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## Morphology of Dormant Twigs of Some Trees and Shrubs of Quetta Valley

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**Abstract:** Morphology of dormant twigs of species belonging to 8 families were comparatively studied with regard to their nodal and inter-nodal characters and a key was constructed for their identification in leafless stage. This key will be useful to foresters and horticulturists who use these twigs for propagation.

**Key words:** Morphology, dormant twigs, nodal, inter-nodal, foresters, horticulturists, propagation

### Introduction

The fall season in Quetta starts in October when leaves start losing their green colour. They first become yellow and then orange. Leaves finally abscise, giving a denuded look to the plantation in December. For the identification of plant a twig must have leaves, flowers/fruits, etc. but in leafless dormant condition, when the required structures are not present, it is very difficult to identify plants even for an accomplished taxonomist. The leafless twig however, is particularly important for foresters and horticulturists who use them for propagation. The compatibility of cultivars or stocks is the limitation for successful propagation by grafting. Generally, similar or related types of plants can inter graft. Most of the Pome fruits like apples, pears etc. and stone fruits like peach, plum, cherry, apricot can be propagated by inter-grafting (Hartman and Kester, 1975). Akiyama (1990) have reported the morphological and taxonomic significance of dormant branch primordial and dormant buds for horticulturists. Jules (1979) used the characters of twigs such as floral buds, leaf scar and lenticels for their identification. A lot of work have been reported by different workers on the morphology of twigs such as seasonal effect (Vincent *et al.*, 1994), effects of soils and management practices (Powel and lowry, 1980), twig diameter length-weight relationship (Ferguson and Marsden, 1977; Basile and Hutchings, 1960; Peck *et al.*, 1971; Provenza and lowry, 1981; Halls and Harlow, 1971) and twig morphology in relation to process of growth (Harlow, 2002). Although keys have been prepared for the identification of twigs having vegetative or reproductive structures by Haines and Vining (1998), Gleason and Cronquist (1991), Symonds (1963) and Harlow (1959) but only very little work has been done on twigs in dormant condition by Rosaryo (1954), Jules (1979) and Campbell *et al.* (1978). Through personal communication with the Forest and Agriculture Departments, it was found that system of identification of dormant twigs has not yet been developed by these departments. Scanning through annotated catalogue of vascular plants of west Pakistan

and Kashmir (Stewart, 1972), forest flora of Punjab with Hazara and Delhi (Parker, 1965). A working list of the flowering plants of Balochistan (Burkill, 1969) and other available literature also revealed that this aspect although very important has been completely ignored in Pakistan. It was, therefore, considered necessary to first study the morphology of defoliated twigs of plants growing in Quetta valley and develop a system for their quick identification.

As a preliminary study, twigs of 16 species were collected. A detailed work will later on be undertaken to develop more comprehensive key for the identification of all deciduous trees and shrubs of Balochistan.

### Materials and Methods

Dormant twigs of 16 deciduous trees and shrubs, belonging to 8 families (Anacardiaceae, Caesalpiniaceae, Moraceae, Papilionaceae, Rosaceae, Salicaceae, Tamaricaceae and Verbenaceae) were collected randomly from different sites in and around, Quetta valley (Table 1) during Dec. 2000 to Jan. 2001.

Table 1: Locality, date of sampling and number of samples collected for twig morphology

Locality	Date of Sampling	No. of Twigs of each Species Collected
Quetta city and surroundings	Dec. 10, 2000	15
Quetta city and surroundings	Jan. 12, 2001	15
DFDC* Quetta	Dec. 15, 2000	15
DFDC* Quetta	Jan. 15, 2001	15
Sariab	Dec. 15, 2000	15
Sariab	Jan. 20, 2001	18
Mastung	Dec. 20, 2000	15
Mastung	Jan. 15, 2001	15
Kuchlak	Dec. 25, 2000	20
Kuchlak	Jan. 24, 2001	20

\* Deciduous Fruit Development Centre, Quetta

Each species was represented by 75 twigs, 15 from each site and saved in nylon bags for study. Since the apical portion of the twigs represented the current year's uniform growth. It is therefore, only apical 15 cm length were used for comparative morphological study.

The parameters used for analysis were divided into three categories as follows:

**Twigs as whole:**

- a. Colour was identified by comparison with standard colour charts.
- b. Armor: The presence or absence of spines, thorn or prickles on the surface.

