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CLONAL PROPAGATION CAPACITY OF TWO NEW APPLE ROOTSTOCKS BY STOOLING

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ABSTRACT

This investigation was carried out at General Commission for Scientific Agriculture Research – Pome and Grapevine Division in Sweida governorate (Syria), from 2013 to 2017, to evaluate the ability of two new local apple rootstocks (SukariAlswieda 'S'and SkarjiAlswieda 'H') to vegetative propagation in stool bed. The results showed that the second year of propagation significantly produced the highest number of rooted shoots (liners) from each rootstock (7 liners and 5 liners in 'S' and 'H' respectively). 'S' and 'H' rootstocks revealed significant difference in average produced liners. However, the length and diameter of liners from 'H' rootstock did not show significant difference among studied years, they were in average 59.1 cm and 6.1 mm respectively.While as, the highest length and diameter of liners from 'S' were in the third year (82.3 cm and 7.6 mm respectively). On the other hand, the two studied rootstocks produced liners with good and stable root system which differed in structure between them, that 'S' rootstock revealed coarse (woody) roots, while in 'H' rootstock the roots were hairy. The number of roots was in average 17 roots and 12 roots in the liners of 'S' and 'H' respectively.As well as. the average length of liners roots were 23.4 cm and 22.2 cm in 'S' and 'H' respectively. Consequently, the clonal propagation for the studied rootstocks in stool bed is a sufficient tool to produce liners similar to the plant parent and they are ready to be budded with cultivars scions.

Key words: *apple, rootstock, vegetative propagation, stool bed.*

INTRODUCTION

Apple rootstocks were used as an easy way of propagating scion cultivars. Nowadays, rootstocks play an important key factor in tree growth and physiology, therefore they have to provide many other valuable characteristics to the orchard tree, such as control growth vigor of trees, induce precocious, help consistent and abundant yields, and tolerance/resistance to pests, diseases and abiotic stress factors (Rober, 2001; Webster, 2003; Dolgov and Hanke, 2006).

Apple growers depend on seedling rootstocks, only in the countries which are difficult to use vegetative rootstocks, or they are not economical (Webster and Wertheim, 2003). However, seedling rootstocks have many advantages rather than

vegetative rootstocks, that they are easy and cheap in propagation, virus free, and free from soil rots (Wertheim and Webster, 2003). Seedling rootstocks produce huge tree between 7 and 10 m in height and spread, while lower size of tree is preferable in most of apple production regions in the world, all of these lead to use vegetative rootstocks which provide wide range of vigor growth, from very dwarf rootstock such as M27, to vigorous rootstock as M25 (Webster and Wertheim, 2003). Moreover, vegetative rootstocks have many compensations over seedling rootstocks, like the ability to control tree size, increase productive efficiency, achieve uniformity and precocity (Wertheim and Webster, 2003).

Vegetative propagation of clonal apple rootstocks is mostly made by division techniques either stooling or layering (Webster, 1995); however, division techniques are ancient applications which were described by Knight *et al*. (1928). Beside division techniques, cutting techniques were used for clonal apple rootstocks propagation (Roberts and Mellenthin, 1957;Hartmann *et al.,* 1965;Rahimi Dvin *et al.,* 2011). Comparatively little numbers of clonal apple rootstocks are propagated by cutting techniques, as well as micro-propagation and root cuttings (Webster, 1995). In Syria apple is an important tree. There are more than 100 cultivars in the GCSAR germplasms (Muzher and Al Halabi, 2012). In addition, there are new selected clonal rootstocks from apple rootstock breeding program such 'S' and 'H' (Al Halabi *et al*., 2012). Therefore, this investigation aimed to study the ability of two new local apple rootstocks to vegetative propagation in stool bed.

MATERIALS AND METHODS

This investigation was achieved during 2013-2017 at Pome and Grapevine Division- GCSAR in Sweida governorate which located in the south of Syria at 1525 m altitude.

Plant material

Two new Apple rootstocks: Sukari Alswieda 'S' is produced from local apple cultivar, and Skarji Alswieda 'H' is a hybrid between MM106 rootstock and the local apple cultivar Skarji.

Methods

Stooling

One-year old rooted plants (9 for each rootstock) were planted vertically in 2013 spring, and left un pruned for 1 year. In 2014 spring the stems were cut back to 2-3 cm. The distance between rows was 1 m, and within the rows was 30 cm. Earthing up of the young shoots was achieved according to Wertheim and Webster (2003). After natural leaf drop, the ridge of soil was forked away and the rooted shoots (liners) were cut loose from parent plants. This process was repeated annually for three years.

