Burr-knot Characteristics of Six Clonal Apple Rootstocks[1]

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Field observations on the occurrence of burr-knots on clonal apple rootstocks in Arkansas and a literature review pertaining to them have been reported (3).

Studies reported here were originated to gain additional information on the tendency of clonal apple stocks to form burr-knots and to observe their development.

A planting of 15 plots, each containing 2 or 4 rooted layers of six clonal rootstocks, obtained from commercial sources, was made in 1970. Rootstocks were planted 3 feet apart in the row and headed at 14 inches. The soil at this location is a Taloka Silt Loam. The stocks were fertilized lightly with NH_4NO_3 a month after growth was established. The area was maintained by clean cultivation and hand weeding around the trees.

In the spring of 1971, all growth below 18 inches was rubbed off or pruned from the trunks. A No. 10 tin can, with both ends removed, was placed over the tree and centered around the trunk on 8 plots. The can was then filled with a mixture of coarse sand and composted soil. On occasion, water was added to this rooting medium. Rootstock trunks so treated are referred to in this paper as those receiving a favorable rooting environment. All rootstocks received ¼ lb of NH_4NO_3 prior to their second leaf and a normal insecticide and fungicide program was followed.

Burr-knot development was observed in the fall when the cans were removed and the rooting medium flushed away with a hose. Data were collected on the number of burr-knots and their development on exposed trunk sections of all plots and those sections given a favorable rooting environment. Data presented are the averages of 14 to 32 observations per rootstock.

Results and Discussion

All six clonal rootstocks studied produced burr-knots on 3 year old trunks. According to Hartman (2), burr-knots originate from pre-formed root initials. Under conditions not fully favorable for their development into roots, these initials form burr-knots which are an aggregation of partially developed roots. On trunks exposed to naturally occurring field conditions of light, temperature and humidity there were significantly more burr-knots formed in the trunk area 0-7 inches above the ground line (average 4.9 burrs per trunk), than in the 7-14 inch area (average 4.1 burrs per trunk), Table 1.

Table 1. Number of burr-knots found on trunks of clonal apple rootstocks at different heights.

Rootstock	Av. no. burr-knots per 7" trunk section: Height above soil 0 to 7"	7" to 14"
Alnarp 2	8.6 a[1]	7.6 a
MM 111	4.9 bc	4.1 bc
MM 106	3.3 c	2.8 cd
M 2	3.6 c	0.7 d
M 7	4.2 bc	3.5 c
M 26	6.3 b	6.5 ab
Average	4.9	4.1**

[1]Mean separation in columns by Duncan's multiple range test, 1% level.
**Means different at 1% level by F test.

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At each height, the clonal rootstocks 'Alnarp 2' and 'M. 26' showed the greatest propensity for burr-knot production. No interaction between rootstock and burr-knot formation on 2 trunk areas was found. The predisposition of clonal rootstocks to form burr-knots on exposed sections of stock between the ground line and a graft union is a liability in view of the hazards posed to rootstock growth and survival cited by Rom (3).

That burr-knot formation was stimulated in a favorable rooting environment was shown when the covered trunk areas were exposed. Burr-knots formed on trunks of this treatment were divided into two categories: (a) burr-knots which developed to a callus stage and (b) those which progressed to rooting (Table 2). 'M. 2' was the only stock that did not have a statistically greater number of burr-knots rooting as compared to those callusing. Less variability in burr-knot formation between rootstocks was noted under the favorable rooting conditions. The average number of burr-knots was 9.3 at 0-7 inches of covered trunk section compared ot 5.7 on exposed trunks above the good rooting condition and 4.9 burr-knots on the 0-7 inches section of exposed trunks above the normal field condition (Table 1).

Table 3. Effect of root growth environment on burr-knot formation on clonal apple rootstock trunks.

	Av. no. burr-knots per 0-7" exposed trunk section		
	Rootgrowth environment[1]		
Rootstock	Normal field condition	Favorable condition	Average
Alnarp 2	8.6 ab	10.0 a	9.3 a[2]
MM 111	4.9 de	6.3 cd	5.6 c
MM 106	3.3 efg	3.4 efg	3.4 d
M 2	3.6 efg	2.0 fg	2.8 d
M 7	4.2 ef	7.1 bc	5.7 bc
M 26	6.3 cd	7.1 bc	6.7 b
Average	4.9	6.0**	

[1]Mean separation for interaction by Duncan's multiple range test, 5% level.
[2]Mean separation in column by Duncan's multiple range test, 1% level.
**Means different at 1% level by F test.

