

Lack of Apple Cultivar and Root Pruning Interaction

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Abstract

The influence of root pruning on five apple cultivars with widely differing growth habits and growth potential on MM.111 rootstock was compared over nine years. Root pruning had little effect on growth or cropping. 'Mutsu' were the largest trees and produced one of the highest cumulative yields/tree, and one of the lowest yield efficiencies. 'Jonathan' and 'Redchief Delicious' had low cumulative yields. 'Lawspur Rome Beauty' and 'Smoother Golden Delicious' had higher yield efficiency than the other cultivars. There was no interaction between cultivar and root pruning.

Introduction

Root pruning has generally resulted in reduced tree size and shoot growth (7, 8, 11, 12, 13, 16). However, in some studies results were inconsistent (1, 2, 9). Generally, these studies were conducted on a single cultivar; however, Ferree and Rhodus (7) worked with four cultivars and found significant interactions of root pruning and cultivar for tree size parameters, but no interaction on yield and inconsistent effects on fruit size.

The present study was established to directly compare root pruning on a series of apple cultivars with the following unique growth and fruiting characteristics: less vigorous spur type ('Redchief Delicious'); vigorous terminal bearer ('Lawspur Rome Beauty'); vigorous conventional fruiting habit ('Smoother Golden Delicious'); less vigorous conventional fruiting habit ('Jonathan'); extremely vigorous triploid with conventional fruiting habit ('Mutsu').

Materials and Methods

In April 1893, the above 5 cultivars on MM.111 rootstock were planted 3m x 5m and trained to a central leader with minimal pruning and without support. Soil management was a 2m herbicide strip with sod middles and a conventional pest control program was used. Half of the trees of each cultivar were mechanically root pruned on two sides 50 cm from the

trunk to a depth of approximately 45 cm using a sharpened subsoiler (12). Root pruning began the second year (1984) and was performed annually at bloom. The treatments were arranged as a split plot, with root pruning as the main plot, cultivars as the split plot with 7 replications.

Yield and trunk circumference were collected annually. In 1988, 1989 and 1990 a sample of 60 fruit/tree were collected and weighed to determine fruit size in June just past the completion of the cell division phase of fruit growth. In 1987, 1988 and 1990 at harvest a sample of 25 fruit were collected at random from the lower canopy and weighed to determine average fruit weight. After 9 years of growth (1991) tree height and spread were measured.

Results and Discussion

Root pruning had little effect on tree growth or ultimate tree size or early season fruit growth (Table 1). 'Mutsu' trees had the largest trunk cross-sectional area (TCA) throughout the study and also one of the largest overall canopy sizes. Although there was a range in TCA's of the other four cultivars due to variability, they did not differ from each other. In 1988 and 1990 there was no significant interaction between root pruning and cultivar for early season fruit weight, with 'Mutsu' having the largest fruit and 'Jonathan' tending to have the smallest fruit. In 1989 the interaction was significant with early

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'Mutsu' usually has low production efficiency due to its very vigorous growth and large tree size (4, 5, 10). 'Jonathan' also generally has relatively low yield efficiency (4, 5, 10) even though it had much less vigorous growth and was a smaller tree.

The effect of root pruning in this study was smaller than in previous studies (3, 12,13,16). In previous studies, root pruning was initiated on mature fruiting trees and it has been shown that the reduction in growth from root pruning is greater when the trees carry a crop (16). In the present study, root pruning was initiated prior to flowering and fruiting, in the second year in the orchard. A greenhouse study on vegetative trees indicated that when growing conditions and moisture supply is optimum, growth reduction due to root pruning is temporary and trees previously root pruned compensate and are less influenced by subsequent root pruning (14). The trees in this study carried only modest crops and initiating the pruning prior to fruiting may have resulted in less response to root pruning. TCA of root pruned trees was consistently smaller than non-root pruned trees even though the difference was small and not significant (Table 1).