Studied parameters

After liners were cut loose the following parameters were studied per parent plant:

- Number of rooted shoots (liners).
- Mean length of liners
- Mean diameter of liner's stem at 15 to 20 cm height.
- Root system of liner:
    - Structure of liner's root (hairy or coarse).
    - Mean number of root.
    - Mean Length of roots.
    - Mean diameter of roots.

Experimental design and statistical analysis

The experiment was designed in completely randomized design (CRD), data were analyzed using analysis of variance (ANOVA) to compare liners means for measured parameters, mean comparison was achieved using LSD test ($p < 0.05$).

RESULTS AND DISCUSSION

Number of rooted shoots (liners) per parent plant

The result showed that the highest number of liners was in the second year (7 liners and 5 liners in 'S' and 'H' rootstocks respectively), the difference was significant with first and third years in 'S' rootstock, while it was significant with the third year only in 'H' rootstock (Figure 1). On the other hand, 'S' rootstock significantly produced liners in stool bed more than 'H' rootstock in the studied years, they were in average 5 liners per 'S' rootstock, and 3 liners per 'H' rootstock. These results reflected the variance ability of propagation in studied rootstocks using stool bed. This was in agreement with Wertheim and Webster (2003), that clonal rootstocks vary in the number of rooted shoots, however the results of stooling propagation at East Malling Research Station ranged between 2.6 per stool for M9 to 13.4 for MM104 (Howard, 1977).

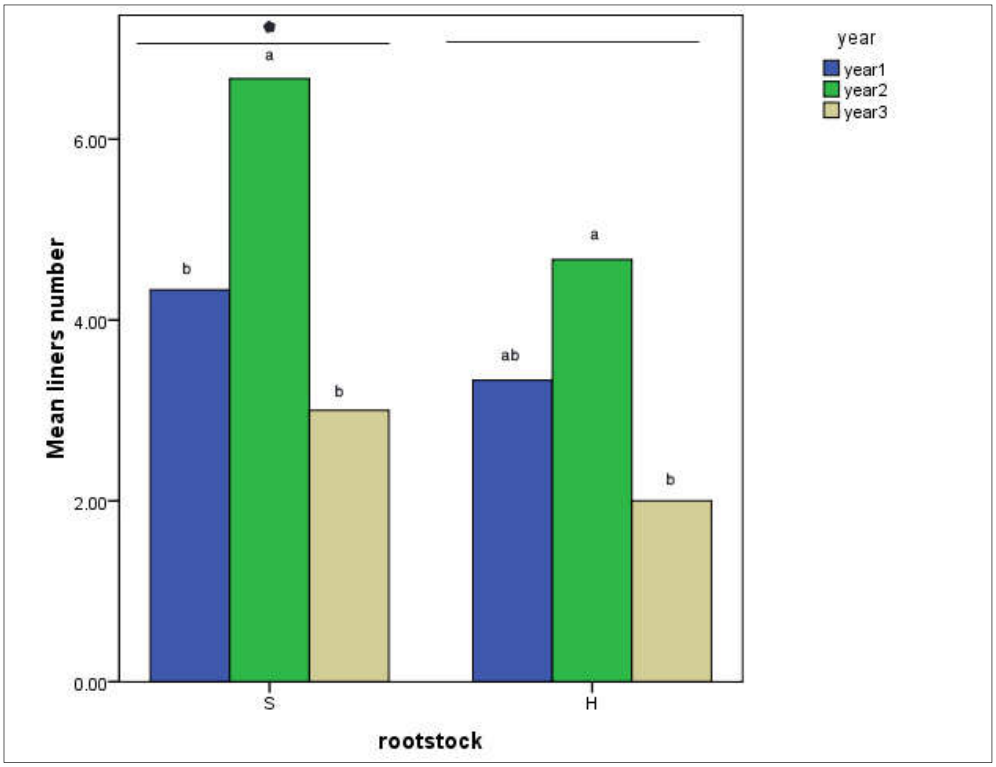

Figure (1): Mean liners number of 'S' and 'H' in stoolbed during studied years. ($LSD_{5\%}$ between years = 1.88 and 2.5 for 'S' and 'H' respectively, $LSD_{5\%}$ between rootstocks = 0.85)
Similar letters (a,b,) in each bar of each rootstock indicated that the variance is insignificant.
*indicated that the variance is significant between rootstocks.

