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Development of improved techniques for grafting of pecan

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ABSTRACT

This project was carried out at the Safiabad Agricultural Research Center of Dezful during 2011–12. Three graft methods are investigated in this project: cleft graft with hot cable system five times from late October till mid-February, cleft graft with polyethylene bag, and side-stub five times from early November till early March. For each grafting method, scion wood of 'GraTex', 'Wichita', 'Choctaw', '10J' and 'GraKing' pecan cultivars were grafted onto two-year old seedling rootstocks 1–1.5 cm in diameter. The best graft time was from late January till late February using the cleft graft with hot cable system graft method and from mid-February till late March using the cleft graft with polyethylene bag grafting method. Also, the highest percentage of graft success was achieved using 'Wichita' scion (92%), while '10J' had the lowest percentage. The side-stub grafting method was unsuccessful compared to the other two methods and percentages of graft success for different cultivars using this method were below 20%.

1. Introduction

Pecan trees are propagated in different ways such as using of seeds, cuttings, layering method and grafting techniques but the common and appropriate method is the use of seedling grafts (Nesbitt et al., 2002). Environmental factors have a high impact on the formation of callus tissue during and after the healing period. Temperature, relative humidity and grafting time, are the most important of these factors (Hartman et al., 2001). At temperatures below 20 °C, callus is not formed in pecan (McEachern, 2010). Similarly, among the environmental factors, temperature has the highest impact on callus formation and graft successes in walnut (Karadeniz, 2005).

The parenchymal cells which form the callus have very thin walls, thus they cannot tolerate drought and dry air. If they are exposed to these factors they will lose moisture quickly and die. Therefore, callus can only proliferate in a humid environment, because when the humidity of scion and that of the grafting location decrease, the formation and joining of callus, cambium, vascular differentiation and their joining, which is essential for the healing of graft, do not happen (McEachern, 2010).

The type of propagation method which is used depends on the skills of nurseryman and to a certain extent on the location of nursery. Pecan nurseries in the southeastern of the U.S. often whip graft seedlings, while those more frequently use patch bud in the western pecan region. Both of these methods require a fair amount of skill, and can be difficult for amateurs to use successfully. An alternative method is the four-flap graft, which is sometimes called a banana graft. This method is commonly practiced in the early spring shortly after the rootstock has begun growing and the cambial layer is actively dividing allowing the bark to slip from the wood (Conner, 2005). But in the banana graft method, seedlings must be grafted only in short early spring time.

The main goal of the present study was proved the possibility of commercial production of pecan grafted seedlings in longer period of year and easier procedure.

2. Materials & methods

Three grafting methods as three experiments were investigated at the Safiabad Agricultural Research Center (SARC) for two years. SARC is located in southwestern of Iran. Dezful.

2.1. Cleft grafting with hot cable system

Seedlings 0.7–1 cm in diameter were selected. One-year old shoots 0.7–1 cm in diameter were used to prepare scions of 'GraTex', 'Wichita', 'Choctaw', '10J' and 'GraKing' cultivars. Scion woods