**Nodal morphology:**

- a. Number of nodes in each twig.
- b. Number of buds at each node.
- c. Size (mean± SD) and shape of buds.
- d. Phyllotaxy, represented by the arrangement of buds and leaf scars.
- e. Visual characters of leaf scar, such as shape and vascular bundle character.

**Inter-nodal morphology:**

- a. Average length of inter-nodes in 15 cm long dormant twigs.
- b. Surface characters of inter-nodes e.g., Hairiness, smoothness and shine.
- c. Shape and size of lenticels.

The large structures were measured by transparent plastic ruler, whereas small structures like lenticels and buds by an ocular micrometer stereoscopically. The sketches were made accordingly.

**Results and Discussion**

The findings were summarized in Fig. 1 to 16 under the headings with diagnostic characters of dormant twigs. A key for identification of these twigs is given in Table 2.

**Diagnostic characters of Dormant Twigs**

**Annacardiaceae**

***Pistacia vera*:** Twigs mushroom coloured, surface rough. One bud node<sup>-1</sup> alternately arranged up to 4.0±0.27 mm long, conical with four visible bracts (Fig. 1). Leaf scar crescent shaped with 10 vascular bundles. Lenticels lens shaped, 1 mm long, number of nodes 14, with an average inter-nodal length of 10 mm (5 to 32 mm).

**Caesalpinaceae**

***Bauhinia retusa*:** Twigs red oxide coloured rough. One bud node<sup>-1</sup>, alternately arranged up to 10.0±2.00 mm,

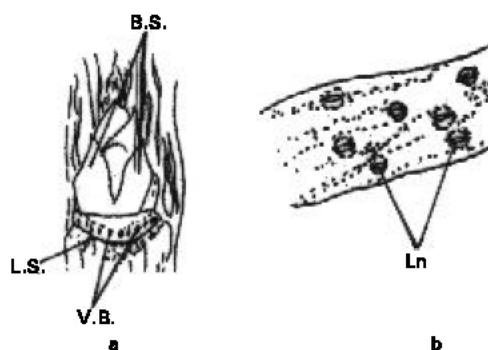


Fig. 1: Morphology of *Pistacia vera* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

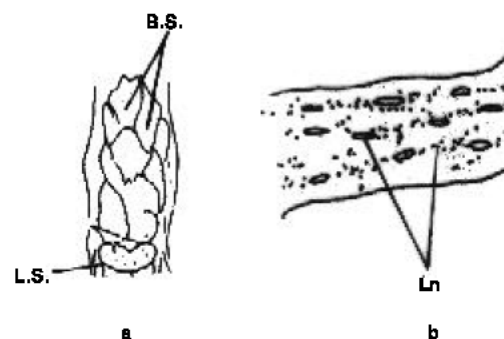


Fig. 2: Morphology of *Bauhinia retusa* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

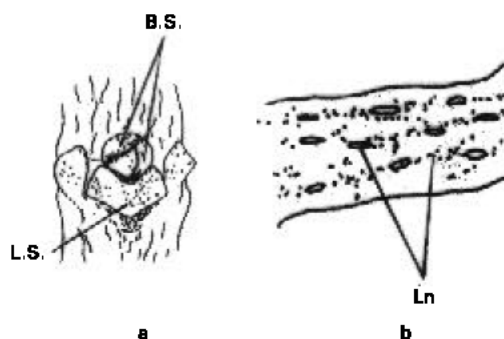


Fig. 3: Morphology of *Ceasalpinia pulcherrima* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

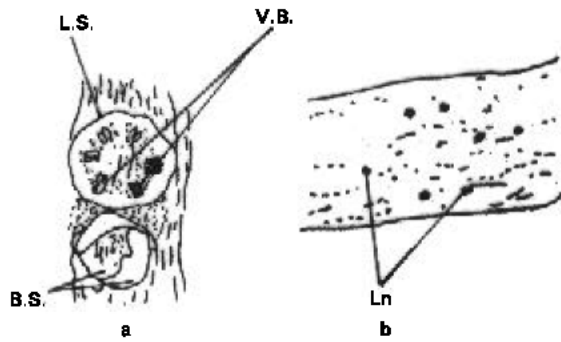


Fig. 4: Morphology of *Ficus palmata* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

