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Research Article

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Grafted-Rooted Vine Production by a New Motorized Grafting Machine

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Abstract This study was designed to increase the efficiency of grafted-rooted vine production. Grafted-rooted vine production is usually done by using of Omega grafting-machine. All around the callus formation remains small and weak because the length of cambium which Omega grafting-machine makes on the joint surface of scion and rootstock is not enough and a firm grip does not occur between the scion and the rootstock. This condition reduces the efficiency of vine production up to 20-25%. To eliminate those problems a grafting machine which works with a rotating disc-shaped blades system has been developed by us. In the preliminary experiment, the quality of first class rooted vine increased to 55-60 %. This grafting machine provides a firm grip between the rootstock and the scion by making desired depth and length of intrusion and ridge; though the length of contact surface of cambium of rootstock and scion is 6 cm in the standard grafting machine, this length reaches to 16 cm by making 2.5 cm depth and length of intrusion and ridge by the new grafting machine. This is important in increasing efficiency of 1st class saplings as well as increasing callus formation. This new grafting machine can also be used for grafting of rooted fruit rootstocks such as apple and walnut. In this research, the usability of the new motorized grafting machine which works with a disc-shaped circular knife, which was developed to increase the efficiency of 1st class grafted-rooted vine production, was compared with Omega grafting-machine.

Keywords Grafting, rooted vine, omega, callus, callusing

Introduction

Especially in orcharding and viniculture there are different reproduction methods. One of these methods is grafting. In order to establish a new vineyard or fruit garden, absolutely seedlings are needed. The grafted seedlings are multiplied by the grafting method. The main grafts used in the production of saplings in orcharding and viniculture are scion and rootstock grafts. Two main materials are needed, namely rootstock and scion, which are compatible with each other in the grafting [1,28, 34].

Generally, a part of a plant, called a grafting, scion or rootstock , is placed on another plant part, called a rootstock, in a special way, to fuse it together and develop as a single plant [23,24,25,30,31].

The main aim of orcharding and viticulture is to obtain new production material (grafted seedlings) and to use them in production which are resistant to diseases and harmful effects and which have high economic value on rootstocks affecting fertility [5,6,7,16, 34].

Today, grape seedling production in vineyards is usually done with omega grafting device on a table . The grafted cuttings, after they have been fused to the callusing room at 22 days at 28 ° C and 85-90% humidity and paraffinization, planted to nursery [8,9, 10,11,12,13,14,15]. The yield of grafted- rooted vine of 1st nursery stock produced by this omega machine does not exceed 20-25%. The main reason for this is; the total contact length of the cambium layer at the wound of this grafting machine, in total does not exceed 6.0 cm. This causes both the germination chamber and the nursery to be lost as it can not generate full callus (scar tissue) all around enough [20,21,22,33,35].

Despite the fact that the number of annual seeded grafting-rooted grape saplings is 10 million in our country, we can produce almost 3 million saplings as public and private sectors [18,19]. World ranked 5th with a total area of 472.790 Ha among the grabber countries; It is necessary to increase the production of seedlings with a new understanding of production, since this seedling production is extremely inadequate in our country [17, 18, 19,32] which is ranked 6th with 4.296.352 tons of grape production per year.
As the main aim of this study; we have compared the motorized grafting machine which we have developed to increase the yield of the first class certified grafted vine seedlings and the Omega grafting-machine which is still in production.

