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The Effects of Different Grafting Methods Applied by Manual Grafting Units on Grafting Success in Grapevines

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Abstract: In this study, Amasya Beyazı and Alphonse Lavallee grape cultivars were grafted on 5 BB (*V. berlandieri* x *V. riparia*) rootstock by chip-budding, cleft and omega cut manual grafting units under nursery conditions in 1996 and 1997. Grafts were made on the 15th of May. One-year-old rooted rootstocks were used in the experiment. The highest graft take was obtained from chip-budding, 87.00% for Amasya Beyazı, and 82.50% for Alphonse Lavallee. The takes of cleft and omega cut grafts were 81.00% and 74.25% for Amasya Beyazı, and 79.75% and 74.50% for Alphonse Lavallee, respectively. The highest rate of grafted grapevines was also obtained from chip-budding, 54.19% and 61.50% for Amasya Beyazı and Alphonse Lavallee, respectively.

Key Words: Grapevine, propagation, grafting, nursery.

El ile Çalışan Aşı Makineleriyle Asmalarda Uygulanan Farklı Aşılama Yöntemlerinin Aşıda Başarı Üzerine Etkileri

Özet: Bu araştırmada, el ile çalışan yongalı-göz, yarma ve omega aşı makineleri kullanılarak Amasya Beyazı ve Alphonse Lavallee üzüm çeşitleri 5 BB (*V. berlandieri* x *V. riparia*) anacı üzerine 1996 ve 1997 yıllarında fidanlık koşullarında aşılanmıştır. Her iki yılda da aşılar 15 Mayıs'ta yapılmıştır. Bir yaşlı köklü anaçların kullanıldığı denemede, en yüksek aşı tutma oranı Amasya Beyazı ve Alphonse Lavallee üzüm çeşitlerinde sırasıyla % 87.00 ve % 82.50 ile yongalı-göz aşı tipinde saptanmıştır. Yarma ve omega aşılarındaki başarı sırasıyla, Amasya Beyazı üzüm çeşidinde %81.00 ve %74.25, Alphonse Lavallee üzüm çeşidinde ise %79.75 ve %74.50 olarak gerçekleşmiştir. Fidan randımanının da Amasya Beyazı'nda % 54.19, Alphonse Lavallee'de ise % 61.50 olmak üzere yongalı-göz aşısında en yüksek olduğu belirlenmiştir.

Anahtar Sözcükler: Asma, çoğaltma, makina aşısı, fidancılık.

Introduction

Rootstocks derived from American vine species have been used in grape culture since the early 1880s, when they were introduced into Europe to counter the effects of phylloxera. Vine growing areas in Turkey are also under the threat of phylloxera. It is well known that the only way to overcome the damage of this insect is to use grafted grapevines. In brief, propagation of grapevines by grafting is done to obtain vines of a fruiting variety with a root system tolerant to phylloxera or other pests and diseases. Recently, the use of these rootstocks has enabled the growth of grapevines under salty, limy and nematod infested soils (1, 2, 3). At this stage, the usage and demand of grafted grapevines is increasing day by day.

Grafted grapevines used in modern viticulture can be propagated by bench grafting, field or nursery budding and different grafting methods (2, 4, 5, 6, 7). It is clear that field budding and grafting in both Turkey and other grape growing countries are intended for top working and changing varieties (8, 9). However, studies on grafted grapevine production under nursery conditions with manual grafting units have been increasing (4, 5, 6, 10). According to observations on Turkish viticultural regions, the need for grafted grapevines is about 10 million per year (11); however, the number of existing grafted grapevines is only 2,662,100 (12).

The budding of rootstocks in an open ground nursery is a widely used method of producing grafted vines in Turkey. It is imperative that grafting by manual grafting units under nursery conditions become widespread in order to increase grafted grapevine production and decrease inputs (6, 13). Grafting in an open-ground nursery is easier and cheaper than classical methods (2). Furthermore the classical methods require expensive investments, extensive care and labour during the callusing period (4, 5).