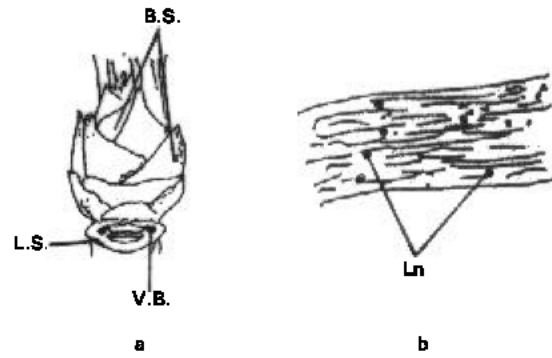


Fig. 7: Morphology of *Prunus amygdalus* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

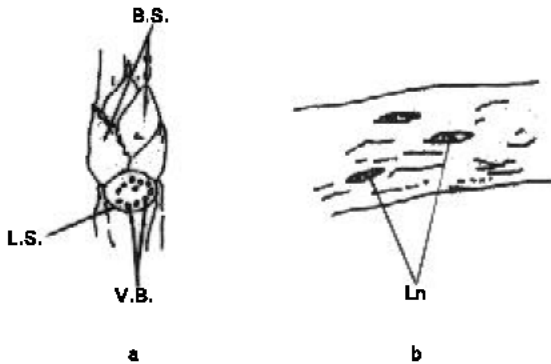


Fig. 5: Morphology of *Morus alba* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

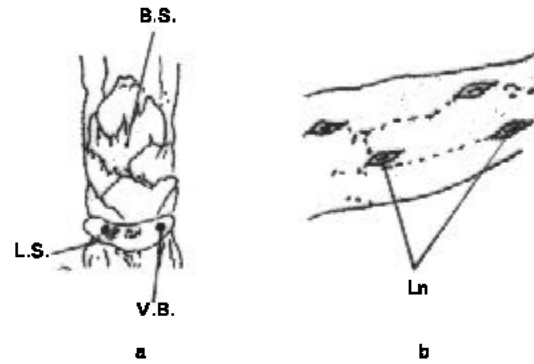


Fig. 8: Morphology of *Prunus avium* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

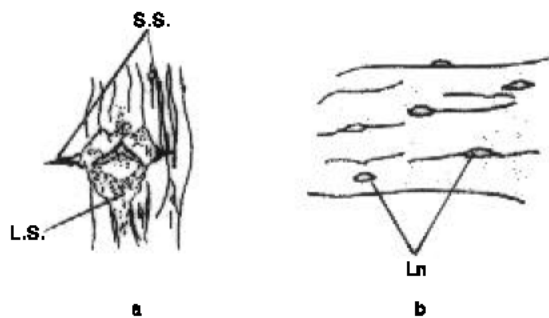


Fig. 6: Morphology of *Robinia pseudo-acacia* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Stipular Spines "S.S.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

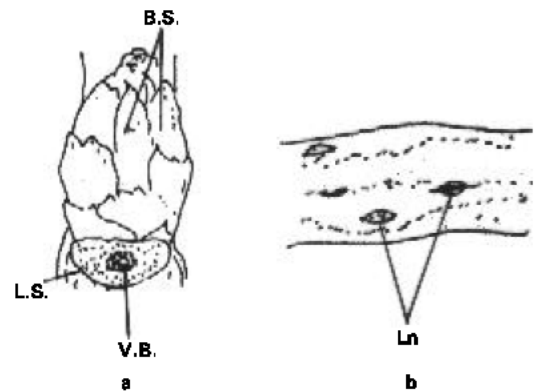


Fig. 9: Morphology of *Prunus cerasus* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

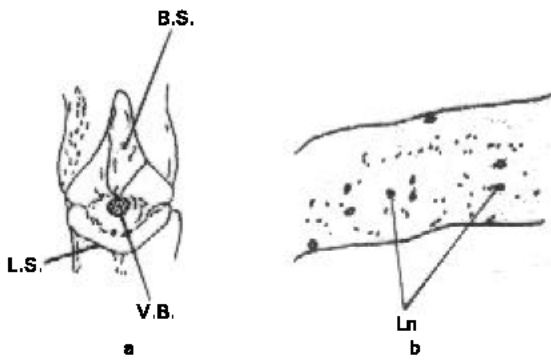


Fig. 10: Morphology of *Prunus domestica* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