The most important finding from this study was the lack of interaction between apple cultivars with very different growth habits and root pruning. Another study that compared the effect of root pruning on nine rootstock and interstem combinations with 'Smoothie Golden Delicious' as the scion (6) found that even though there was a 3.3-fold difference in tree size from largest to smallest, root pruning produced similar results across all genetic combinations. Root pruning generally affects growth and fruit characteristics through its effect on water relations, although the effect on root produced phytohormones may also have an influence (8,14,15). The results of this study and the rootstock study (6) indicate that even though growth habit and vigor differ among cultivars and rootstocks, the response to root pruning is similar.

Literature Cited

1. Baugher, T.A., K.C. Elliott and D.M. Glenn. 1995. Effect of sod competition and root pruning on 'Stayman' apple tree growth and fruit cracking. *HortScience* 30(2):222-226.
2. Elfving, D.C., E.C. Loughhead and R.A. Cline. 1991. Daminozide, root pruning, trunk scoring, and trunk ringing effects on fruit ripening and storage behavior of 'McIntosh' apple. *J. Amer. Soc. Hort. Sci.* 116(2):195-200.
3. Ferree, D.C. 1992. Time of root pruning influences vegetative growth, fruit size, biennial bearing, and yield of 'Jonathan' apple. *J. Amer. Soc. Hort. Sci.* 117(2):198-202.
4. Ferree, D.C., D.R. Chandler, and J.C. Schmid. 1991. Performance of selected apple cultivars on semi-standard rootstocks in southern Ohio. *Fruit Crops-1980; A Sum. Of Res. OARDC Res. Circ.* 259:1-3.
5. Ferree, D.C., D.R. Chandler, and J.C. Schmid. 1986. Apple cultivar performance on M.26 in southern Ohio. *Fruit Var. J.* 40(3):97-102.
6. Ferree, D.C. and M. Knee. 1997. No interaction between root pruning and rootstock on growth and performance of 'Golden Delicious' apple. *HortScience* 32(4):645-648.
7. Ferree, D.C., and W.T. Rhodus. 1993. Apple tree performance with mechanical hedging or root pruning in intensive orchards. *J. Amer. Soc. Hort. Sci.* 118(6):707-713.
8. Geisler, D. and D. Ferree. 1984. Response of plants to root pruning. *Hort Reviews* 6:155-188.
9. Miller, S.S. 1995. Root pruning and trunk scoring have limited effect on young bearing apple trees. *Hort Science* 30(5):981-984.
10. Rom, C. and D. Ferree. 1984. Spur leaf characteristics of nine apple cultivars. *Fruit Var. J.* 38(1):2-5.
11. Schupp, J.R. 1992. Effect of root pruning and summer pruning on growth, yield, quality, and fruit maturity of 'McIntosh' apple trees. *Acta Hort.* 322:173-176.
12. Schupp, J. R. and D.C. Ferree. 1987. Effect of root pruning at different growth stages on growth and fruiting of apple trees. *HortScience* 22(3):387-390.
13. Schupp, J.R. and D.C. Ferree. 1988. Effect of root pruning at four levels of severity on growth and yield of 'Melrose'/M.26. *J. Amer. Soc. Hort.Sci.* 113:194-198.
14. Schupp, J.R. and D.C. Ferree. 1990. Influence of time of root pruning on growth, mineral nutrition, net photosynthesis, and transpiration of young apple trees. *Scientia Hort.* 42:299-306.
15. Schupp, J.R. and D.C. Ferree. 1994. Effect of root pruning on shoot tip ethylene production and xylem concentrations of cytokinin and 1-aminocyclopropane-1-carboxylic acid in young apple trees. *Fruit Crops-1994: A Sum. Of Res. OARDC Res. Circ.* 298:38-42.
16. Schupp, J.R., D.C. Ferree and I.J. Warrington. 1992. Interactions of root pruning and de-blossoming on growth, development and yield of 'Golden Delicious' apple. *J. Hort. Sci.* 67:465-480.