It is believed that grafting or budding under nursery or vineyard conditions will take effect for many years. At this stage, the most important matter is to determine the most suitable grafting time and types for viticultural regions and widespread manual grafting units. These devices eliminate the need for grafting skill, which directly affects graft take. Studies on omega cut manual grafting unit indicate that it has a high rate of graft take, between 67% and 78% (4, 5, 6, 7, 10, 14, 15, 16). The chip budding known as the “Birebent” graft, which has two chip-incisions at the top and bottom of the chip-bud, yielded 95% graft take when applied for changing variety without yield loss (17). Grafting machines or devices can prepare different graft surfaces, such as omega, lamella, whip, tenon and cleft (18). Omega and lamella machine grafts have been found to be the most successful when joined dorsiventrally (19). However, whip and tongue grafting have been found to be better for cultivars with “soft” wood, whilst the tenon or omega methods are better for those with “hard” wood (20). In the present study, chip-bud, cleft and omega cut manual grafting units were investigated for grafting success.

Material and Methods

This experiment was carried out at the Department of Horticulture, Faculty of Agriculture, University of Ondokuzmayıs, in 1996-1997.

The single-budded scions and buds taken from dormant hardwood cuttings of Amasya Beyazı and Alphonse Lavallee grape cultivars were grafted on one-year-old rooted rootstocks (*Berlandieri* x *Riparia* Teleki 8B Sel. Kober 5BB). Three manual grafting units were used: KING (for chip budding), VITO (for omega graft) and CEO (for cleft graft). These grafting units are suitable for all types of fruit-bearing and ornamental plants. They are very lightweight, and are made in Italy by the Carlo A. Manaresi Firm. They have single parts produced from highly resistant fibre material. All of the grafts were made on the 15th of May (10, 13), as illustrated by Çelik (7) (Fig. 1). After grafting, only omega and cleft grafts were wrapped in parafilm, and then all grafts were mounded with fine and damp soil. The following parameters were examined to determine out the effects of different grafting methods on grafting success (21, 22):

- The rate of graft take (%): Percentage of grafted grapevines that have an adequate or all-around callus ring formation on the surface of the graft union.

- The rate of bud-burst (%): Percentage of grafted grapevines that have an adequate shoot length and diameter flushed from scion bud.

- The rate of grafted grapevines (%): Percentage of grafted grapevines that have a vigorous root system and matured shoot, as defined at the TSE 3981 numbered standard.

- Grade of callus development (0-4): A scale ranging from 0 to 4 was used: 0=no callus, 1=25%, 2=50%, 3=75% and 4=100% callus formation on graft union surface.

- Grade of shoot growth (0-4): A scale ranging from 0 to 4 was used: 0=no shoot, 1=thin, 2=medium, 3=vigorous and 4=very vigorous shoot growth.

- Diameter of main scion shoot (mm): Measured by digital compass at a point 1 cm above the second node.

- Length of main scion shoot (cm): Shoot length of grafting after lifting.

Twenty-five grafts with three replications were used in the experiment, which was designed on randomised complete blocks. Data calculated as percentages were transformed to the arcsin√x transformation method and statistical analyses were made over the transformed data. The original data are given as percentages in the tables. Analysis of variance of the data was carried out with MSTAT software. The least significant difference were calculated at the level of $P<0.01$.

Results and Discussion

Data for the rate of take, sprouting and grafting are presented in Table 1. The results revealed differences between graft types for all characters examined except for bud-burst rate in Amasya Beyazı were found to be significant. Chip budding yielded the highest graft take for Amasya Beyazı and Alphonse Lavallee, 87.00% and 82.50%, respectively. According to Çelik and Zenginbal (10), the omega grafts made by manual grafting unit on rooted rootstocks gave 66.9% take (10) and rootless stocks reduced the rate of take to 36.6% (5). The rate of take obtained from the present study was slightly higher than the author’s results mentioned above (Table 1). This difference may have been caused by the grafting units used in this experiment, humidity control and temperature within the mound, and the use of rooted rootstocks. According to the authors, the main factors affecting the callus-ring formation and graft take are humidity and temperature within the mound and around the graft union (2, 23, 24, 25). Rooted rootstocks also have a positive effect on graft take (4, 24, 26).