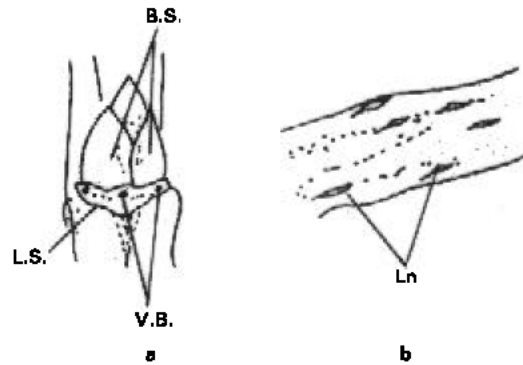


Fig. 13: Morphology of *Pyrus malus* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

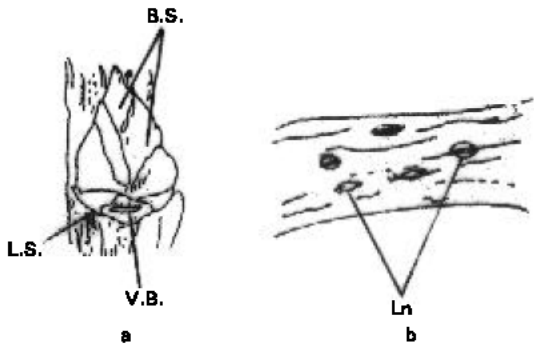


Fig. 11: Morphology of *Prunus mahaleb* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

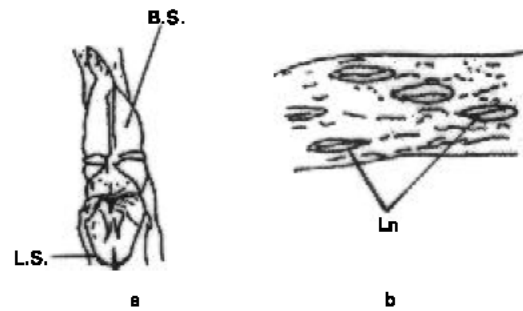


Fig. 14: Morphology of *Populus alba* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

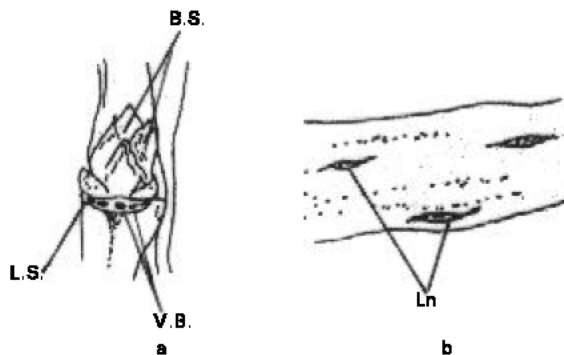


Fig. 12: Morphology of *Pyrus communis* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

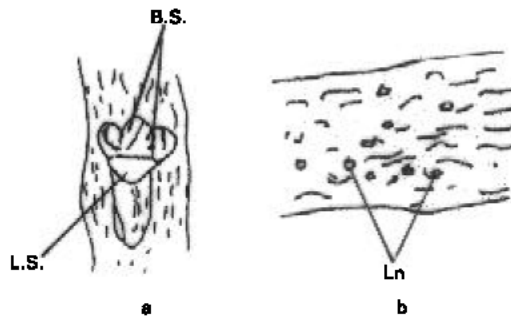


Fig. 15: Morphology of *Tamarix galica* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

Table 2: Identification key for leaf less twigs of the trees and shrubs of Quetta valley