To determine if stocks growing well had a stronger tendency to form burr-knots on their trunks, a comparison was made between the amount of burr-knots formed on 0-7 inches exposed trunk sections above the field soil line and above the more favorable rooting environment (Table 3). The assumption was made that in the more favorable rooting environment, soil condition and moisture relations were more desirable than under field soil conditions. Trunk diameter of these trees averaged 26.4 mm versus 23.8

Table 2. Number of burr-knots forming on covered trunks of clonal apple rootstocks and on a 7" trunk section above the covered area.

	Av. no. burr-knots per trunk section				
	Covered Section				
	Burr-knot condition[1]				
Rootstock	Callus	+ Rooting	=	Total	0-7" above the covered trunk
Alnarp 2	2.1 efg	9.1 a		11.2 a[2]	10.2 a[2]
MM 111	1.7 fg	7.3 bc		9.0 ab	6.3 bc
MM 106	1.2 g	7.0 bc		8.2 b	3.4 cd
M 2	3.6 de	4.9 d		8.5 b	2.0 d
M 7	2.3 efg	8.4 ab		10.7 a	7.1 b
M 26	2.9 ef	6.5 c		9.4 bc	7.1 b
Average				9.3	5.7**

[1]Mean separation for interaction by Duncan's multiple range test, 1% level.
[2]Mean separation in columns by Duncan's multiple range test, 1% level.
**Means different at 1% level by F test.

mm for rootstocks in field soil conditions.

Burr-knots were found in greater numbers on trunks above a soil in which conditions were favorable for rooting, the comparison being 6.0 burr-knots on the 0-7 inches trunk section under favorable conditions to 4.9 burr-knots on the 0-7 inches trunk section on stocks in the field soil condition (Table 3). Only 'M. 7' had a significantly greater tendency to respond to the rooting condition of the stock by increased burr-knot formation.

These data indicate, however, that field conditions most favorable to good growth of young trees also result in increased formation of the undesirable burr-knots on rootstock trunk sections exposed above the soil line.

Rooting from burr-knots on uncovered trunk sections given favorable conditions varied with the clonal rootstock. Counts were made of the root number per burr-knot. Burr-knots were thus placed in three categories as follows: (a) those with 1-3 roots, (b) those with 4-10 roots and (c) those with over 10 roots per burr-knot (Table 4). A significant interaction between rootstock and rooting per burr-knot indicated that 'MM 111' and 'MM 106' notably had more burr-knots developing numerous roots. This would indicate that these stocks characteristically may have more pre-formed root initials. Fugatt (1) had shown this to be a characteristic of these roots. Above ground burr-knots, on stocks having a strong root initial potential per burr-knot, may tend to proliferate more under optimum conditions for their growth but not for rooting. The attendant problem associated with their presence would thus be increased.

Table 4. Relationship of clonal rootstock to number of roots per burr-knot under condition favorable for root development.

Rootstock	Av. no. of burr-knots in each category 1-3	4-10	over 10 roots/ burr-knot
Alnarp 2	2.1 cdefg[1]	3.1 bc	3.9 b
MM 111	0.5 g	1.0 fg	5.9 a
MM 106	1.3 efg	1.9 cdefg	3.8 b
M 2	1.3 efg	1.4 defg	2.2 cdef
M 7	2.4 bcde	2.8 bcde	3.1 bcd
M 26	1.8 cdefg	2.4 bcdef	2.3 bcdef
Average[2]	1.4 b	1.9 b	3.5 a

[1]Mean separation for interaction by Duncan's multiple range test, 1% level.
[2]Mean separation in row by Duncan's multiple range test, 1% level.

This study has shown that burr-knots may develop on exposed trunk sections of six clonal apple rootstocks. Actively growing rootstocks may have an increased tendency to form burr-knots. The rooting potential of burr-knots is variable. In conditions not optimum for root initals to remain dormant or to develop into roots, the initials may advance to form burrs with varying degrees of proliferation. If clonal rootstocks are set in the field so that a minimum of stock trunk is exposed above the soil line the problems associated with burr-knot development will be minimized and rooting from the stock into the soil will occur.

Literature Cited

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