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Original Research Article

Phenological Stages of Medlar (*Mespilus germanica* L. 'İstanbul') according to the BBCH Scale

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ABSTRACT

The BBCH scales are wellknown in phenology studies and practical for the communication between different scientific disciplines. In this study, extended BBCH scale was used to describe the phenological growth stages of 'İstanbul' medlar variety. The BBCH scale for medlar can be used widely by researchers as well as agrochemical companies. This is the first study on analysis of medlar phenological development using BBCH scale.

Key Words: Anatolia, deciduous, chemical industry, phenology, pome fruit

BBCH Skalasına Göre Muşmulanın (*Mespilus germanica* L. 'ISTANBUL') Fenolojik Aşamaları

ÖZET

BBCH skalaları, fenoloji çalışmalarında yaygın olarak kullanılmakta ve farklı bilimsel disiplinler arasındaki iletişimi kolaylaştırmaktadırlar. Bu çalışmada, 'İstanbul' muşmula çeşidinin fenolojik büyüme aşamalarının tanımlanmasında genişletilmiş BBCH skalası kullanılmıştır. Muşmula için oluşturulmuş BBCH skalası, araştırıcıların yanı sıra agrokimyasal şirketler tarafından da geniş ölçüde kullanılabilir. Bu, muşmulanın fenolojik gelişiminin analizinde BBCH skalasının kullanıldığı ilk çalışmadır.

Anahtar kelimeler: Anadolu, kışın yaprağını döken, kimya endüstrisi, fenoloji, yumuşak çekirdekli meyve

INTRODUCTION

Medlar (*Mespilus germanica* L.) has been cultivated for over thousands of years in temperate zones of Anatolia. The medlar (called as 'Muşmula' or 'Beşbıyık' or 'Döngel', in Turkish) is botanically classified as a pome and produces edible fruits. Medlars have a wide variety of uses for humans, although being less frequently consumed compared to other related genera such as *Malus* (apple) and *Pyrus* (pear) (Phipps 2003). Medlar tree is also used for ornamental and medicinal purposes. 'İstanbul' medlar variety fruits have a rather high total antioxidant capacity (1.1mmol trolox equiv./L.) and they also contain some fatty acids such as palmitic acid, stearic acid, oleic acid and linoleic acid (Canbay *et al.* 2011).

Medlars are deciduous large shrubs to small trees. Flowers are large and white. Fruits ripen in late summer and are light brown in colour. The native forms of medlar in Turkey, exist in open forests, on rocks and in macchie, and they are also widely cultivated (Davis 1972).

The characterisation of phenological stages is essential to achieve high fruit quality and fruit weight, since a number of management practices (pruning, application of bioregulators, fertilisers, thinning, diagnosis of physiological disorders, weed control, harvest, pest control etc.) rely on the recognition of certain phenological stages (Salazar *et al.* 2006; Salinero *et al.* 2009). The abbreviation BBCH derives from **B**iologische Bundesanstalt, **B**undessortenamt and **CH**emical industry and this scale is a system for uniform coding and description of phenologically similar growth stages of plant species (Meier *et al.* 2009). The BBCH scale has been employed for some fruit species such as apple, pear, quince, cherry, plum, peach, apricot, guava, mango, kiwifruit (Martinez-Valero *et al.* 2001; Perez-Pastor *et al.* 2004; Salazar *et al.* 2006; Meier *et al.* 2009; Salinero *et al.* 2009; Hernandez Delgado *et al.* 2011), yet this scale has not been employed for medlar. The objective of this study was to describe the phenological growth stages of 'İstanbul' medlar variety based on BBCH scale.

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'İstanbul' is the only local medlar variety registered to Variety Registration and Seed Certification Center (TTSM) of Turkey. TTSM is a member of The International Union for the Protection of New Varieties of Plants (UPOV).