Mean length and diameter of liners per parent plant

The mean length and diameter of liners which were produced from 'S' rootstock significantly differed among studied years. The highest length and diameter were in average 82.5 cm and 7.6 mm respectively in the third year (Table 1). This due to the low number of liners were produced from each parent plant. While 'H' did not reveal significant differences in plant length and diameter among studied years (Table 1). This result reflected the stability of 'H' liners traits in stool bed. However, the difference between the studied rootstocks was insignificant in plant length, while 'S' significantly showed higher plant diameter than 'H'. Moreover, the results in table (1) showed that the diameter of liners especially from 'S' were suitable for budding with scion cultivars according to Wertheim and Webster (2003).

Table 1. Mean length and diameter of liners produced from 'S' and 'H' rootstocks in stoolbed.

	Mean length (cm)			Mean diameter (mm)		
Rootstock	**'S'**	**'H'**	**Mean**	**'S'**	**'H'**	**Mean**
First year	64 b	57.2	60.6 ab	7.2 ab	6	6.6 ab
Second year	50.3 c	46	48.1 b	6.8 b	5.8	6.3 b
Third year	82.3 a	74.1	78.2 a	7.6 a	6.6	7.1 a
Mean	**65.5**	**59.1**	**62.3**	**7.2***	**6.1**	**6.7**
LSD5% (years)	9.6	-	19.6	0.52	-	0.8
LSD5% (rootstocks)	-			0.8		

Similar letters (a,b,c) in each column indicated that the variance is insignificant.
*indicated that the variance is significant between rootstocks.

Root system of liners per parent plant

The results showed that the two studied rootstocks differed in the structure of root system of liners. However, 'S' rootstock revealed separated and coarse (woody) roots similar to the obtained roots by seed propagation, this considered as a plus feature to this rootstock. While in 'H' rootstock the roots were hairy gathered into groups (Figure 2).

The results in Table (2) illustrated that the average number of roots per liner was 17 roots and 12 roots in 'S' and 'H' respectively. The average of root length and diameter were 23.4 cm and 2.6 mm in the liners of 'S' rootstock, and 22.2 cm and 2.2 mm in the liners of 'H' rootstock. These results were insignificantly differed between the two rootstocks and among years of study, except the average number of roots in the third year, which was superior above second year. Consequently, the two rootstocks gave plants with good and stable root system, which is necessary in rootstock production. However, this issue is the most important concept of apple rootstock breeding programs worldwide (Cummins and Aldwinckle, 1995; Janick *et al.,* 1996; Webster *et al*., 1997; Bite and Lepsis, 2007; Johanson *et al*., 2007).

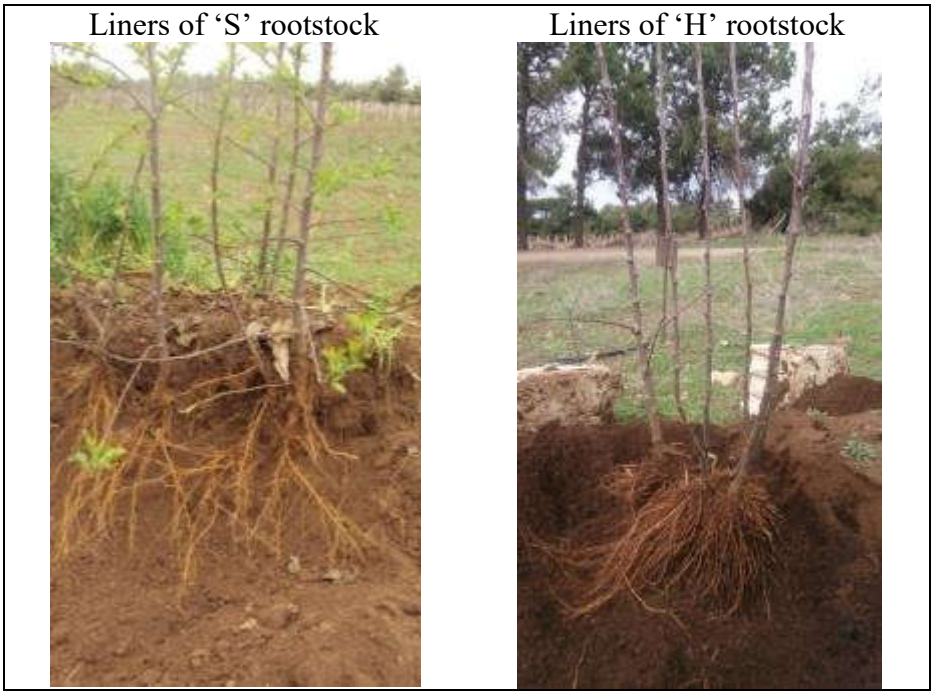

Figure 2. root system of liners produced by stooling from 'S' and 'H' rootstocks.

