Burr-Knot Observations on Clonal Apple Rootstocks in Arkansas

Roy C. Rom*

Burr-knot, an aggregation of dormant root initials, is common to some apple cultivars. They have been observed on clonal apple rootstocks in Arkansas. Some problems associated with these stocks may be related to their presence.

Swingle (6) reviewed the early literature and cited an 1809 report by Knight, who described the burrs as, "conigeries of points capable of forming roots under favorable conditions." He credits Loudon with the name burr-knot which first appeared in print in 1829.

Brown (1) eliminated the speculation that typical burr-knots were caused by *Agrobacterium tumefaciens.* She observed wooly aphis *(Erisoma langera)* associated with the condition and suggested a casual relationship. She reported that other insects may be found in burred areas and indicated that fire blight bacteria, *(Erwinia amylovora)* could enter the plant system through burrs.

Swingle (6) reconfirmed the nonpathological nature of the growths and further stated that wooly aphis were not a causal agent but they found refuge in the burred areas. He noted that the root initials were true morphological roots as opposed to wood roots. Their presence was a normal condition and characteristic of many apple varieties.

The relationship of root initials to the stems vascular system was studied

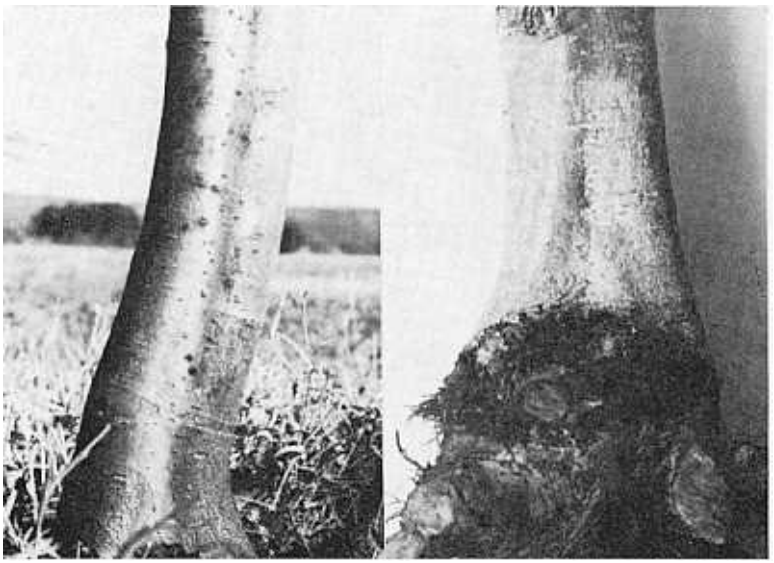

Fig. 1. Relationship of burr-knott to trunk fluting: On left 4-yr.-old Jonathan on Al-2 burr-knot at ground line; on right 5-yr.-old Wayne on MM 106 excavated, showing massive burr-knot at ground line.

*Professor, Department of Horticulture and Forestry, University of Arkansas, Fayetteville, Arkansas.

by Swingle, who found that root germs develop from parenchyma cells in medullary ray tissue at a point where it crosses the cambium. Certain cells assume meristematic activity, and, by the third year, the resulting root knobs are elongated, branched, and erupting to form burr-knots. Oberle (4) reports that the presence of burrs on some apple tree limbs causes death to terminals apparently due to interference with translocation.

Hartman (3) stated that preformed root initials remain dormant until environmental conditions are correct for further development. The clonal apple rootstocks in the trade are commonly propagated in stool beds; but Hartman (2) has found that some root readily from hardwood cuttings. Oberle (5), working with burr-knot affected apple seedlings, found no relationship between degree of burr-knot and ease of rooting from cuttings.

Extensive burr-knot development was noted in 1966 in a three-year-old replicated planting of seven clonal apple rootstocks on the Main Experiment Station, Fayetteville, Arkansas. The planting had been established from rooted layers obtained from two commercial propagators. The block had been used to screen herbicides for 3 seasons. While it may be suggested that the herbicides stimulated burr-knot development, observations indicated as much frequency of development in the non-treated check plots as in the herbicide plots. All clonal stocks showed a high percentage of burr-knot incidence by the end of 1968 (Table 1). Thus, it is concluded that these stocks have a strong natural tendency toward burr-knot development which becomes manifest under certain environmental conditions. MM 111 and MM 106 had the highest percent of trees showing burring and also had the greatest development of burrs. MM 111 is known to root readily from cuttings (2). Burr-knots were observed up to 18 inches above ground and were associated with lateral branch axis or found at nodes on clear trunk areas. In cases of heavy burring, the trunk appeared girdled by the burrs. Larvae of several insect species, one of which was identified as oriental fruit moth, *Grapholitha molesta* (Brusk), were found in the burrs.

