Development of Stock/Scion Tissues of 'Starking'/MM 104 When Grown Under Adverse Conditions

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The MM 104 rootstock is productive in stool beds, roots very well and does not require staking. Since it requires a well-drained soil and developes collar rot on waterlogged soils, it is not generally recommended (1) (2). Tissue variables included in this report were similar to those reported for 'Golden Delicious'/EM IX (3).

'Starking'/MM 104 was planted in northern Illinois in 1963 as part of a large planting of different apple cultivars on various rootstosks. By 1971, approximately 40 trees out of the 160 total were dying or were seriously affected with measles. The other cultivar/rootstock combinations in adjacent tree rows were not affected.

Examination of the trees showed a disintegration of the bark within the graft-union area. Removal of the bark disclosed that the surface of the underlying woody cylinder was smooth and normal in appearance. Upon excavation of the trees, it was found that the roots extended in a horizontal direction (Fig. 1, arrows), plus indicating poor anchorage. Soil profile examination revealed a poorly drained tight clay, through which the roots did not penetrate. There was no root growth downward through this impervious, waterlogged clay, during periods of abundant rainfall. The scion tissue was alive, so that the trees responded well when inarched.

The functioning phloem adjacent to the cambial zone was alive with the phloem-ray cells, and adjacent sieve tubes appearing normal. However, there was a lack of sieve tube growth between the ray cells (Fig. 2).

Extreme callousing had taken place in MM 104 tissue, as indicated by the thickening of the outer bark. Disintegration of the non-functioning phloem and the outer bark had been progressing for a long period with continuous sloughing-off of these tissues as a response to the wound stimulus. Tissue regeneration of the outer bark took place in the form of disorganized callus. The only tissue capable of translocation was a thin layer of functioning phloem, which was in a state of decline. Necrosis was prevalent throughout this area with severe in-

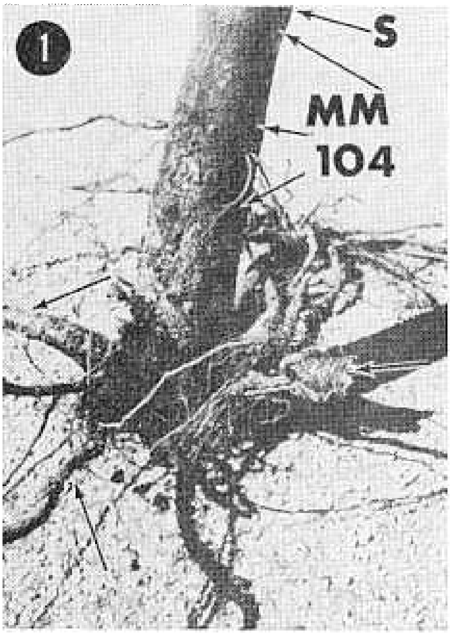

Fig. 1. Trunk and rot abnormalities of 'Starking'/MM 104 rootstock. Arrows indicate horizontal root development at the zone in the soil profile where soil aeration and drainage was poor.

