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PHYLLODY (FLOWER ABNORMALITY) IN SWEET CHERRY (*PRUNUS AVIUM* L.)

H. Engin and Z. Gokbayrak*

Department of Horticulture, Faculty of Agriculture, Canakkale Onsekiz Mart University, 17020 Canakkale TURKIYE
Corresponding author's e-mail: hakanengin@.comu.edu.tr

ABSTRACT

This report deals with a case of phyllody, flower abnormality which is described as leaf-like development of the floral organs. In most extreme form, the organ involved is replaced by a foliage-type leaf. Any floral organ, even the ovule, may become leafy in form or color.

Phyllody, a report deals with a case of phyllody, flower abnormality which is described as leaf-like development of the floral organs (Meyer, 1966; Sim *et al*., 2004). In most extreme form, the organ involved is replaced by a foliage-type leaf. Any floral organ, even the ovule, may become leafy in form or color.

This flower abnormality was observed in sweet cherry (*Prunus avium* L) orchards in Yenice region of Çanakkale, Turkey. This region is one of the major sweet cherry producing and exporting areas in Turkey. The main sweet cherry grown in this region is '0900 Ziraat. Early Burlat, Noble, Stella, Bing and Starks Gold (pollinizer to 0900 Ziraat) are also grown in this region.

Approximately twenty sweet cherry orchards ranging in size between 5 and 30 decares were examined during the spring of 2008. Varying percentage of some sweet cherry flowers without petals, stamens and pistil (5 to 100%) were observed in all the orchards. In some orchards, this phenomenon was so high that none of the trees had one single normally developed flower. These flowers had no floral organs. No abnormal flowers were found in the regions other than the Yenice, Çanakkale, Turkey. The most affected cultivars were 0900 Ziraat and Starks Gold.

In this abnormality, there was no difference in the appearance between normal and abnormal flower buds at bud burst. However, in the following days, some morphological differences in the appearance between normal and abnormal flowers began to occur. The strange appearance of sweet cherry flower bud was distinguished during early white bud stage. Flower buds appeared to be about the same size and had star-like shape at full bloom. These appendages developed leaf-like structures in the center of flower buds (Fig. 1a-e). Close-up views of the buds under a stereo zoom microscope revealed that the flower organs were replaced by leaf and stem-like structures (Fig. 2a-c).

It is known that sweet cherry flower is differentiated in the flower bud previous season (Beppu *et al.*, 2001; Engin and Ünal, 2007). Therefore, we think that the conditions responsible for this phenomenon must have existed during the summer of 2007.

Under natural conditions, in sweet cherry, the first morphological indication of the transition from vegetative to reproductive development took place on July 5, in western part of Turkey. Flower primordia initially formed in the axils of bracts on July 15. The sepal primordia occurred on July 25. Stamen primordia became visible between 4 and 24 August and by the end of August, pistil primordia initiated within the floral cup (Engin and Ünal, 2007). Our observations in the bud sample taken at the beginning of April, 2008 showed that most of the buds were still at the stage of between sepal differentiation and pistil initiation. This fact suggested that the buds of trees during the period from sepal formation to pistil initiation were affected by some stress factors and the progression of petal, stamen and pistil primordia had not been formed. We observed that if apex's transition from petal primordia to early pistil primordia was stopped, it reverted to the vegetative state.

It was determined that we have in our hands is a case of phyllody. In the genus *Prunus*, whole flower or flower parts except for bracts can convert to vegetative state (Meyer, 1966). Battey and Lyndon (1990) and Tooke *et al*. (2005) provided many examples of species in which this abnormality occur. A number of factors such as environmental conditions (Tucker, 1935; Battey and Lyndon 1990; Beppu *et al*., 2001), and infection by phytoplasmas and viruses (Szyndel, 2003) might be responsible for this phyllody.

There is a paucity of information on factors causing abnormal flower formation in sweet cherry. Abnormal flowers, such as pistil-like appendages which replaced anters on the terminal part of the filaments (Ryugo, 1988), abnormal development of the petals (Philp, 1933), flowers which small more than normal (Engin and Ünal, 2003), and double pistil formation (Tucker, 1934; Beppu *et al.,* 2001) in sweet cherry have been reported.

Possible Reasons: Goethe (1790) published his seminal essay on the metamorphosis of plants in which he proposed that all plant organs could be thought of as equivalent or analogous to a single type organ, which he

called the leaf. Nageli in 1884 suggested 'phyllome' as a more suitable name, a suggestion with which later morphological botanists such as Arber in 1937 strongly concurred (Glover, 2007). Goethe's work provided important data that supported the theory of evolution by natural selection, suggesting that the various organs of the flower evolved by gradual changes, as a result of mutations, from an ancestral leaf-like structure (Glover, 2007).

The idea that floral organs are only a few mutations different from leaves has been the foundation stone of modern molecular genetic analysis of flower development. Genetic analysis in the 1980s and 1990s identified lines of plants with mutations that caused interconversion of floral organs. Combination of these mutations into a single plantline resulted in a plant which produced four whorls of leaves in place of the four whorls of floral organs, finally providing the molecular 'proof' for Goethe's foliar theory in the work of Coen and Meyerowitz 1991(Glover, 2007).

In the light of the reports and studies, we speculated on the possible reason(s) for this event. If environmental factors such as hot weather around flower differentiation were the cause, all the sweet cherry trees in this region would have been expected to show this abnormality, but some of trees in the other orchards looked completely free and healthy. High occurrence in "0900 Ziraat" and its pollinizer "Starks Gold" might have been the result of their genetic differences from the other cultivars. However, conclusive results could not be given here due to the lack of genetic research.

One of the other possible causes of phyllody in many plants is phytoplasmas (MyCoy *et al.,* 1989; Sim *et al*., 2004). Phytoplasmas are one of the first causes of abnormal floral differentiation to be widely recognized. They are prokaryotes, lacking a cell wall (Sim *et al.,* 2004). Apparently, phytoplasmas that inhabit the phloem tissue of infected plants can disrupt hormone production balance. Phytoplasmas are reported to cause many different plant diseases. Insects, especially leafhoppers, can spread these, so the appearance of phyllody in the garden often raises concerns about possible disease spread (Sim *et al.,* 2004). It is very difficult to determine if a plant was infected with phytoplasmas because of the necessity of an electron microscope. We suspect that phytoplasmas could be the reason. We speculated that the orchard might have been contaminated from a yet unidentified source last year. Phytoplasmas might have obstructed the evocation signal from the leaf by disrupting phloem flow to the floral meristem. In the absence of the stimulus, the meristem reverted back to vegetative state. Because it is well known that once floral induction has occurred, and the plant is committed to flowering, many physiological changes occur at the shoot apical meristem to prepare it for the developmental transition it must undergo. Without these physiological changes, the floral transition will not usually occur successfully (Glover, 2007).

We have not yet specifically determined the exact reason for it but studies have been underway. When sweet cherry phyllody is due to genetic and environmental factors, the flower abnormality is limited to the blossoms and normal flowers appear at the other years. When phyllody in sweet cherry is due to phytoplasmas, infection is unlimited to the blossoms and a serious disease. Future research on the causes of phyllody in sweet cherry should be examined.

Fig.1. Progressive phyllody formation in sweet cherry floral buds

Fig.2. Close-up view of abnormal flower buds under microscope in which all floral organs are replaced by leaf-like appendages.

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