

Anatomical study of the bud union in „Chip” and „T” budded 'Jonagold' apple trees on MM 106 rootstock

Végvári, Gy. and Hrotkó, K.

UHFI Faculty of Horticulture
H-1118 Budapest, Villányi út 35-43.

INTERNATIONAL
JOURNAL OF
HORTICULTURAL
SCIENCE



AGROINFORM
Publishing House, Hungary

Key words: anatomy, apple budding, MM 106, Jonagold, bud union formation,

Summary: The traditional methods for vegetative propagation of apple and its varieties are the T-budding, and the winter grafting, but this latter way is a difficult and expensive procedure.

In our experiment carried out in the Fruit Tree Nursery Soroksár, the healing process of chip- and T-budded apple trees 'Jonagold' on MM 106 rootstock was studied.

The budding (T- and Chip-) was made in the first week of August, samples for microscope examination were taken monthly after this time until leaf fall.

The investigated part of plants was made soft with 48 % HF (hydrogenfluoride), then cross and longitudinal section were made and examined by microscope.

Based on analysis of microscope pictures in case of Chip-budding, it was established, that development had started quickly after budding on the rootstock and scion too. But the callus originated almost entirely from the rootstock tissue as new parenchyma cells fills the gap between the two components of graft (scion and stock), becoming interlocked and allowing for some passage of water and nutrients between the stock and the scion. This quantity of callus in case of T budding was under the scion buds larger, than the Chip-budded unions, where the thickness of callus mass is uniformly thick round the chip. The large mass of callus pushes the scion bud outwards from the shoot axis, which later results in a larger shoot-curvature above the bud union.

Following this process on the Chip-budding it can be observed also, that a continuity of the cambium is established between bud and rootstock. Then the newly formed cambium started typical cambial activity, forming new xylem and phloem.

Later the callus begins to lignify, and it is completed within about 3 months after budding.

Introduction

The traditionally used method for vegetative propagation of apple and other fruit varieties is the T-budding (Proboskai, 1969, Hrotkó, 1995), in Hungarian nurseries. With Chip-budding the bud-take may reach 100% (Hartmann *et al.* 1990), it is higher than the result of conventional T-budding, but what is more, budding unit is smooth (Howard *et al.*, 1974). First in Hungary, Mukred & Hrotkó (1989) reported about the good results with Chip-budding in the case of apple. They stated, the Chip-budding gave a better bud-take, make a stronger union, and the healing process is better than the case of T-budding. They observed also, that the scion growth is more upright using chip budding in comparasion to T-budding. They supposed, it might come from the bud position.

For some forest trees, which had been propagated before with difficulties, the Chip-budding was successfully applied by Kohnert (1991), and for varieties of field maple *Acer campestre* (Kothencz *et al.*, 1998), and pyramidal English oak *Quercus robur* 'Fastigiata' (Kothencz & Végvári, 1997).

The histology of bud union formation was studied by Skene *et al.* (1983). In their experiment *Malus* and *Tilia* chip

and T-budded plants were used. They detected, that Chip budding resulted in more rapid union formation, following a good juxtaposition of the cambial zone of the budded components. In the case of apple varieties *Suriyapanon* SURIYAPANON (1990) made the observation, that the first callus-cells formed on the 3-6th day and the first vascular tissues on the 33-34th day.

Our experiment and investigation was carried out to clear the reason of differences in shoot curvature following the T-budding.

Material and methods

The bud union with both budding method was investigated on 'Jonagold' apple variety budded on MM 106 rootstock.

As first step of the experiment the budding was carried out in the fruit-tree nursery in Soroksár. As rootstock MM 106 liners originated from stoolbed were planted out at a spacing of 150 x 25 cm in the spring of 1997. The budsticks were collected from virusfree 6 years old 'Jonagold' mother plants.

The diameter of rootstock collar at the time of budding was 10-15 mm, and the diameter of budsticks was 6-8 mm.

The two different kind of budding methods, the T-, and Chip-budding were carried out at the same time by the same workers.