The grade of callus formation on graft union is another factor in the determination of whether there is a good compatibility between stock and scion. Chip budding gave the highest callusing grade (3.75 for the Amasya

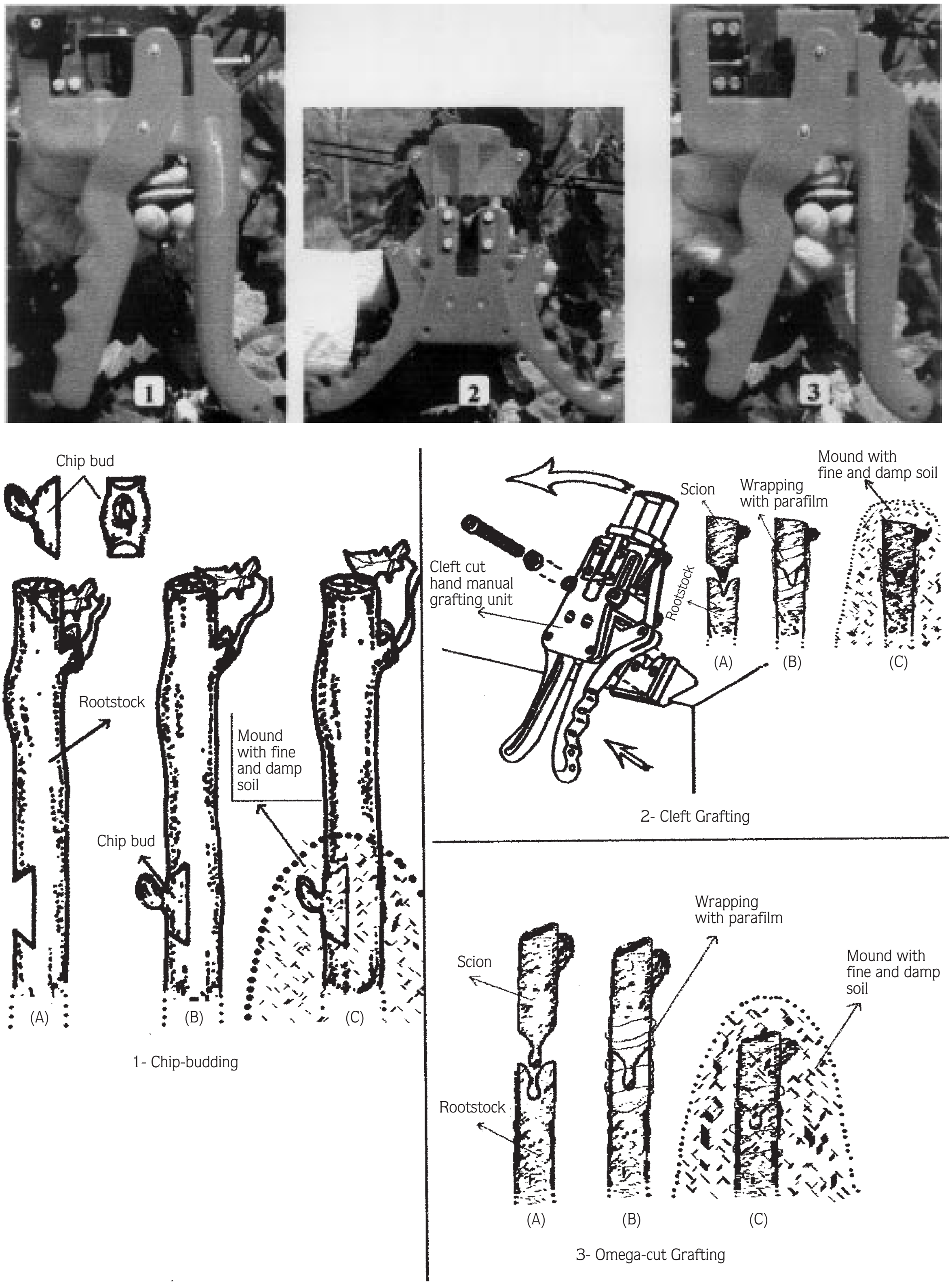

Figure 1. The manual chip-budding (1), cheft (2) and omega (3) cut grafting units and grafting processes.

