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SELF-GRAFTING, A SIMPLE METHOD FOR VEGETATIVE PROPAGATION OF APPLE CLONAL ROOTSTOCKS[1]

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ABSTRACT

Four vegetative methods of propagation were compared including: 1) stem hardwood cutting; 2) root cutting; 3) grafting scions and stocks from the same plant (self grafting); and 4) grafting "Red Delicious" scions on the self-grafts (double-grafting). Three-year-old M.7 apple clonal rootstocks were used. The prepared plant material was kept at 4-5°C for a month and then planted outdoors. Results were recorded 2.5 and 5 months later. At both times there was a highly significant increase in percentage of rooted plants in double-grafts over stem and root cuttings. A similar increase was found in self-grafts and root cuttings over stem cuttings at the second recording. Similar tests were made on M.2 and MM 111, but due to shortage of plants no statistical analysis could be made on their results. However, these results tend to support those of M. 7.

INTRODUCTION

Stool layering is the most common vegetative method of propagation of apple *(Malus sylvestris* Mill.) clonal rootstocks (1,4,10,11,12). However, this method is slow and costly. Other methods which have been tested and used to some extent include: a) hardwood and softwood stem cutings (3,5,6,7,8,11, 12), b) trench layering (1,11, 12), c) air layering (12), d) layering of root grafts (9), e) suckering (11), and f) nurse-root grafting (2). The objective of the present study was to develop a rapid and more practical method for vegetative propagation of apple clonal rootstocks.

MATERIALS AND METHODS

Four vegetative methods of propagation were compared including: 1) stem hardwood cutting; 2) root cutting; 3) a new approach called "self-grafting"; and 4) a modification of self-grafting called "double-grafting". Three 3-year-old M.7 plants (Fig. 1)

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were used as 3 replicates for each method, using a randomized complete block design. Due to shortage of plants, only one plant each of M.2 and MM 111 were used for each method. Stem cuttings, 5-6 cm long, were taken and treated with a 1000 ppm solution

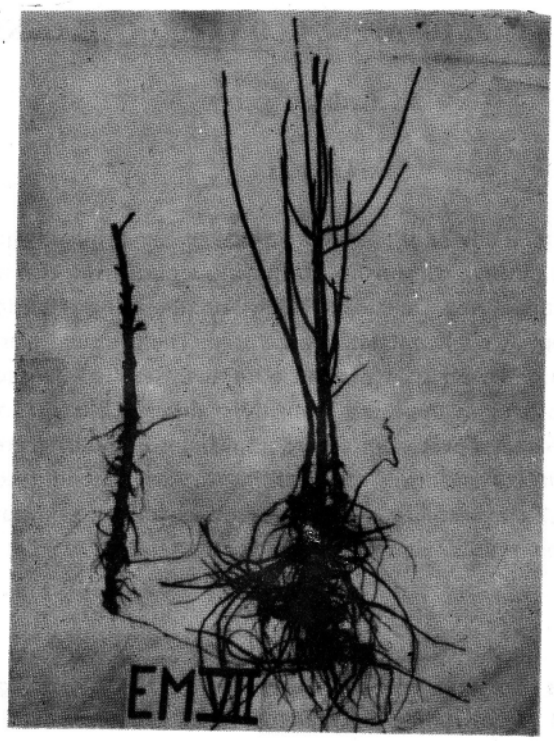

Fig. 1. Three-year-old plants of M.7 apple clonal root-stock. Right: regular plant; Left: a similar plant with roots and shoots cut for propagation.

of potassium salt of indole butyric acid to enhance root formation. Root cuttings, 4-8 cm long and 0.3-0.8 cm thick, were taken from all usable parts of the root system. For preparing self-grafts, 5-10 cm long scions were whip grafted on stocks, 5-15 cm in length from the same plants. In double-grafting, "Red Delicious" scions were whip grafted on self-grafts made as above. Cuttings or grafts (Fig. 2) from each plant were separately placed in polyethelene bags containing damp peat moss and were placed in refrigerator at 4-5°C. On February 15, 1970 after a month of refrigeration, cuttings and

grafts were planted outdoors, in rows spaced 90 cm apart. Stem cuttings were planted with 1 cm of their tips left out of soil. Root cuttings were planted vertically, 1 cm below the soil surface. Self-grafts were planted with the union and the lower half of the scion below the soil surface. Double-grafts were planted with the lower unions and the lower half of the interstock below the soil surface.

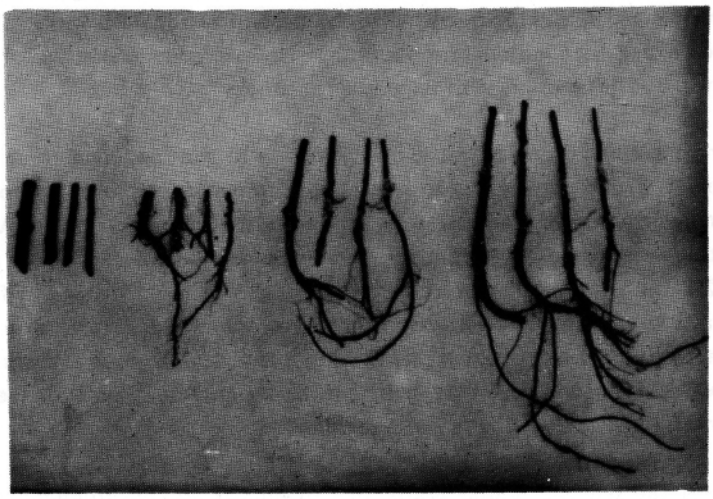

Fig. 2. Plant material prepared by different vegetative methods for propagation of M.7 apple clonal root-stocks. Left to right: stem hardwood cuttings, root cuttings, self-grafts, and double-grafts.