MATERIALS AND METHODS

Phenological stages of 'İstanbul' medlar variety were described and defined according to the extended BBCH scale (Meier *et al.* 1994). The experiment was conducted during four growth seasons (2007-2010) in a mature orchard in full production (average annual harvest of 10-14 t/ha), located in Boğazova valley, Isparta, Turkey (latitude 37^{o} 49' N and longitude 30^{o} 52'). In this region, winters are cold and rainy, and summers are hot and dry. Orchard soils were clay-loam textured, with 7.9-8.2 pH, 2.5-3.5 % organic matter content, and 0.15-0.17 mS cm^{-1} salinity. *Mespilus germanica* L. trees were used in the study. They were grafted onto quince A (QA) rootstock and trained according to central leader system. There was not any medlar variety to be used as pollinator for 'İstanbul' in the orchard. The trees were fertilized with mineral nutrients together with drip irrigation water at regular intervals in the vegetation period as required. Twenty trees were appointed in the orchard for the study and periodical visits were made to the orchard.

RESULTS

The extended BBCH scale uses 10 principal stages numbered from 0-9, divided each one in 10 secondary (0-9) growth stages (Hernandez Delgado *et al.* 2011). Fig. 1 shows the different phenological stages as well as the phenological codes.

Principal growth stage 0: Sprouting/bud development

00 Dormancy: leaf buds and the thicker inflorescence buds closed and covered by dark brown scales (Figure 1).
01 Beginning of leaf bud swelling: buds visibly swollen, bud scales elongated, with light coloured patches (Figure 1).
03 End of leaf bud swelling: bud scales light coloured with some parts densely covered by hairs
07 Beginning of bud break: first green leaf tips just visible (Figure 1).
09 Green leaf tips about 5 mm above bud scales

Principal growth stage 1: Leaf development

10 Mouse-ear stage: Green leaf tips 10 mm above the bud scales; first leaves separating
11 First leaves unfolded (others still unfolding) (Figure 1).
15 More leaves unfolded, not yet at full size
19 First leaves fully expanded

Principal growth stage 3: Shoot development

31 Beginning of shoot growth: axes of developing shoots visible
32 Shoots about 20% of final length
33 Shoots about 30% of final length
39 Shoots about 90% of final length

Principal growth stage 5: Inflorescence emergence

51 Inflorescence buds swelling: bud scales elongated, with light coloured patches
52 End of bud swelling: light coloured bud scales visible with parts densely covered by hairs
53 Bud burst: green leaf tips enclosing flowers visible
54 Mouse-ear stage: green leaf tips 10 mm above bud scales; first leaves separating
55 Flower buds visible (still closed)

56 Green bud stage: single flowers separating (still closed)
57 Pink bud stage: flower petals elongating; sepals slightly open; petals just visible
59 Most flowers with petals forming a hollow ball

Principal growth stage 6: Flowering
60 First flowers open (Figure 1).
61 Beginning of flowering: about 10% of flowers open
62 About 20% of flowers open
63 About 30% of flowers open
64 About 40% of flowers open
65 Full flowering: at least 50% of flowers open, first petals falling (Figure 1).
67 Flowers fading: majority of petals fallen (Figure 1).
69 End of flowering: all petals fallen

Principal growth stage 7: Fruit development
71 Fruit size up to 10 mm; fruit fall after flowering (Figure 1).
72 Fruit size up to 20 mm
73 Second fruit fall
74 Fruit diameter up to 40 mm; fruit erect (T-stage: underside of fruit and stalk forming a T)
75 Fruit about 50% of final size (Figure 1).
76 Fruit about 60% of final size
77 Fruit about 70% of final size
78 Fruit about 80% of final size (Figure 1).
79 Fruit about 90% of final size

Principal growth stage 8: Maturity of fruit
81 Beginning of ripening: first appearance of cultivar-specific colour
85 Advanced ripening: increase in intensity of cultivar-specific colour (Figure 1).
87 Fruit ripe for picking (Figure 1).
89 Fruit ripe for consumption: fruit have typical taste and firmness

Principal growth stage 9: Senescence. Beginning of dormancy
91 Shoot growth completed; terminal bud developed; foliage still fully green
92 Leaves begin to discolour (Figure 1).
93 Beginning of leaf fall
95 50% of leaves discoloured (Figure 1).
97 All leaves fallen (Figure 1).
99 Harvested product

