reported positive correlation of oil content with dry matter content of pulp in avocado.

CONCLUSION

The fruit weight, fruit length, fruit width, pulp weight and seed weight showed highly significant positive correlation with fruit yield and can be utilized for selection of high-yielding genotypes. The dry-matter content of pulp showed highly significant positive correlation with oil content of fresh and dry pulp whereas moisture contentment showed negative correlation with oil content of fresh pulp. The dry-matter and moisture content of pulp can be utilized for selection of high oil yielding accessions.

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