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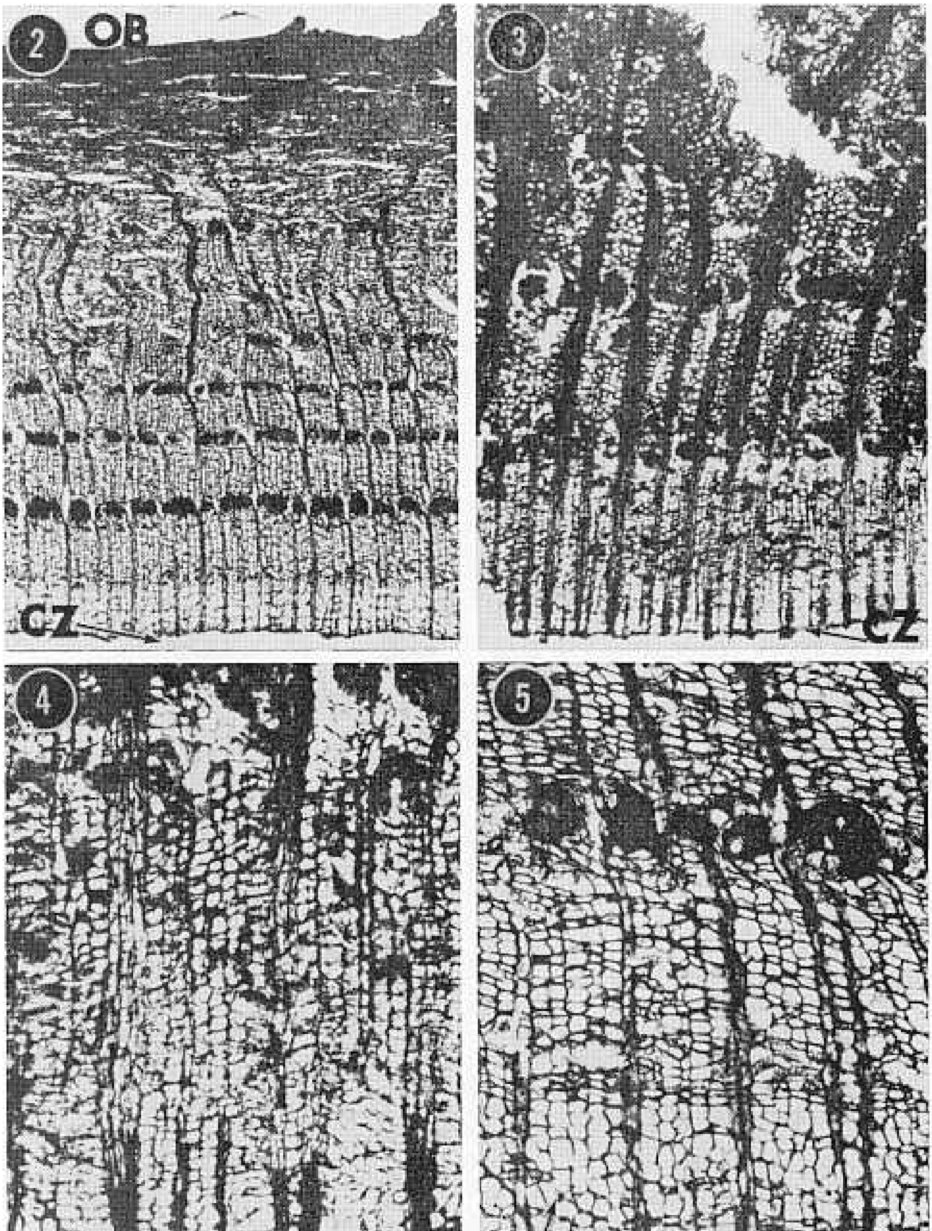
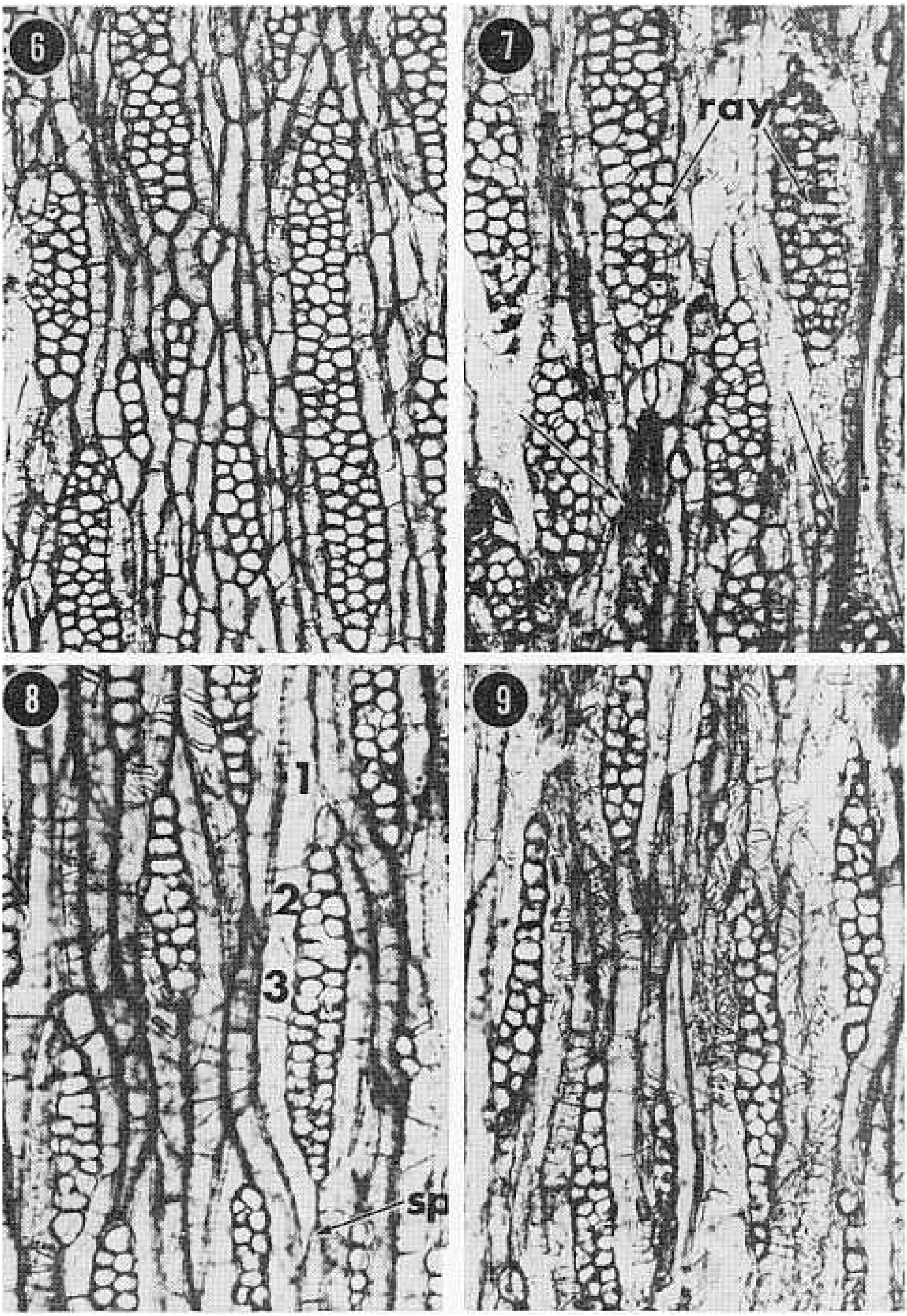