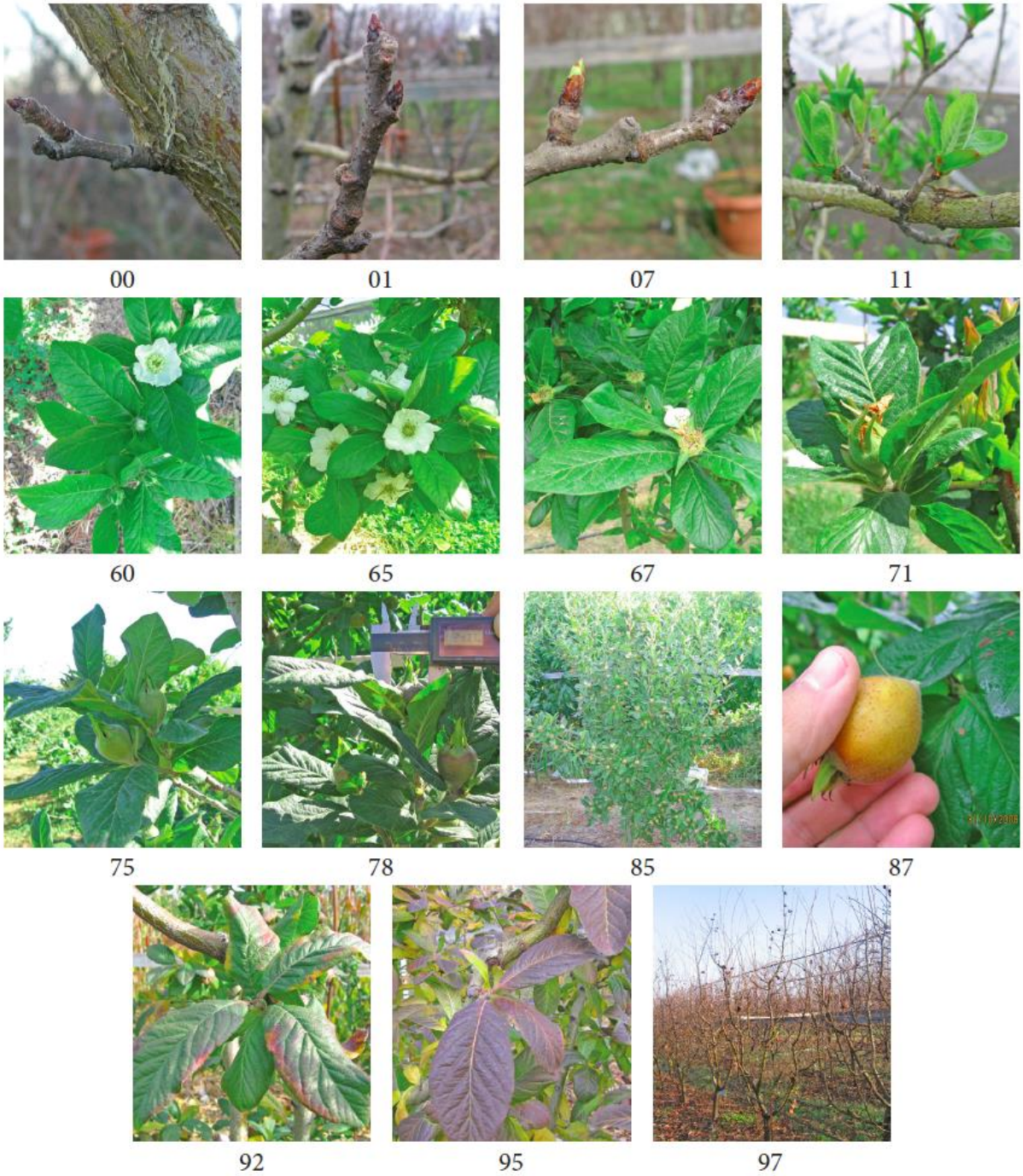

Figure 1. Some of the primary and secondary phenological growth stages of 'İstanbul' medlar variety according to BBCH scale.

DISCUSSION

The use of extended BBCH scale for medlar is important for successful implementation of orchard management practices including disease and pest control. Hence, the BBCH scale will be a useful source for medlar growers, agrochemical companies, researchers etc. The results of this study coincide with those obtained by Meier *et al.* (1994) for pome fruit (apple and pear trees). Medlar phenological development is described here for the first time using BBCH scale.

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