Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2019, 6(12):253-256**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

External and Internal Symptoms of Graft Incompatibility in Grapevines

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Abstract The grape is an ancient crop used for fresh fruit, raisins, and making wine. There are two types reproduction in grapevines. One is sexual and involves the production of vines by seeds. The second types is asexsual in which vines are increased by vegetative means from part of existing plants other than seeds. Propagation refers to utilization of reproductive processes in the controlled perpetuation of grapes. The basis for asexsual reproduction is the ability of grapevines to reproduce itself easily from cuttings. Grapevines are propagated commercially by grafts using different rootstocks. The grape production area in Turkey, is planted on rootstocks. This is necessary to combat root infesting pests, principally the grape Phylloxera (*Phylloxera vitifoliae*). So use of the vine-roostocks, is compulsory for viticulture area in Turkey. Primary causes of the grapevine graft incompatibility between the grapevines and rootstocks are considered in this review.

Keywords Grafting, compatiility, incompatibility, graft union, blockage

1. Introduction

Vitis vinifera, is the grape of antiquity often mentioned in the historical books and Bible. Most table, wine and raisin grapes are produced from this variety. *V. vinifera* originated in the regions between and South of the Caspian and Black seas in Asia Minor (Turkey) [14], has been carried from region to region by civilized man in all temperate climates, and has been grown more recently in subtropical climates. Several thousand varieties of grapes have been derived from this species. Vinifera is also a parent of many hybrid grapes in eastern America, as breeders in this region desired to introduce some of the qualities of vinifera in to their grapes [8, 13].

Graft compatibility the ability of two different plants (scion and rootstock), grafted together, to produce a successful union satisfactorily into one composite or compound plant [12]. Investigation of graft-incompatibility were begun because it constitutes a problem in practical viticulture. Such investigatins have had three main objectives; to overcome incompatibility, to recognize it at the earliest possible moment and to discover its underlying causes. Although motiveted mainly by practical considerations the study of graft incompatibility also has a bearing on such plant physiological problems as water conduction, translocation and sites of synthesis [11]. Advance made in these fields of study have conributed in their turn to an understanding of the possible causes of incompatibility.

Graft incompatibility, is an interruption in cambial and vascular continuity leading to smooth break at the point of the graft union. Normal vascular tissue does not develop in the graft union. Consequently, the gap formed is filled in by proliferating ray tissue that does not lignify normally [1, 9, 10]. Graft incompatibility occurs because of adverse physiological responses between the grafting partners, virus or phytoplasma transmission, anatomical abnormalities of vascular tissue in the callus bridge [11].

Graft union malformation resulting from incompatibility can usually be correlated with certain external symptoms) Fig. 1). The following symtoms have been associated with incompatible graft combinations [7]:

- Failure to form a successful graft or bud union in a high percentage of cases,

- Yellowing foliage in the latter part of the growing season, followed by early defoliation. Decline in vegetative growth, appearance of shoot die-back and general ill health on the vines
- Marked differences in growth rate or vigor of scion or rootstock,
- Differences between scion and rootstock in the time at which vegetative growth for the season begins or ends,
- Overgrowths on the vines, at above or below the graft union,
- Suckering of rootstock, new shoots forms from the rootstock,
- Graft components breaking apart cleanly at the gratf union.

Types of graft incompatibility are explained as follows [4, 6,7, 12];

Anatomical flaws leading to incompatibility: There is a greater autolysis of cells and generally a very low degree of differentiation [12]. Poor differentiation of the phloem below the union may be due to a lack of hormones, carbohydrates and other factors the size of the sieve tubes depend on aux, cytokinin and sucrose levels. Incompatible Çavuş/5BB graft, some callus differentiation into cambium and vascular tissue does occur [6].

Physiological and pathogen induced incompatibility: Graft incompatibility has been traditionally classified as non-translocatable (Localized) or Translocatable [10, 11]. Pathogen induced (virus, phytoplasma) incompatibility is a third category. Anatomical symptoms of incompatibility can include phloem degeneration or phloem compression an cambial or vascular discontinuity in the union area, causing mechanical weakness and subsequent breakdown of the union . The following summarizes the main distinguishing features of two types of compatibility [2, 7, 11].