Beyazı and 3.55 for the Alphonse Lavallee) (Table 2). These results indicate that callus formation could vary according to the graft types. It also differs in connection with the rootstock and grafting time. Our findings support the results of Çelik et al. (4), Çelik (6), Çelik (7) and Çelik and Zenginbal (10).

Table 1. The rate of graft take, bud-burst and grafted grapevines (%) according to the graft type made by manual grafting units.

Graft Type	Rate of Graft Take (%)	Rate of Bud-burst (%)	Rate of Grafted grapevines (%)
AMASYA BEYAZI			
Chip budding	87.00 a*	71.25	54.19 a*
Cleft	81.00 b	68.75	51.95 ab
Omega	74.25 c	68.25	49.47 b
$LSD_{\%1}$	*4.40*	*NS*	*2.50*
ALPHONSE LAVALLEE			
Graft Type (%)	Rate of Graft Take (%)	Rate of Bud-burst (%)	Rate of Grafted grapevines (%)
Chip budding	82.50 a*	71.50 a*	61.50 a*
Cleft	79.75 a	64.00 b	53.75 b
Omega	74.50 b	63.75 b	53.25 b
$LSD_{\%1}$	*3.58*	*2.96*	*3.92*

* Values within a column followed by the same letter are not significant (P<0.01).
NS : Non significant

Table 2. The rate of callus development (0-4), shoot growth (0-4), main scion shoot diameter (mm) and length (cm) according to the graft type made by manual grafting units.

Graft Type	Grade of Callus Development (0–4)	Grade of Shoot Growth (0–4)	Diameter of Main Scion Shoot (mm)	Length of Main Scion Shoot (cm)
AMASYA BEYAZI				
Chip budding	3.75 a*	3.725 a*	11.85 a*	151.50 a*
Cleft	3.35 b	2.950 b	9.18 b	104.03 b
Omega	3.05 b	2.200 c	8.90 b	102.05 b
$LSD_{\%1}$	*0.37*	*0.518*	*1.32*	*14.80*
ALPHONSE LAVALLEE				
Graft Type	Grade of Callus Development (0–4)	Grade of Shoot Growth (0–4)	Diameter of Main Scion Shoot (mm)	Length of Main Scion Shoot (cm)
Chip budding	3.55 a*	3.90 a*	12.00 a*	146.38 a*
Cleft	3.18 ab	2.80 b	10.00 b	116.30 b
Omega	2.68 b	2.30 c	8.98 c	96.48 c
$LSD_{\%1}$	*0.57*	*0.50*	*0.80*	*10.44*

* Values within a column followed by the same letter are not significant (P<0.01).

The data in Table 2 also revealed that there were significant differences amongst the shoot growth grade, main scion shoot diameter and length that determine the quality of grafted grapevines. The chip-budding that showed vigorous shoot growth gave the longest shoot (151.50 cm for the Amasya Beyazı and 146.38 cm, for the Alphonse Lavallee) and the thickest diameter (11.85 mm for the Amasya Beyazı and 12.00 mm for the Alphonse Lavallee). These results indicate that growth of grafted grapevines could be different in respect to graft types, as reported by Çelik et al. (4), Çelik and Zenginbal (10), Çelik and Odabaş (15) Tangolar and Ergenoğlu (27) and Mannini et al. (28).

Chip budding is also a top-working procedure used to change varieties in vineyards (2, 6, 8, 9). Chip-budding made by manual grafting unit has two incision made on rootstock like those done for bottom of the classic chip-budding made by hand. A dormant bud is inserted laterally like a piece of puzzle into the rootstock trunk. Thus both angles above and below the bud will fit better than the classic one. This type of chip budding does not require wrapping during mounding. We believed that all hand manual grafting units especially chip budding could be used effectively for producing grafted grapevines under nursery conditions. All of them are very practical, portable and manually used, which reduces that eliminate time consumption, and does not require skilled and qualified grafters. The required grafted grapevines could be produced within a short period under nursery conditions with these practical grafting machines.