2. Materials and Methods

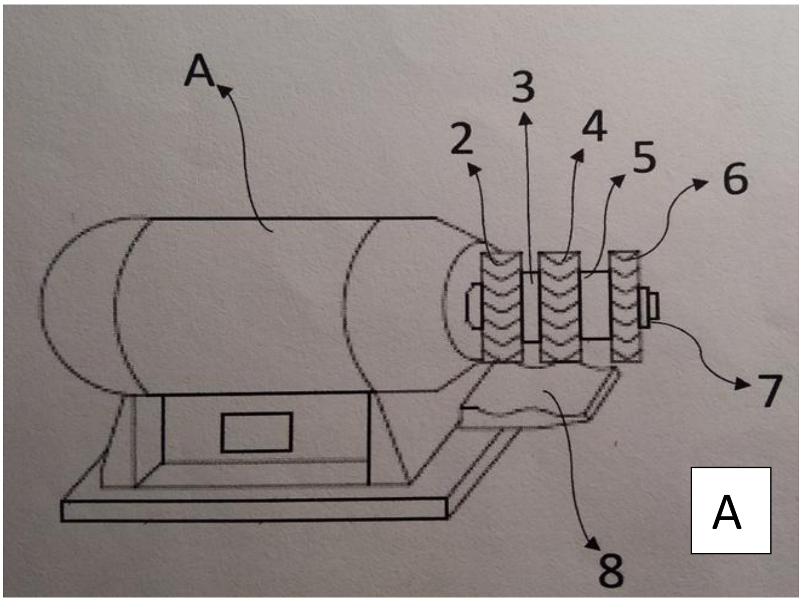
2.1. Materiel

Merlot grape variety and rootstock **SO_4** (Vitis berlandieri x Vitis riparia Teleki Selek No.4) were selected as hardy-wood material. A total of 200 single-eye scion and a total of 200 standard (35-40 cm length) rootstocks of the same diameter(10 mm) with scion, were used for both the Motorized and Omega grafting machines to compare two machines in terms of first-year seedling yield [2,4].
A total of 100 grafted cuttings (4 x 25) were planted to the nursery after passing through the conventional production stage. Grafted –cutting vines that were maintained during the vegetation cycle were removed in the autumn and their yields were calculated by comparing them according to the standard criteria of 1st grade certified saplings. The levels of grafting and callus formation in saplings were taken into account both at the exit from the callusing chamber and at the dismantling from the nursery [3].

2.2. Method

The total length of the cambium contact surfaces at the wound of both grafting machines, in the rootstocks and in the scion is not equal. This causes a significantly increase in the formation of wound tissue and graft retention.
The blade of the Omega grafting machine is a omega letter-haped letter , and opens a protrusion in the rootstock (or vice versa) and they are joined and grafted [Fig.1abc] is a layer of cambium that forms callus (scar tissue) just below the skin at the wound site. Omega is not more than 6.0 cm in length due to the constant camber length of the camel in contact with the scion and the rootstock in the omega machine. In the motorized grafting machine, the total length of the cambium contact surfaces of the blades in the form of cove and protrusion is 16 cm. In addition, the recess and protrusion length of rootstock and scion can be increased or decreased by special settings (Fig.2abc).

Figure 1: Grafting with omega (abc)