The natural wounding of tissue associated with proliferation of root initials in the growth of a burr-knot creates an avenue of entrance for fire blight bacterial washed down the

Table 1. Incidence of burr-knot on clonal apple rootstocks, Fayetteville, Arkansas, 1968.[1]

Root-stock	Tree No.	% Burr-knot[2] Light	Med.	Severe	% of Total
EM 2	78	85.9	6.4	0.0	92.3
EM 7	96	16.7	40.6	37.5	94.8
EM 9	81	25.9	41.9	24.7	92.6
M-26	61	50.8	39.3	3.3	93.4
MM 104	96	11.5	46.9	37.5	95.9
MM 106	85	3.5	4.7	90.6	98.8
MM 111	97	4.1	13.4	79.4	96.9

[1]After 5 growing seasons
[2]Light = lumps or swellings only
Medium = root initials showing – several burrs
Severe = many root initials showing, numerous burrs, growth constriction, insect infested

Table 2. Burr-knot and fire blight canker observations in a 4-yr.-old Jonathan planting, Fayetteville, Arkansas, 1969.

Rootstock	No. Trees	Trees with burr-knot	Trees with blight canker at grouund line
MM 104	16	0	0
MM 106	18	4	0
MM 111	17	7	1
Al-2	20	5	5
EM I	20	2	7
EM II	18	1	1
EM VII	19	5	1

trunk of the tree by rain action. Evidence of this occurring has been noted. Observations made in a 4-year-old Jonathan block propagated on seven clonal rootstocks (Table 2) show a relationship between burr-knots on the rootstock and fire blight lesions on the stock and/or scion adjacent to a burr-knot. *Erwinia amylovora* bacteria have been isolated from these lesions. Loss of trees due to killing of the rootstock by fire blight is a problem in Arkansas, particularly with blight susceptible EM IX and M-26 clones.

A final observation relating to the incidence and degree of burr-knotting is the effect on the stock or scion with respect to twisting or fluting. It has been observed that, when a burr-knot develops close to the union of stock and scion, trunk diameter growth is depressed in the area immediately above the burr (Fig. 1). This growth distortion may become more prominent as the burr-knot increases in size and the trunk increases in diameter. The interference with normal cambium growth by a burr-knot originating in ray tissue which crosses the cambium and the subsequent enlargement of the burr-knot may be offered as one explanation for the trunk twisting or fluting noted on some scions. An examination of three scion varieties propagated on MM 106 rootstock showed that trunk distortions were frequently found above well developed burr-knots (Table 3). Burr-knots tend to develop near graft unions where carbohydrate reserves accumulate (5, 7). When environmental conditions are favorable, these root primordia may be induced to further development. Full root development from a burr-knot into a birds nest located in the crotch of a young tree has been observed. The conditions of temperature and humidity in the warmer apple growing regions such as Arkansas may be favorable for early burr-knot development.

Table 3. Relationship of stock or scion fluting to presence of burr-knot on MM 106 rootstock, Fayetteville, Arkansas, 1970.

Variety[1]	No. Trees	Burr-knot[2] Avg. No./Tree	% Fluted Stock	% Fluted Scion
Wayne				
Grafted	20	–	95	75
Nu Red Rome				
Grafted	30	3.1.	90	50
Golden Del				
Budded	40[a]	4.3	83	31
	40[b]	5.9	90	51

a = low vigor trees
b = high vigor trees
[1]Three separate locations
[2]Bud or graft union set at 6-8" above ground

With increased usage of the clonal apple rootstocks now common in the trade and with the trend to bud or graft high and plant with unions well above the soil line, burr-knots are more frequently observed. When unions were located at the soil surface, burr-knots below the soil proceeded to full root development, and their growth and presence was not detected.

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