According to the results of the present study, chip budding done by the manual grafting unit gave the best rate of graft take and the best rate of grafted grapevines, about 60%. We recommend this type of graft unit to vine growers who want to produce their grafted vines by themselves and do not want to inoculate diseases and insects to their local area because of inadequate quarantine precautions.

References

1. Nicholas, P.R., Chapman, A.P. , Cirami, R.M., Grapevine Propagation. In: Viticulture. Volume 2, Practices (ed. B.G. Coombe and P.R. Dry). pp: 1-22. Winetitles, Adelaide, Australia, 1997.
2. Çelik, S., Bağcılık (Ampelologi). Cilt I. Trakya Üniv. Tekirdağ Ziraat Fak. 426s., 1998.
3. May, P., Using Grapevine Rootstocks: The Australian Perspective. Winetitles, Adelaide, 62p., 1997.
4. Çelik, S., Delice, A., Arın, L., Fidanlık Koşullarında Aşılı Asma Fidanı Üretimi. DOĞA, Türk Tar. ve Orm. Dergisi, 16: 507-518, 1992.
5. Çelik, H., Marasalı, B., Söylemezoğlu, G., Göktürk, N., Ergül, A., Patlak, H., Bağda Uygulanan Farklı Aşılama Yöntemlerinin Aşıda Başarı Üzerine Etkileri. Türkiye II. Ulusal Bahçe Bitkileri Kongresi. Cilt II : 480-484. Çukurova Üniv. Ziraat Fak. Bahçe Bitkileri Böl., 3-6 Ekim, ADANA, 1995.
6. Çelik, H., Samsun İli Fidanlık Şartlarında Aşılama Yoluyla Aşılı Asma Fidanı Üretiminde Aşı Tipi ve Aşılama Zamanlarının Etkileri (Basılmamış Doktora Tezi). Ondokuz Mayıs Üniv. Ziraat Fak. Bahçe Bitkileri Bölümü, 285s., 1995.
7. Çelik, H., Bağcılıkta Makine İle Aşılama. HASAD, 13(148): 30-38, 1997.
8. Alley, C.J., Koyama, A.T., Grapevine Propagation XVI. Chip-budding and T-budding At High Level. Amer. J. Enol. Vitic., 31(1): 60-63, 1980.
9. Uslu, İ., Samancı, N., Koludar, J., Bağlarda Çeşit Değiştirmede Kullanılabilecek En Uygun Çevirme Aşısının Saptanması. Tarım ve Köyişleri Bak., Bağcılık Araşt. Proj., Atatürk Bahçe Kült. Merkez Araşt. Enst. Yalova, 27s., 1987.
10. Çelik, H., Zenginbal, H., Bağ Tesisi İçin Dikilen Köklü Anaçların Aynı Yıl Aşılanmasında Başarı Üzerine Aşılama Zamanlarının Etkileri. BAHÇE, 24(1-2): 45-52, 1995.
11. Çelik, H., Çelik, M., Kadıoğlu, R., Çelik, S., Kocamaz, E., Yalçın, R., Özkaya, M.T., Türkiye'de Meyve ve Asma Fidanı Kullanımı ve Üretimi. IV. Türkiye Ziraat Mühendisliği Teknik Kongresi. T.C. Ziraat Bank. Kültür Yay.: No.: 26, Cilt: 2, 941-964, ANKARA, 1995.
12. Anonim, Fidan Üretim ve Dağıtım Talimatı (1996-1997). T.C. Tarım ve Köyişleri. Bak., Tarım Ür. Gelş. G. Müd. Yay. Dairesi Bşk., 232s, Ankara, 1997.
13. Çelik, H., Odabaş, F., Değişik Üzüm Çeşitlerinin Bağda Kober 5 BB Anacına Aşılanması Üzerinde Bir Araştırma. Ondokuz MayısÜniv. Ziraat Fak. Dergisi, 9(3): 71-77., 1994.
14. Çelik, H., Ardalı, T., Çetin, H., Sucu, R., Doğrudan Fidanlığa Dikilen Aşılı Asma Çeliklerinden Fidan Üretiminde Başarı Üzerine Siyah Plastik Tünel ve Örtü Materyallerinin Etkileri. Tarım Bilimleri Dergisi, 2(3): 33-38, 1996.
15. Çelik, H., Odabaş, F., Farklı Anaçlar Üzerine Aşılanan Bazı Üzüm Çeşitlerinde Aşı Tipi ve Aşılama Zamanlarının Fidanların Büyüme ve Gelişmesi Üzerine Etkileri. Türkiye II. Ulusal Bahçe Bitkileri Kongresi, Cilt II: 464-468, Çukurova Üniv. Ziraat Fak. Bahçe Bitkileri Böl. 3-6 Ekim, ADANA, 1995.