During the Chip-budding, we tried to get the cambium layer of the bud piece placed in juxtaposition with the cambium layer of the stock, preferably on both sides.

After both kind of budding, polyethylene-tapes were used for bud-tying. It is very important to have the bud piece protected from drying out so it has to be wrapped to seal the cut edges as well as to hold the bud piece tightly into the stock.

Material for anatomical studies of budded unions was collected 4 and 12 weeks after the budding.

The samples were washed and after than softened in 48 % HF, as emollient for 2 weeks. Finally, the samples were washed for one day, and in the mixture of water-glycerine was stored until being dissected.

60 thick cross and longitudinal sections were made with freezing microtome.

The air from the sections was removed in vacuum. After this procedure, the samples were studied under stereo and light-microscope.

Results and discussion

The bud union and the scion shoot formation followed the same way, well known from the literature (HOWARD ET AL. 1984, MUKRED AND HROTKÓ, 1989). The chip budded trees formed a smooth union with sraight upright shoots, while on the T-budded trees a larger shoot-curvature was observed (*Fig. 1*).

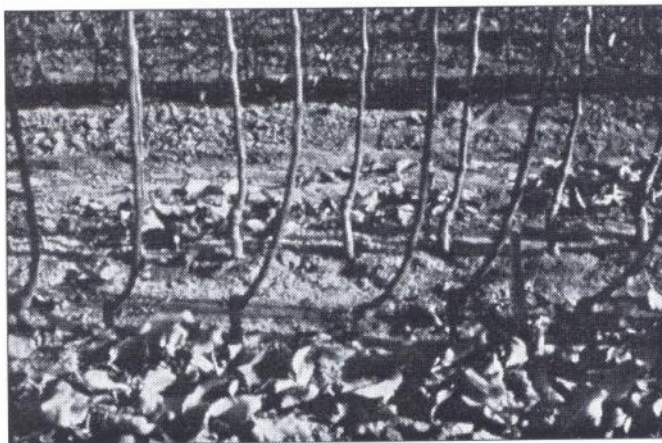


Figure 1 Formation of curvature above the budding place in apple budded with Chip- and T-budding methods.
First line: T-budding, Rear line: Chip-budding

Figure 2 shows the budsprouting stage of T budding. It can be observed that the healing process between the rootstock and scion was accomplished, and the budding place was tumefied.

The longitudinal section shows the reason of larger curvature formation of T-budded shoots better, than the cross section.

The longitudinal section of the budding place is shown in *Fig. 3*. The space between the stock and the bud piece is completely filled with callus. Formation of this tissue was intensive between 4–8 week after budding. The section

illustrates well, that the formation of callus is not uniform on the surface of the bud shield, it was very intensive under the bud, and very little callus was produced from the edges of the bud shield.