Figs. 2 to 5. Fig. 2: Transverse sections of functioning phloem of outer bark (OB) adjacent to the cambial zone (CZ) of 'Starking' tissue. Fig. 3: MM 104 tissue below the graft-union area showing extreme disintegration of the outer bark and formation of new callus tissue. Figs. 4 and 5: Blockage and suberization of ray cells with some sieve-elements (SE) already destroyed. Fig. 2, X 25; Fig. 3, X 32; Fig. 4, X 10; Fig. 5, X 100.



Figs. 6 to 9. Figs. 6 and 7: Tangential longitudinal sections of functioning phoem tissue. Fig. 7: 'Starking' tissue showing both normal and some abnormal necrosis (arrows) which may be attributed to measles. Figs. 8 and 9: MM 104 tissue with series of sieve elements identified as 1-3 with a distinct sieve plate (SP) in Fig. 8. (Figs. 6, 7, X 128 magnification; Figs. 8, 9, X 160.)

jury being apparent in the phloem-fiber tissue (Figs. 3, 4 and 5).

Death of the ray cells (Figs. 4 and 5) indicates the severity of the malfunction of these tissues, thus making it impossible for translocation from the leaves to the roots. This whole area engulfs the functioning phloem and is adjacent to the cambial zone. Injury apparently was due to excess soil moisture near the tree trunk and the graft-union.

A longitudinal section through the functioning phloem of 'Starking' appear to be normal, with uninjured functioning tissues between the sieve tubes and plates (Fig. 6). However, necrotic tissues are apparent between the phloem-ray cells (Fig. 7). Some of the phloem-ray cells themselves are also necrotic. Bark necrosis might be accentuated by this condition.

Phloem tissue of MM 104 shows a marked decrease in size of the phloem-ray cells as compared with that of 'Starking' (Figs. 8 and 9). However, the size of sieve tubes and plates were greater, accounting for the thick, spongy bark that was found in the graft-union area.

These findings stress the need for careful selection of site and soil for MM 104. It is imperative that a well-drained soil be selected, since this rootstock is sensitive to wet soil conditions.

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Myrobalan Selections As Rootstocks* for Plum

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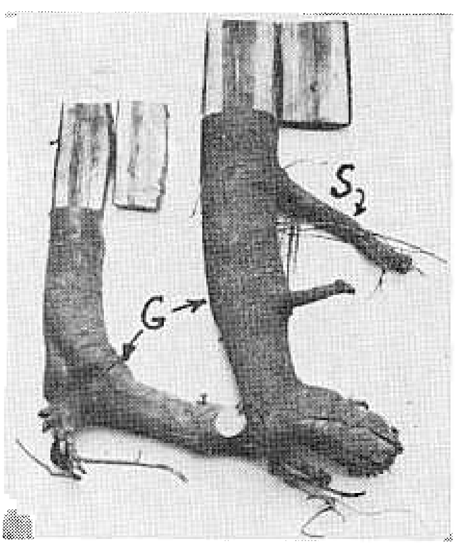

Fig. 1. Portions of two plum trees, as found in a commercial orchard. Note weak tree (left) with one large root coming from the graft union. The tree to the right had a larger root system and scion roots (top right), but also a reduced trunk diameter below graft union. Both trees were in the 6th growing season. G = graft union and S = scion-root.

Variable degrees of incompatibility in the graft union of 'Stanley' plum on 'Myrobalan' rootstock has been observed during the last decade. In commercial plum orchards in Michigan, many trees have been observed to decline in the sixth year in the orchard, when they come into fruit. Such trees have been found to have a reduced root system and an enlarged trunk immediately above the graft (Fig. 1). The rootstock portion of the trunk is

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