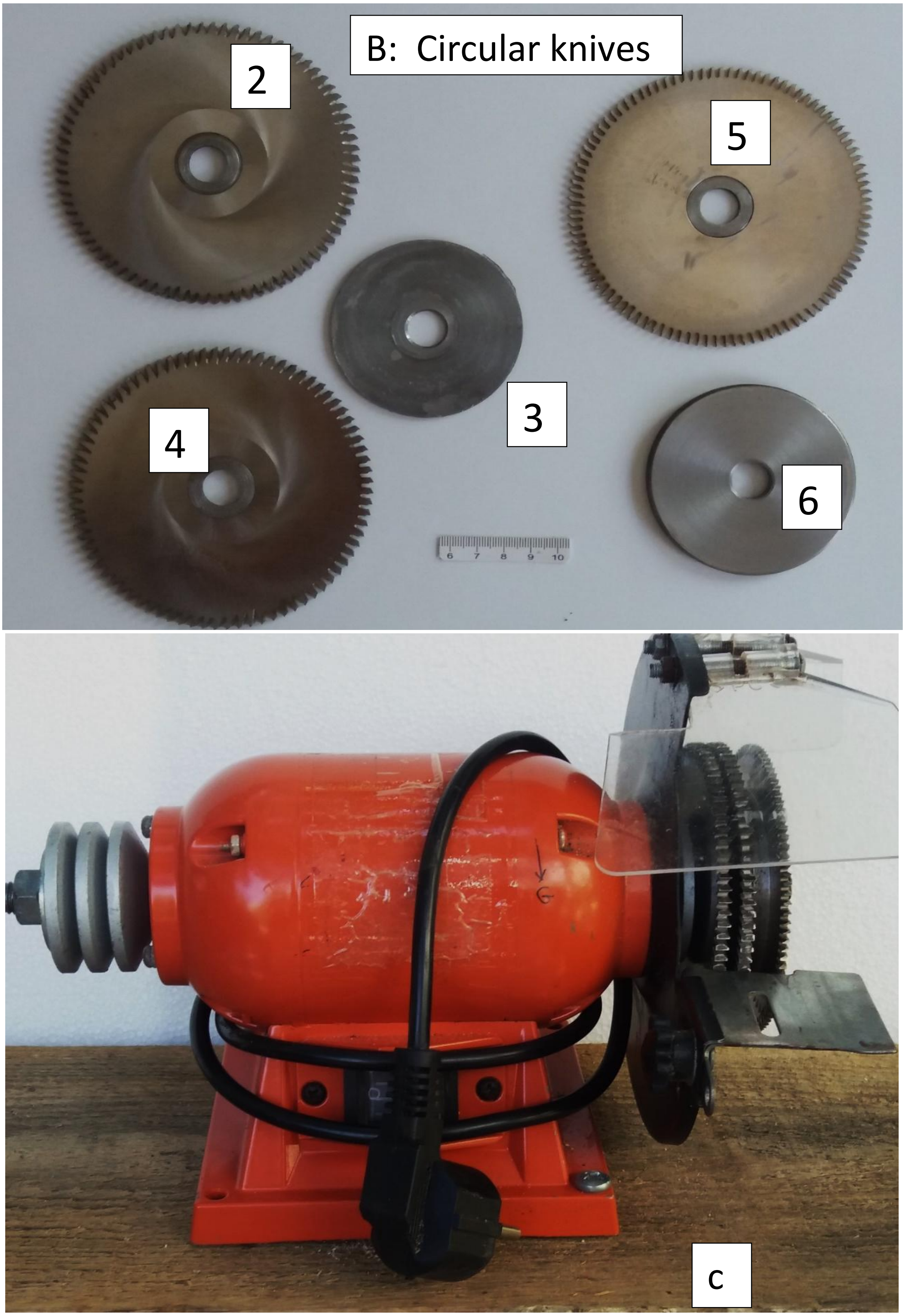


Figure 2: New grafting machine (A: Shematic.B:Circular knives,C: Actual size of machine)

2.3. Structure of Motorized Machine

The motorized grafting machine is made up of three stainless steel cutting blades , which are mounted on a table with 180 W [1/4 HP] power and 2900 rpm electric motor, which acts as a shaft knife [Fig.3A/ 2, 4, 6]. Two washers are placed between these cutting teeth. Blades 2 and 4 have a thickness of 5 mm, a diameter of 10 cm, and 80 chopping teeth, each of which serves as a cutting blade. The blades, numbered 6 is the same diameter [10 cm] and has a thickness of 2.5 mm and carries 100 cutting teeth. The center hole diameter of all three blades (knives) passing through the motor shaft is 12 mm [26,27,29].

To adjust the length of the protrusion of the scion [or root], a washer [Fig. 3A/3] with a diameter of 2.5 mm and a diameter of 7 cm is inserted between two teeth No. 2 and No. 4; a second washer of 7 mm in diameter and 10 mm in thickness was placed between the blades No. 4 and No. 6 to adjust the depth of the groove in the root [or scion][Fig. 2/5].