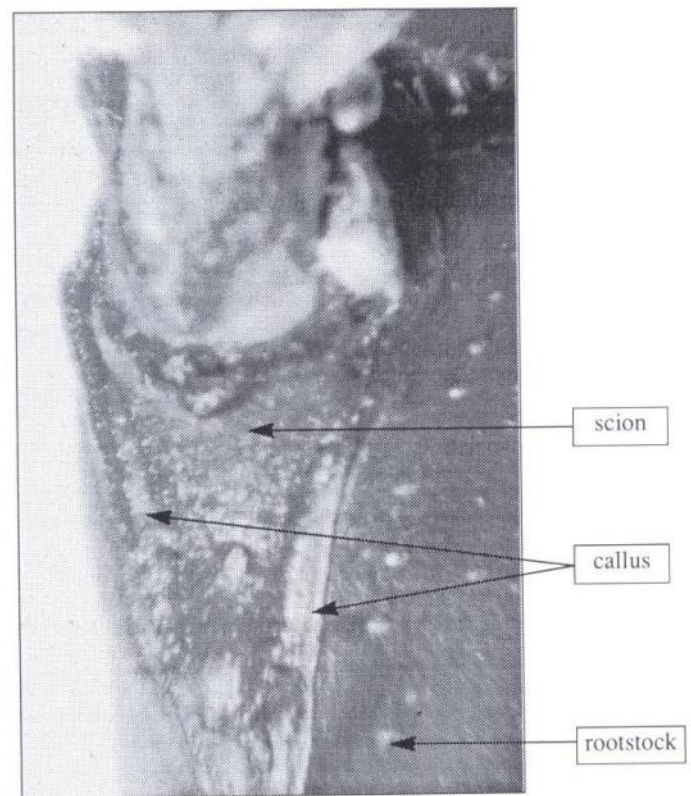


Figure 2 T-budded rootstock in the time of bud-sprouting

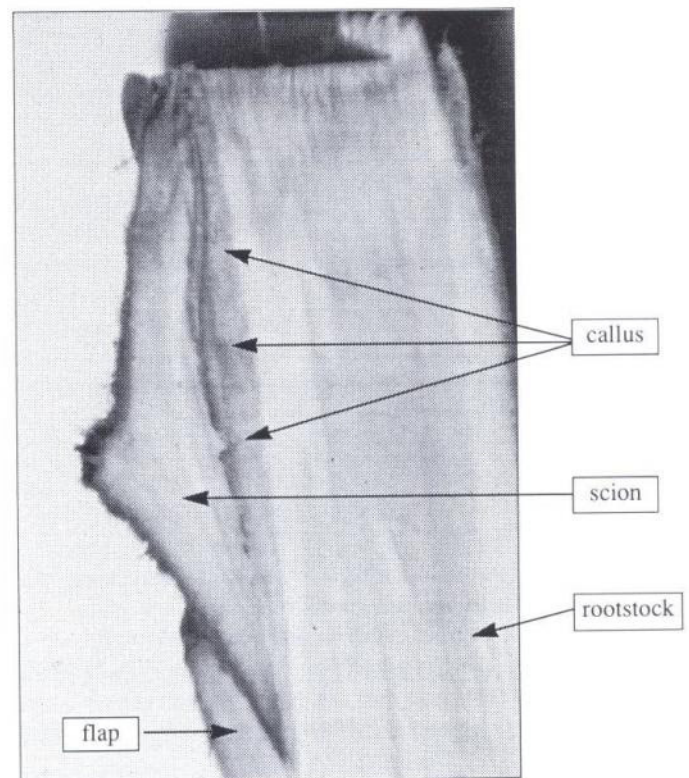


Figure 3 Longitudinal section of T-budded rootstock

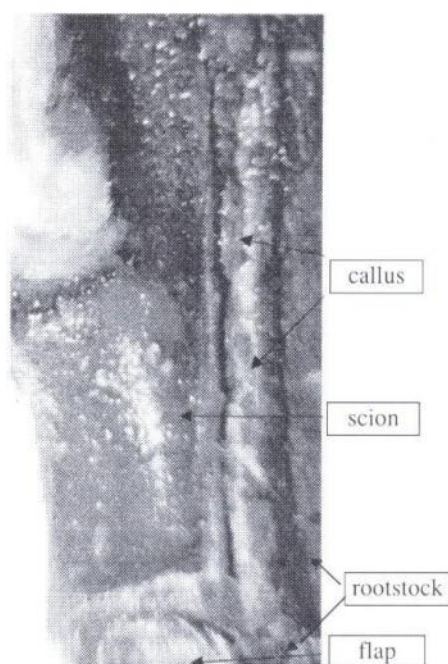


Figure 4 Chip-budded rootstock in the time of bud-sprouting

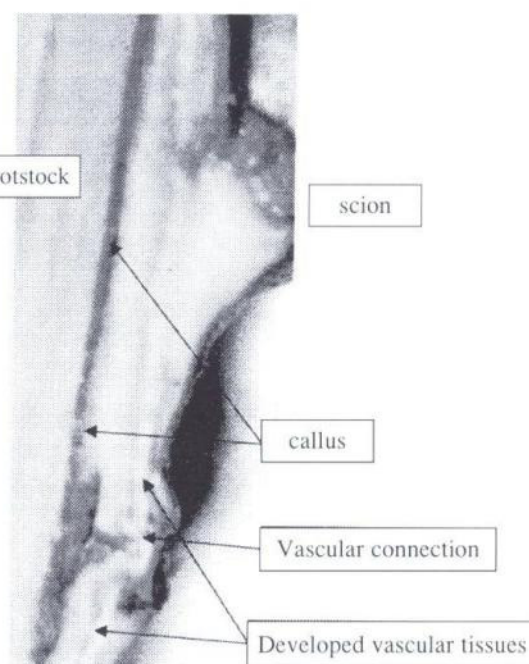


Figure 5 Longitudinal section of Chip-budded rootstock

The uneven development of callus causes the curvature of the bud shield and this later affects the curvature of shoot developing from the bud. Differentiated vascular tissue can't be observed. It may be caused by the later and slighter sprouting of T-budded plants compared to chip-budded ones.

Figure 4 shows the chip-budded plants at the same time. Lignification of callus around the chip can be seen. In Figure 5 can be observed that the callus formed between the components is thin, but uniform, it follows from this, that the bud shield keeps its original position and does not stick out from the vertical. This causes the little curvature of shoot developing from the bud. This figure shows too, that callus was not developed between the bottom of the bud shield and rootstock, actually the vascular tissues between the components are shown.

This tissue was not observed in the case of T-budding. According to our study, this histogenetic process facilitates the rapid spring growth of chip-budded plants, compared to T-budded ones (Howard et al. 1974, Mukred and Hrotkó 1989).

References

- Hartmann, H.T., Kester, D.E., Davis, F. T. (1990): Plant propagation Principles and Practices. Prentice-Hall. Inc. New Jersey.