16. Erdem, B., Ergenoğlu, F., Köklü Amerikan Asma Anaçlarından Fidan Eldesinde En Uygun Aşı Yöntemi ve Zamanının Saptanması. Türkiye II. Ulusal Bahçe Bitkileri Kongresi. Cilt II : 500-503 Çukurova Üniv. Ziraat Fak. Bahçe Bitkileri Böl. 3-6 Ekim, ADANA, 1995.

17. Nicholson, C., "Birebent" Graft is Hailed as a Breakthrough in Viticulture. Wines and Vines, September, 16-18p, 1990.

18. Ağaoğlu, Y.S., Çelik, H., Effect of Grafting Machines On Success Of Grafted Vine Production. Uludağ Üniv. Ziraat Fak. Dergisi, 1(1): 25-32, 1982.

19. Schenk, W., Untersuchungen über die Wervachsung Vorgaenge bei Pfropfreben. Weinberg u. Keller, 22(2): 55-70, 1975.

20. Schumann, T., Untersuchungen über den Einsatz von Veredlungsmaschinen bei der Pfrobfrebenezeugung. Weinberg u. Keller, 22 (5): 221-239.

21. Çelik, H., Samsun İli Fidanlık Şartlarında Aşılama Yoluyla Aşılı Asma Fidanı Üretiminde Aşı Tipi ve Aşılama Zamanlarının Etkileri, Doktora Tezi (Yayınlanmamış), 283s, 1995.

22. Çelik, S., Delice, A., Arın, L., Fidanlık Koşullarında Aşılı Köklü Asma Fidanı Üretimi. DOĞA, Turkish J. of Agriculture And Forestry. 16: 507-518, 1992.

23. Alley, C.J., Grapevine propagation XVIII. Spring Chip-budding of Mature Grapevines at High Level From February Through April. Amer. J. Enol. Vitic. 32:29-34, 1981.

24. Bautista, D., El injerto en la vid bajo condiciones tropicales: predimiento y mortalidad. Agronomia Tropical, 35(1/3): 69-75, 1985.

25. Çelik, H., Aşılı Köklü Asma Fidanı Üretiminde Başarıyı Etkileyen Etmenler. Türkiye I. Bağcılık Simp., 14-19 Eylül 1981. Bağcılık Araşt. Enst. Müd. Tekirdağ, Cilt 1:139-153, 1985.

26. Chanana, Y.R., Singh, A., Propagation of Grapes by Grafting. Hort. Abst. 46(3): Nr. 2031, 1974.

27. Tangolar, S., Ergenoğlu, F., Değişik Anaçların Erkenci Bazı Üzüm Çeşitlerinde Vegetatif Gelişme Üzerine Etkileri. DOĞA, Türk Tar. ve Orm. Dergisi : 13, 3B: 1242-1266, 1989.

28. Mannini, F., Schneider, A., Gerbi, V., Eynard, I., Effect of Rootstocks of Different Vigor on Grapevine Must and Wine Acidity. XXIII. International Hort. Congress, 27 August-1 Sept., Italy (3356), 1990.