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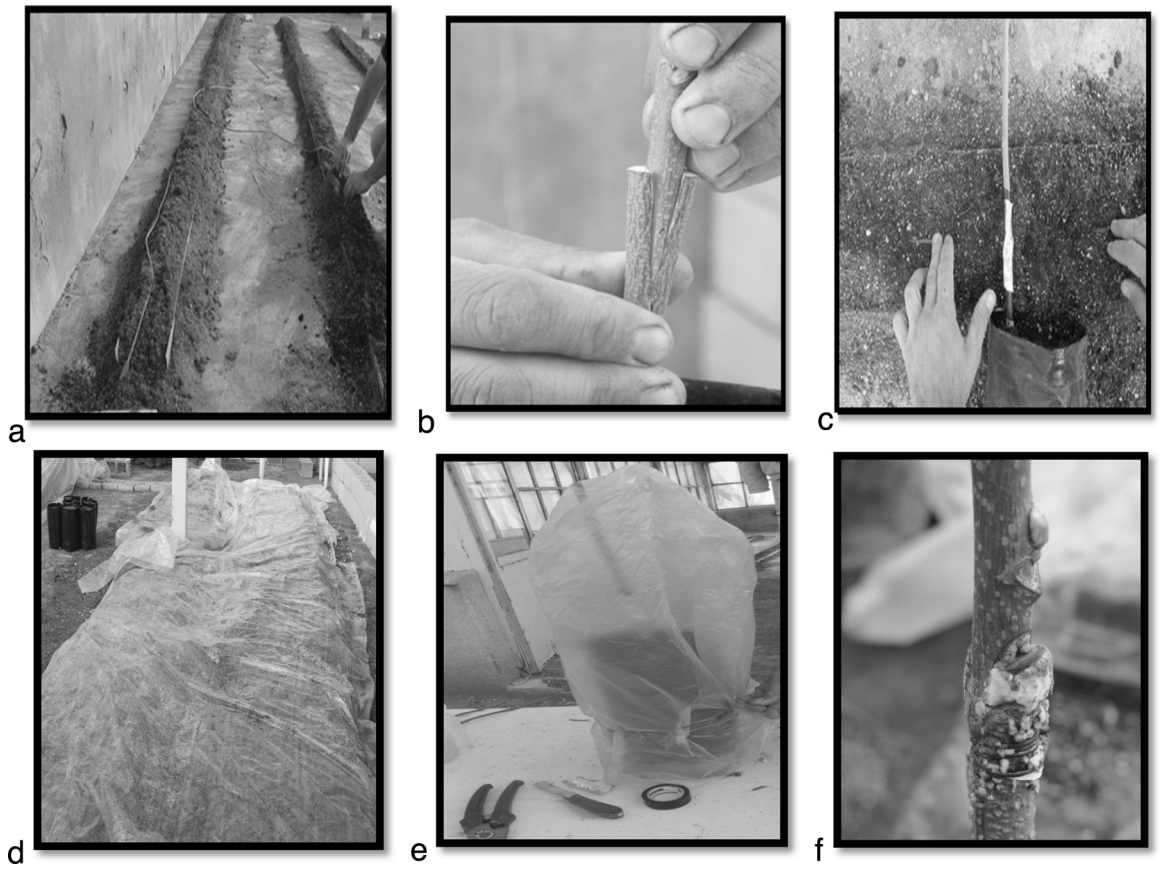

Fig. 1. Pecan grafting methods (a) Hot cable system. (b) Scions wood were cut in a V-shaped form (c). Graft section was placed on the hot cable system. (d) Whole system (scion, rootstock and hot cable) covered by using a humid coco peat layer and a plastic cover. (e) Cleft grafting with polyethylene bag (f). Callus formation in cross section.

were carved on both sides and placed into a vertical gap that was prepared on rootstock such a way that the cambium layers of scion and rootstock have the maximum area of contact. The grafted area was wrapped using an electrical insulator tape and was placed on a hot cable system at 26 ± 1 °C. Then the whole system (scion, rootstock and hot cable) was covered in a layer of humid coco peat and a plastic cover (Fig. 1a–d). Grafting of seedlings were performed from early November till early March at one month intervals. Grafted seedlings were kept under this condition for 4 weeks.

2.2. Cleft grafting with polyethylene bag

Seedlings grafted according to from late October till mid-February. In order to retain humidity and temperature, all areal parts of scion wood and rootstock were covered with plastic bags after irrigating the pots (Fig. 1e). Grafted seedlings were kept under this condition for 4 weeks.

2.3. The side-stub grafting

Seedlings grafted from early November to early March at one month intervals. Scions were carved on both sides and inserted into a gap that was prepared laterally on rootstock. Graft section was then wrapped up carefully with electrical insulator tape and covered with plastic bags.

The experiments were performed in a completely randomized design with a factorial combination of treatments with three repetitions. The percentages of graft-take were determined 6 months after grafting, based on the percentage of scions with callus formation in the cross section, plump buds and suitable growth.

2.4. Anatomical studies

The cross sections of rootstock and the scion union zone were taken (six months after grafting) to determine callus development in the union zone. The transverse sections of 25 μm thickness in prepared organs were cut using rotary microtome. Saffranin techniques were used in staining and photographs were taken by microscope and binocular.

Statistical analyses were conducted using SAS software (SAS Institute, Cary, NC, USA), and means were compared using Duncan's New Multiple Range Test at $P \leq 0.01$.

3. Results and discussion

Effect of different date, method and cultivar of pecan on percentage graft success during the first and second years are significant at 0.01 probability levels (Table 1).

The effect of graft method on pecan graft success was significant at 0.01 probability levels (Fig. 2). Cleft graft with hot cable system gave the most success compared to cleft graft with polyethylene bag and side-stub grafting. Due to inconsistencies in cleft graft with hot cable system in terms of humidity adjustment in the first year, there was little success in callus formation in rootstock and scion, and also the healing of grafts; but in the second year, this problem was solved by using a humid coco peat layer and covering the whole system (scion, rootstock and cleft graft with hot cable system) by a plastic cover (Fig. 1d) that ultimately led to the success of grafting operation.

The effect of date on pecan graft success was significant at 0.01 probability levels (Fig. 3). February and March were the best date for pecan graft.