- Howard, b. H., Skene, D. S. and Coles, J. S. (1974): The effects of different grafting methods upon the development of one-yr-old nursery apple trees. J. Hort. Sci. 49.:287-295.
- Hrotkó K. (1995): Gyümölcsfaiskola, Mezőgazda Kiadó, Budapest.
- Kohnert, H. (1991): Neue Möglichkeiten bei der heterovegetativen Vermehrung von Waldbäumen durch die Chip-Veredlung. Holzzucht. 1991, 45: 3-4, 30-32.
- Kothencz, Zs., Schmidt, G., Végvári Gy. (1998): Effect of budding methods and budding times on the budtake and shoot growth of field maple (*Acer campestre*) varieties. Publ. Univ. Horticulturae Industrie Alimentariae vol. LVII. 83-88.
- Kothencz, Zs., Végvári, Gy. (1997): Xenovegetative propagation of Pyramidal English Oak (*Quercus robur* L.' Fastigiata') by chip-budding. Hort. Sci. 29. (3-4): 114-116.
- Krüssmann, G. (1981): Die Baumschule. Paul Parey Verlag, Berlin-Hamburg.
- Mac Cartraigh, D. (1997): Die vermehrung von *Quercus*, in: Krüssmann, G. die Baumschule, Paul Parey Verlag, Berlin-Stuttgart, 1997.
- Mukred A., Hrotkó K., (1989): A szemzési mód hatása az oltványnevelés kihozatali arányaira és az oltványok minőségére, Kertgazdaság (2:) 13-19.
- Probocskai E. (1969): Faiskola. Mezőgazdasági Kiadó, Budapest.
- Skene, Dr., Shepherd, H. R., Howard, B. H. (1983): Characteristic anatomy of union formation in T - and chip-budded fruit and ornamental trees, J. of Hort.Sci. (1983) 58(3:) 259-299.
- Suriyapananont, V., Suriyapananont, S. (1990): Bud-union development of apple variety Anna on MM 106 and Docynia stock and nutrient levels variation of Anna on Docynis, Acta Horticulturae 279: 599-606.