Translocated incompatibility associated with:

- Starch blockage, i.e. accumulation of starch above and its almost complete absence the union.
- Phloem degeneration.
- Different behaviour of reciprocal graft.
- Normal vascular continuity at the union, although there may sometimes be marked overgrowth of the scion with consequent development of a crease containing compressed bark tissue.
- Early effects on growth

Localized incompatibility associated with:

- Characteristic breaks in cambial and vascular continuity, although normal union structure may accur in a few instances.
- Similiar behaviour of reciprocal combinations.
- Gradual starvation of the root system, with slow development of external symptoms proportional in severity to degree of vascular discontinuity at the union.

Although there is a incompatibility, between the rootstock and the scion, the yield will not fall as long as the vine develops healthy. However, when choosing rootstocks and scion, clone material showing good affinity with each other should be used.

2. Material and Method

Graft incompatibility shows, a 10-years-old who has been grafted on 5BB rootstock Çavuş grape variety is based. The same vine was examined both externally and internally and longitudinal sections were taken from the incompatible grafting point. Xylem, phloem, core (pith) and junction of rootstock and scion were examined on the surface of the section. In this smooth surface section, interrupted xylem and phloem conduction bundles were examined on the section surface (Figure 1, 2).

3. Results and Discussion

External appearance in grafting-incompatibility between the scion (A) and rootstock (C). İt is possible scion (A) to overgrowth the rootstock and yet develop into strong vine. Graft compatibility the ability of two different

plants (scion and rootstock), grafted together, to produce a successful union satisfactorily into one composite or compound plant (Fig. 1).

İnternal appearance abnormalities in grafting-incompatibility between the scion and rootstock. Graft incompatibility an interruption in cambium and vascular continuity leading to a smooth break at the point of graft union, causing graft failure İt caused by adverse physiological responses between the grafting partners, disease or anatomical abnormalities. A. Scion (Çavuş, local variety), B. Graft union, C. Rootstock (5 BB). D, E, F: Abnormalities spreading to the peripheral starting from stem pith. a, b, c, d, e, f : Xylem in the graft union is interrupted by parenchyma tissue which limits waterfowl and survival of scion (Fig.2).

The reason for the incompatibility caused by physiological and biochemical reasons is also explained as follows: Biochemical compounds synthesized from rootstock and scion, from the rootstock to the scion or from the scion to the mainstream to the effects of harm to the physiological functions of the effect of toxicity.

For example, when the Jaoument and Aramon grape varieties are grafted onto 57R (Richter) rootstock, they are secreted from the scion and pass through the rootstock by phloem to form precipitate on the rootstock. Precipitin (antigen) prevents starch transport and deposition by acting on starch metabolism at the graft union. This prevents necrosis in phloem and xylem bundles and prevents the integration of lignin in cell walls. In this case, starch sent to the subsoil organs for storage formed in the upper organs, it can not provide sufficient development due to incomplete compatibility, and the subsoil organs (roots) of the vine remain weak [2, 4, 7].

Dotti [5] reported rapid phloem degeneration below the union in vine rootstock 57 R under the incompatible scion variety Barbera [14]. On the other hand, incompatibility between the vine Jaoumet on the rootstock 57 R persist even when the Jaoumet scion is defoliated [5]. Longitudinal sections, through graft unions, a strong degenerated compatible graft union. So connected union showing incompatibility symptoms.

Although there is a incompatibility, between the rootstock and the scion, the yield will not fall as long as the vine develops healthy. However, when choosing rootstocks and scion, clone material showing good affinity with each other should be used.

4. Conclusion

In order to obtain high quality products and high yields in viticulture, the rootstocks and scions that compatible each other, should be selected in production basic clone material for grafts. This should be taken into consideration especially in grafted vine seedlings production. In addition, cultural procedures should be done in a timely manner.

Figure 1: External appearance in grafting-incompatibility between the scion (A) and rootstock (C). İt is possible scion (A) to overgrowth the rootstock and yet develop into strong vine. Graft compatibility the ability of two different plants (scion and rootstock), grafted together, to produce a successful union satisfactorily into one composite or compound plant.

Figure 2: İnternal appearance abnomalities in grafting-incompatibility between the scion and rootstock. Graft incompatibility an interruption in cambium and vascular continuity leading to a smooth break at the point of graft union, causing graft failure İt caused by adverse physiological responses between the grafting partners, disease or anatomical abnomalities.

A. Scion (Çavuş, local variety),

B. Graft union,

C. Rootstock (5 BB).

D,E,F : Abnomalities spreading to the peripheral starting from stem pith.

a, b, c, d, e, f : Xylem in the graft union is interrupted by parenchyma tissue which limits waterfolw and survival of scion.

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