1.	+	Twigs with spines		4.1 <i>Robinia pseudo-acacia</i>
	-	Twigs without spines	2	
2.	+	3 buds at each node		7.1 <i>Tamarix galica</i>
	-	bud at each node	3	
3.	+	Twigs of dark coloured	4	
	-	Twigs of light coloured	13	
4.	+	Twigs of coffee colour	5	
	-	Twigs of other colours	8	
5.	+	Leaf scar bundles 3-4	6	
	-	Leaf scar bundles 6-10	7	
6.	+	Nodes 10, leaf scar bundles 3		5.7 <i>Pyrus malus</i>
	-	Nodes 8, leaf scar bundles 4		3.1 <i>Ficus palmata</i>
7.	+	Buds flask shaped up to 15 mm long, leaf scar bundles 6		6.1 <i>Populus alba</i>
	-	Buds oval shaped up to 3 mm long, leaf scar bundles 12		3.2 <i>Morus alba</i>
8.	+	No. of nodes 11-18	9	
	-	No. of nodes 5-7	11	
9.	+	No. of nodes 11, leaf scar bundles 5		5.6 <i>Pyrus communis</i>
	-	No. of nodes 18	10	
10.	+	Buds oval shape with 2 visible bracts		8.1 <i>Duranta repens</i>
	-	Buds flask shape with 4 visible bracts		5.4 <i>Prunus domestica</i>
11.	+	No. of nodes 5		2.1 <i>Bauhinia retusa</i>
	-	No. of nodes 7	12	
12.	+	Buds up to 6 mm with 10 visible bracts		5.3 <i>Prunus cerasus</i>
	-	Buds up to 8 mm with 14 visible bracts		5.2 <i>Prunus avium</i>
13.	+	Twigs of mushroom colour	14	
	-	Twigs of other colours	15	
14.	+	Buds up to 4 mm long with 5 visible bracts, twigs surface smooth	5.5 <i>Prunus mahaleb</i>	
	-	Buds up to 4 mm long with 4 visible bracts, twigs surface rough		1.1 <i>Pistacia vera</i>
15.	+	Twigs of lime stone colour		5.1 <i>Prunus amygdalus</i>
	-	Twigs of pale cream colour		2.2 <i>Caesalpinia pulcherrima</i>

(A) 1 to 15 refer to number of dichotomy, (B) 1.1 to 8.1 are the cross reference to "Diagnostic characters of dormant twigs"

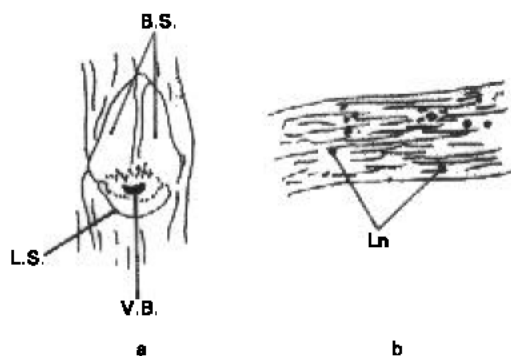


Fig. 16: Morphology of *Duranta repens* Twig  
 (a) Nodal Morphology: Bud and Leaf Scar Structure of Dormant twigs. (Bud Scales "B.S.", Leaf Scar "L.S.", Vascular bundles "V.B.")  
 (b) Inter-nodal Morphology: (Lenticels "Ln")

oval with 18 visible bracts (Fig. 2). Leaf scar bowl shaped lenticels up to 0.05 mm, lens shaped number of nodes 5 with an average inter-nodal length of 30 mm (22 to 44 mm).

**Caesalpinia pulcherrima:** Twigs pale cream coloured, rough. One bud node<sup>-1</sup>, alternately arranged, up to 2.0±0.30 mm, round number of bracts not distinguished (Fig. 3). Leaf scar circular shaped. Vascular bundles not clear. Lenticels up to 0.7 mm long, lens shaped, number of nodes 54, with an average inter-nodal length of 3 mm (1 to 5 mm).

#### Moraceae

**Ficus palmata:** Twigs coffee coloured, rough, one bud per node, alternately arranged up to 3.0±0.24 mm long, conical shape having 4 vascular bundles in a ring (Fig. 4). Lenticels up to 0.2 mm long, number of nodes 8 with an inter-nodal length of 25 mm (20 to 58 mm).

**Morus alba:** Twigs coffee coloured, smooth. One bud node<sup>-1</sup>, alternately arranged, up to 4.0±0.15 mm long, oval shaped with four visible bracts (Fig. 5). Leaf scar circular shaped, with 10 vascular bundles, arranged in a ring. Lenticels lens shaped, up to 0.8 mm. Number of nodes 7, with an average inter-nodal length of 20 mm (12 to 45 mm).

#### Papilionaceae

**Robinia pseudo-acacia:** Twigs mushroom coloured, smooth. One bud node<sup>-1</sup>, alternately arranged (Fig. 6). Up to 7.0±1.0 mm long. Leaf scar somewhat rhomboidal shaped, with strong stipular spines. Lenticels lens shaped up to 1 mm long, number of nodes 7, with an average inter-nodal length of 20 mm (12 to 45 mm).