The number of rooted plants were recorded 2.5 and 5 months after planting and the percentage of rooted plants were calculated. At each recording, plants having at least 2-4 healthy leaves were considered as rooted. Vegetative growth was measured only at the second recording. Total shoot length and number of shoots per plant were determined and average length of each shoot was calculated.

RESULTS AND DISCUSSION

Most graft unions healed firmly within 10 days after placing in the refrigerator. Healing was more advanced in thin wood as compared to thick wood grafts. After one month, healing was apparently completed in almost all grafts and they were ready for

outdoor planting. Not much callus tissue, however, was formed in stem or root cuttings within this period (Table 1).

In M.7 the percent of rooted plants in double-grafts was more, at a highly significant level than in root and stem cuttings. Percent of rooted plants in double grafts was 5 times greater than in stem cuttings and 4 times greater than in root cuttings. Shoot growth seemed to be greater in the two grafted plants than in cuttings. The results obtained from M.2 and MM 111 showed that the percent of rooted plants in the self-grafts was much higher than in stem or root cuttings. However, due to shortage of plants, statistical analysis was not possible with these two rootstocks.

At second recording 5 months later, many of the stem cuttings, in all three clones, had died (Table 1, 2) presumably due to lack of root formation. More of the root cuttings, however, which were protected by the soil showed signs of growth. In M.7 the two graft methods showed a 15 percent increase in rooted plants over the first recording (Tables 1,2). The increase in percent of rooted plants in root cuttings, self-grafts, and double-grafts over stem cuttings was highly significant. There was also a highly significant increase in percent of rooted plants in double-grafts over root cuttings (Table 2). Shoot growth differences were not significant. Shoot growth of some of the single shoot plants measured 49 cm at the second recording.

In some of the self and double grafts, due to unfavorable environment, part or all of the scions located out of soil died. New shoots, however, were formed later from the protected parts of the scions or the stocks.

Advantages found for self-grafting were that starting with a well rooted layer, by stooling, fruit trees on clonal stocks can be produced in at least 3 years. Whereas, similar trees can be produced, by self-grafting, in 2 years and, by double-grafting, in only 1 year. Therefore, the time necessary for tree production is reduced by one-third and two-thirds, respectively. Under ideal conditions in a mature MM 111 stool-bed, 10 rooted layers per plant were produced (11). Using the self-grafting method 66 new plants were produced from a 3-year-old plant of MM 111 (Table 2). Thus, the yield of new plants was increased more than 6 times. Since there is no problem of incompatibility or need for root and/or shoot bud initiation, grafts heal easily and grow rapidly. This may provide a means for propagation of hard-to-root species, especially self-rooted uniform fruit and ornamental plants useful for different experimental or commercial purposes. The use of this method may eliminate costs and problems of seedling production and the work can be done in winter.

TABLE 1. The number of propagation units used, the number and percent rooted, 2.5 months after planting of M.7, M.2 and MM 111 apple rootstocks propagated by different vegetative methods.

Method	Rootstocks								
	M. 7			M. 2[1]			MM 111[1]		
	Number used	Number rooted	Percent rooted	Number used	Number rooted	Percent rooted	Number used	Number rooted	Percent rooted
Stem cutting	205	23	11.0 a[2]	75	30	40.0	94	30	31.9
Root cutting	402	60	13.1 a	104	22	21.1	142	51	35.9
Self-grafting	142	53	36.3 ab	72	47	65.5	80	52	65.0
Double-grafting	109	57	53.8 b	37	15	40.5	49	26	53.0

1 Due to limitation in number of available stocks statistical analysis was not possible.

2 Means followed by different letters are significantly different at 1% level (Duncan's test).

Table 2. The number of propagation units used, the number and percent rooted, 5 months after planting of M.7, M.2 and MM 111 apple rootstocks propagated by different vegetative methods.

Method	Rootstocks								
	M. 7			M. 2[1]			MM 111[1]		
	Number used	Number rooted	Percent rooted	Number used	Number rooted	Percent rooted	Number used	Number rooted	Percent rooted
Stem cutting	205	3	1.3 a[2]	75	0	0.0	94	1	1.0
Root cutting	402	154	43.8 b	104	42	40.3	142	62	43.6
Self-grafting	142	73	50.9 bc	72	47	65.2	80	66	82.5
Double-grafting	109	79	69.5 c	37	15	40.6	49	37	75.5

1 Due to limitation in number of available stocks statistical analysis was not possible.

2 Means followed by different letters are significantly different at 1% level (Duncan's test).

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