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Influence of Rootstocks and Crop Load Ratios on Gibson Golden Delicious Apple Yield and Fruit Quality

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Abstract
Rootstocks and crop-load management are important factors that influence the profitability of apple orchards. Rootstocks influence tree vigor, precocity, sustained productivity, fruit size, and tree stress tolerance. Crop load affects fruit maturity, size and grade, and return bloom in the subsequent year. Modern high-density systems require careful selection of rootstocks and management of crop-loads to optimize yield and ensure a return crop for following seasons. This report summarizes the yield and fruit quality of Gibson Golden Delicious apple grown on a combination of different rootstocks and cropping levels during 2010.

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Influence of Rootstocks and Crop Load Ratios on Gibson Golden Delicious Apple Yield and Fruit Quality

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Introduction

Rootstocks and crop-load management are important factors that influence the profitability of apple orchards. Rootstocks influence tree vigor, precocity, sustained productivity, fruit size, and tree stress tolerance. Crop load affects fruit maturity, size and grade, and return bloom in the subsequent year. Modern high-density systems require careful selection of rootstocks and management of crop-loads to optimize yield and ensure a return crop for following seasons. This report summarizes the yield and fruit quality of Gibson Golden Delicious apple grown on a combination of different rootstocks and cropping levels during 2010.

Material and Methods

The orchard was established in 2003 at the ISU Horticulture Research Station with trees planted 8 ft 2 in. within rows and 16 ft between rows. Five rootstocks [Malling 9 T337 (M.9, T337), Geneva 16 (G.16), Malling 26 (M.26), Cornell-Geneva 3041 (CG.3041), and Budagovsky 62-396 (B.62-396)] and four crop load levels of 2, 4, 6, and 8 fruits per trunk cross-sectional were evaluated in this study. Data were collected on fruit growth, yield, and fruit quality at harvest and after 60 days of refrigerated storage. Trunk cross-sectional areas (TCA) were calculated from measurements of the individual tree trunk circumference at 25 cm above the graft union.

Results and Discussion

In 2010, the apple orchard was damaged by frost during bloom and a severe wind/storm event and flooding during fruit enlargement and maturation. The information summarized presents preliminary analyses.

Total yield was higher on trees with rootstocks M.9.T337, G.16, M.26, and B.62-396 than CG.3041 (Table 1). CG 3041 had the lowest value for yield efficiency (0.43kg/cm^2 of trunk cross-sectional area) as compared with the other four rootstocks. Higher yield efficiency values indicate more productive trees. Fruit from trees with rootstock M.26 had the smallest average fruit weight and percent of fruit equal to or greater than 3 in., which would reduce the overall market value. Lower crop load treatments of 2 and 4 fruits per TCA resulted in higher percentages of fruits greater or equal to 3 in. compared with the highest crop load of 8 fruits. Yield increased as crop load was increased, but resulted in a higher percentage of smaller sized fruits.

Fruits at harvest from trees on CG.3041 rootstocks had higher percentage of soluble solids, but fruit was less firm when compared with the other rootstocks (Table 2). After 60 days in storage, fruits had a higher percentage soluble solids when grown on CG.3041 rootstock than fruit on M.9 T337, M.26, and B.62-396. Fruit firmness was similar after storage among all rootstock and crop load level treatments.

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Table 1. Preliminary analysis of yield variables on Gibson Golden Delicious apple grown with different dwarfing rootstocks and under different crop load levels.

		Yield (kg per tree)	Yield efficiency (kg/cm^2 of TCA)	Average fruit weight (grams)	Number of fruits ≥ 76mm (3 in.)	Percent of fruits ≥ 76mm (3 in.)
Rootstock	Malling 9 T337	35.9 [zy]	0.76 a	171.7 ab	130 a	63 a
	Malling 26	32.0 a	0.74 a	155.9 b	89 bc	44 b
	Geneva 16	33.0 a	0.52 bc	173.4 a	115 ab	63 a
	Cornell-Geneva 3041	16.0 b	0.43 c	186.8 a	53 c	68 a
	Budagovsky 62-396	28.1 a	0.71 ab	173.7 a	108 ab	66 a
Crop Load level (TCA = trunk cross section area)	2 fruits per TCA	21.6 b	0.40 b	180.3 a	77 c	66 a
	4 fruits per TCA	26.6 b	0.55 b	172.8 ab	93 bc	62 a
	6 fruits per TCA	31.2 a	0.87 a	167.9 ab	137 a	60 ba
	8 fruits per TCA	42.9 a	0.96 a	159.5 b	124 ab	47 b

[z]Means in the same column for each treatment main effect with the same letter are not significantly different (alpha value of 0.05).
[Y]Means of 2 to 4 replications.

Table 2. Percent soluble solids (SSC) and fruit firmness of Gibson Golden Delicious apple at harvest and after 60 days of refrigerated storage.

		At harvest (10/4/2010)		After 60 days storage (11/27/2010)	
		SSC (%)	Fruit firmness (Newtons)	SSC (%)	Fruit firmness (Newtons)
Rootstock	Malling 9 T337	12.1 b[zy]	89.54 a	15.5 b	52.26 a
	Malling 26	11.6 b	91.24 a	15.8 b	52.27 a
	Geneva 16	11.8 b	89.20 a	15.9 ab	49.16 a
	Cornell-Geneva 3041	13.4 a	73.06 b	16.5 a	50.41 a
	Budagovsky 62-396	12.2 b	79.73 b	15.6 b	50.62 a
Crop load level (TCA = truck cross section)	2 fruits per TCA	12.9 a	80.56 c	16.2 a	50.22 a
	4 fruits per TCA	12.4 ab	83.64 bc	15.7 a	51.19 a
	6 fruits per TCA	11.4 bc	90.15 ba	15.6 a	51.35 a
	8 fruits per TCA	11.2 c	93.61 a	15.8 a	51.10 a

[z]Means with the same letter are not significantly different (alpha value of 0.05).
[y]Means of 2 to 4 replications.
Newton is a unit of force and 1 kilogram force is equal to 9.81 Newtons.