Table 2.Mean roots number, Mean root length and diameter of liners produced from 'S' and 'H' rootstocks in stoolbed.

	Mean roots number (root)			**Mean root length (cm)**			**Mean root diameter (mm)**		
Rootstock	**'S'**	**'H'**	**Mean**	**'S'**	**'H'**	**Mean**	**'S'**	**'H'**	**Mean**
First year	20	12	16 ab	26.5	24	25.2	3	2.6	2.8
Second year	12	7	10 b	20.5	22.6	21.6	2.4	2.2	2.3
Third year	17	17	17 a	23.3	20	21.7	2.6	1.7	2.2
Mean	17	12	14	23.4	22.2	22.8	2.6	2.2	2.4
LSD5% (years)	**-**	**-**	**6.5**	**-**	**-**	**-**	**-**	**-**	**-**

Similar letters (a,b) in each column indicated that the variance is insignificant.

CONCLUSION

Stool bedpropagation of the studied rootstocks showed that the two rootstocks gave different numbers of liners, with good traits of stem length and diameter, beside root system (number of roots, root length and diameter). Thus, stooling is a sufficient tool to produce liners similar to the plant parent and they are ready to be budded with cultivars scions.

REFERENCES

Al-Halabi, O., T., Muzher, B., M. and Hamed, F. (2012). Preliminary evaluation of some apple seedlings rootstocks genotypes in apple rootstock breeding program. Damascus University Journal for the Agricultural Sciences, 28(2): 473-483.

Bite, A. and Lepsis, J. (2007). Preliminary Evaluation of New Apple Clonal Rootstocks in Latvia. Acta Hort., 732:177-179.

Cummins, J. N. and Aldwinckle, H. S. (1995). Breeding rootstocks for tree fruit crops. New Zealand Journal of Crop and Horticultural Science, 23: 395-402.

Dolgov, S. V. and Hanke, M. V. (2006). Transgenic temperate fruit tree rootstock. In: Tree transgenesis recent developments, Fladung, M. and Ewald, E. (Eds.). Springer, Hiedelperg. pp:335-350.

Hartmann, H. T., Hansen, C. J. and Loreti, F. (1965). Propagation of apple rootstocks by hardwoodi cuttings. C a l i f o r n i a Agriculture, pp. 5.

Howard, B. H. (1977). Effects of initial establishment practice on the subsequent productivity of apple stoolbeds. Journal of Horticultural Science, 52: 437-446.

Janick, J., Cummins, J. N., Brown, S. K. and Hemmat, M. (1996). Apples. In: Janick, J. and Moore, J. N. (Eds). Fruit Breed, volume I: Tree and Tropical fruits. Pp: 1-77.

Knight, R. C., Amos, J., Hatton, R. G. and Witt, A. W. (1928). The vegetative propagation of fruit- tree rootstocks. In: Annual report East Malling Research Station for 1926, Vol. II, Supplement. Maidstone, UK, pp. 11-30.

Muzher, B. and Al-Halabi, O. (2012). Evaluation of the most important apple varieties in Syria. Damascus university journal for agriculture science, 28(1): 65-76.

Rahimi Dvin, S., Ganji Moghadam, E. and Kiani, M. (2011). Rooting response of hardwood cuttings of MM111 apple clonal rootstock to Indolebutyric acid and rooting media. Asian Journal of Applied Science, 4(4): 453-458.

Roberts, A. N. and Mellenthin, W. M. (1957). Propagating clonal rootstock. Agricultural Experiment Station Oregon State College Corvallis, pp:7.

Webster, A. D. (1995). Temperate fruit tree rootstock propagation. New Zealand Journal of Crop and Horticultural Science, 23: 355-372.

Webster, A. D**.** (2003). Breeding and selection of apple and pear rootstocks. Acta Hort., 622: 499- 512.

Webster, A. D., Tobutt, K. .R., James, D. J., Evans, K. M. and Alston, F. A.(1997). Rootstock Breeding and Orchard Testing at Horticulture Research International - East Malling. Acta Hort., 451:83-88.

Webster, A.D. and Wertheim, S.J. (2003). Apple rootstocks, In: Botany, Production and Uses, D.C. Ferree and I.J. Warrington (eds.), *CAB* International. pp. 91-124.

Wertheim, S.J. and Webster, A. D. (2003). Propagation and Nursery Tree Quality, In: Botany, Production and Uses, D.C. Ferree and I.J. Warrington (eds.), *CAB* International. pp. 125-151.