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Study of linear relations between fruit traits in ecologically grows varieties of apple

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Abstract: Apple has many benefits to human health and is a favorite fruit among consumers. The biological material for this study was composed by five apple varieties from an ecological orchard ('Jonathan', 'Florina', 'Gala', 'Jonagold', 'Golden Delicious E') in comparison with 'Golden Delicious C' from an conventional orchard. Ten random selected and mature fruits from each variety have been analyzed for the following traits: diameter, height, firmness, weight soluble solid content, dry matter content. The objective of this study was to evaluate the interrelationships between different fruits traits in order to establish their contribution on fruit development. The fruit diameter showed the highest contribution to fruit weight variability, based on values of 92.86-93.94% for 'Gala' and 'Jonagold' varieties, 83.65-84.50% for 'Golden Delicious E' and 'Jonathan' varieties, respectively. In the case of 'Florina' and 'Golden Delicious E' varieties, the contribution of the diameter to the fruit mass was also associated with an important influence of 13.39-18.65% from the fruit height.

Introduction

Environmental and agronomic factors along all the growing season strongly affect the final apple quality including the nutraceutical aspects. The detrimental effects of intensification in apple orchards have increased the interest in developing more environmentally friendly production, through either integrated production or organic management. The objective of this study was to evaluate the interrelationships between different fruits traits in order to establish their contribution on fruit development.

Material and method

The biological material for this study was composed by five apple varieties from an ecological orchard ('Jonathan', 'Florina', 'Gala', 'Jonagold', 'Golden Delicious E') in comparison with 'Golden Delicious C' from an conventional orchard. Ten random selected and mature fruits from each variety have been analyzed for the following traits: diameter, height, firmness, weight soluble solid content, dry matter content. The data were statistically processed using analysis of variance for multiple regressions with five independent variables Pearson correlation coefficient between studied traits was also calculated.

Results and discussions

Fruits diameter has a major (83.65%) and significant contribution to growth of 'Golden Delicious E' fruits followed by fruit height which influences to an extent of approximately 13.39%. The variability of fruit weight was influenced to a very low extent by firmness (0.72 %) and dry matter content (0.1 %).

Variance components of multiple regressions between fruit weight and other traits in Golden Delicious varieties

Variability source	DF	Golden Delicious E			Golden Delicious C		
		SS	MS	F	SS	MS	F
Regression	5	4620.45	924.089	828.49**	3110.90	622.18	12.66**
Fruit diameter (x_1)	1	3868.52	3868.52	3468.34	2131.42	2131.42	43.37**
Fruit height (x_2)	1	619.20	619.20	555.15	58.10	58.10	1.18
Fruit firmness (x_3)	1	33.47	33.47	30.00	106.25	106.25	2.16
Soluble solids content (x_4)	1	94.85	94.85	85.04	225.23	225.23	4.58
Dry matter content (x_5)	1	4.40	4.40	3.94	589.90	589.90	12.00*
Residual	4	4.46	1.12		196.56	49.14	
Total	9	4624.91			3307.46		

Golden Delicious E $y = -120.2 + 1.62x_1 + 2.59x_2 + 23.00x_3 - 4.63x_4 - 0.15x_5$;
 $R^2 = 0.9990$; $R_a^2 = 0.8978$; SDE = 1.06 mm; DW= 2.690

Golden Delicious C $y = -226.3 + 5.2x_1 + 1.93x_2 - 33.1x_3 - 9.59x_4 + 10.19x_5$;
 $R^2 = 0.9406$; $R_a^2 = 0.8663$; SDE = 7.01 mm; DW= 2.30

Likewise, in the case of the variety 'Golden Delicious C', the fruit diameter has the major significant influence of approximately 64.44% in the achievement of fruit weight, being followed by dry matter content which influences the fruit weight with 17.84%.



The fruit weight in 'Golden Delicious E' variety shows positive and strongly significant correlations with the diameter and height of the fruits, on the background of negative correlations with the sugar and dry matter content. Fruit height and diameter are strongly correlated with each other, showing negative correlations with sugar and dry matter content. The fruit firmness shows positive and non-significant correlations, compared to other traits.

Values of correlation coefficients between fruit traits in Golden Delicious varieties

Traits	1.	2.	3.	4.	5.	6.
1. Fruit diameter	-	0.807**	0.369	-0.411	-0.249	0.915***
2. Fruit height	0.725*	-	0.310	-0.452	-0.507	0.954***
3. Fruit firmness	0.940***	0.676*	-	0.477	0.141	0.424
4. Soluble solids content	0.363	0.745*	0.191	-	0.544	-0.474
5. Dry matter content	0.636*	0.633*	0.505	0.781**	-	-0.458
6. Fruit weight	0.818**	0.613	0.634*	0.633*	0.820**	-

Values above diagonal for Golden Delicious E;

Values below diagonal for Golden Delicious C;

$r_{5\%} = 0.632$; $r_{1\%} = 0.765$; $r_{0.1\%} = 0.872$

In the case of the 'Golden Delicious C' variety, the fruit weight shows positive and significant correlations with the other traits. The dimensions and firmness of the fruit show significantly positive relationships between them, associated also with close relationships between sugar and dry matter content. In the case of the fruit height there is also a significant positive correlation with dry matter and sugar content.

Conclusions

The fruit diameter showed the highest contribution to fruit weight variability, based on values of 92.86-93.94% for 'Gala' and 'Jonagold' varieties, 83.65-84.50% for 'Golden Delicious E' and 'Jonathan' varieties, respectively. In the case of 'Florina' and 'Golden Delicious E' varieties, the contribution of the diameter to the fruit mass was also associated with an important influence of 13.39-18.65% from the fruit height.