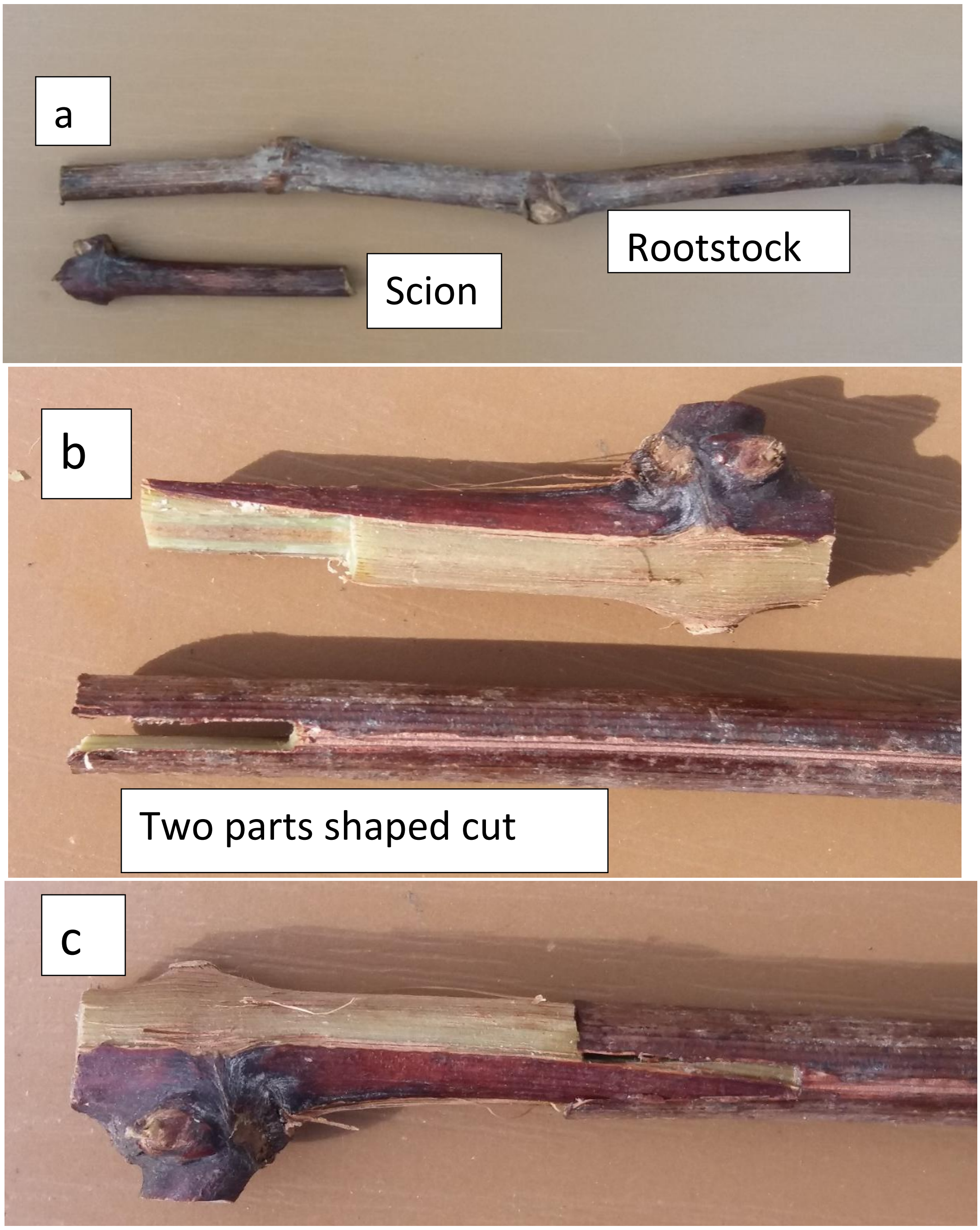


Figure 3: Grafting with new machine (abc)

2.4. Working Principles of Motor Grafting Machine

It is desired that the rootstock and the scion used in the production of grafted rootstock seedlings have the same thickness, that is, 7-12 mm in diameter. To make a protrusion-shaped wound on a scion with 5 to 6 cm length and carrying an eye, insert the scion between cutter blades 2nd and 4th in motion and trim it until the touchto 3rd washer .

If the rootstocksare prepared 35-40 cm long and the eyes are blunted, the number 6thblade is used to open a suitable burrowfor scion protrusion-shaped. The depth of the burrow is adjusted to the desired length by the number 5washer. The same size (2.5 cm) and width (2.5 mm) recess and protrusions can be opened by the same diameter but different thickness of number 3washer (diameter 7 cm, thickness 2.5 mm) and number 5 washer (diameter 7 cm, thickness 10 mm). The reverse can also be done if these chopping operations are done on the rootstock and scion.

Since the indentations and protrusions in the rootstock and scion are of the same size, they are tightly interlocked and there is no need to make the wrapping. The graftsareparaffinizedand stratificated in moistened sawdust for 22 days at 28 °C and held at 85-90% humidity, then re-paraffinized and planted in the nursery [22,26].

In order to avoid accumulation of the cutting tooth coming out of the chipped pieces in the motorized layer, tooth depth was chosen as 4.5 mm, the distance between the teeth was 3.5 mm and the tooth angle was 30^0.

Waxed grafts for callusing room

Grafted wallnut saplings by motorized device

3. Conclusion and Discussion

The same grape variety [Merlot] and rootstock [SO_4] were grafted to each other by means of the conventional production stages and were planted in the nursery to test the usability of the motorized grafting machine and to compare with the current omega grafting machine in terms of 1st grade grafted-young vines yield. The grafted-young vines that were removed from the nursery in the autumn were compared in terms of both first class quality criteria and efficiency.

With this preliminary experiment, the yield of grafted-rooted young vines exceeding 1 st class was found to be 20% in the omega grafting machine, but 60% in the motorized grafting machine. As can be seen below, a higher rate is obtained in the motorized grafting machine at the exit from the callusing chamber.

	Omega grafting machine	Motorized grafting machine
Number of grafted cuttings	100	100

Exit rate in callusing chamber (%)	55	85
1st class grafted vine yield from nursery(%)	20	60

(The study was preliminary trial, so no statistical analysis was done).

Total first class grafted vine production is only 3 million in Turkey. But Turkey needs 10 millions.This ratio, between two devices is very important for Turkey.

The high ratio of the motorized grafting machine is due to the excess of the cambium contact surface on the rootstockandscion. For example, in a 10 mm diameter rootstock and a scion, the cambium contact surface of the omega graft is 6 cm in length, whereas the length of the cambium on the contact surface is 16 cm when the protruding length and protrusion length of the scion and the rootstock of the motor are selected to be 2.5 cm. It improves the rate of grafting through overfitting and reduces the losses in production phases [22,26,27]. By varying the diameter of the washers placed between the cutting blades of the motorized grafting machine [Fig.3A/, 3,5], the length of the indentation and protrusion in the rootstock and the scion can be changed. Although omega grafting is used to graftscion

and rootstocks that are 7-12 mm in diameter, thicker rootstocks and scion [20 mm] can be grafted together with a motorized graft. Motorized graft device can also be used to graft rooted of apples, walnuts and some forests and ornamental plants . In the production of grafted vines, the use of this tool in a wider form will continue.

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