#### Rosaceae

**Prunus amygdalus:** Twigs limestone coloured, smooth. One bud node<sup>-1</sup>, alternately arranged up to 7.0±1.12 mm (Fig. 7). Oval shaped with 15 visible bracts. Leaf scar bowl shaped with two visible vascular bundles. Lenticels up to 0.7 mm, circular shaped, number of nodes 11 with an average inter-nodal length of 14 mm (2 to 22 mm).

**Prunus avium:** Twigs chocolate coloured, smooth, shiny and waxy. One bud node<sup>-1</sup>, alternately arranged up to 8.0±0.80 mm. Oval shaped with 14 visible bracts (Fig. 8). Leaf scar crescent shaped with three visible vascular bundles. Lenticels up to 1.2 mm long, lens shaped, number of nodes 7 with an average inter-nodal length of 25 mm (4 to 35 mm).

**Prunus cerasus:** Twigs brick red coloured, smooth, shiny and waxy. One bud node<sup>-1</sup>, alternately arranged up to 6.0±0.84 mm long. Oval shaped with 10 visible bracts (Fig. 9). Leaf scar boat shaped, number of nodes was 7 with an average inter-nodal length of 25 mm (11 to 45 mm).

**Prunus domestica:** Twigs red-oxide coloured, smooth shiny. One bud node<sup>-1</sup> alternately arranged, up to 2.0±0.05 mm. Flask shaped with 4 visible bracts (Fig. 10). Leaf scar bowl shaped, with one strong vascular bundle. Lenticels up to 0.5 mm long, lens shaped, number of nodes 18 with an average inter-nodal length of 8 mm (3 to 21 mm).

**Prunus mahaleb:** Twigs mushroom coloured, smooth, waxy. One bud node<sup>-1</sup>, alternately arranged up to 2.0±0.08 mm. Conical shaped with 5 visible bracts (Fig.11). Leaf scar crescent shaped with one strong vascular bundle. Lenticels up to 0.6 mm long, lens shaped, number of nodes 13 with an average length of 12 mm (4 to 20 mm).

**Pyrus communis:** Twigs battleship grey coloured, smooth, shiny. One bud node<sup>-1</sup> alternately arranged up to 4.0±0.32 mm. Conical shaped with three visible bracts (Fig. 12). Leaf scar crescent shaped with 5 vascular bundles. Lenticels up to 1 mm long, lens shaped, number of nodes 11 with an average inter-nodal length of 14 mm (5 to 32 mm).

**Pyrus malus:** Twigs coffee coloured, smooth, shiny. One bud node<sup>-1</sup>, alternately arranged up to 4.0±0.22 mm, conical shaped, with three visible bracts (Fig. 13). Leaf scar crescent shaped with three visible vascular bundles. Lenticels up to 1.4 mm long, lens shaped, number of nodes 10 with an average inter-nodal length of 15 mm (5 to 38 mm).

#### Salicaceae

**Populus alba:** Twigs coffee coloured, smooth, shiny and waxy. One bud node<sup>-1</sup> alternately arranged up to 15.0±1.65 mm long, flask shaped with two visible bracts (Fig. 14). Leaf scar horse shoe shaped with 6 visible vascular bundles. Lenticels up to 0.4 mm, lens shaped, number of nodes 7 with an inter-nodal length of 25 mm (2 to 49 mm).

#### Tamaricaceae

**Tamarix galica:** Twigs coffee coloured, smooth, shiny and waxy. Three buds node<sup>-1</sup>, at one side, alternately arranged, up to 1.0±0.01 mm long, oval with two visible bracts (Fig. 15). Leaf scar bowl shaped, with no recognizable vascular bundles. Lenticels up to 0.2 mm circular shaped, number of nodes 86 with an average inter-nodal length of 1.5 mm (1 to 5 mm).

#### Verbenaceae

**Duranta repens:** Twigs brick red coloured, smooth. One bud node<sup>-1</sup> oppositely arranged up to 3.0±0.02 mm oval with 2 visible bracts (Fig. 16). Leaf scar bowl shaped with one visible strong vascular bundle. Lenticels upto 1 mm, Circular shaped, number of nodes 18 with an average inter-nodal length of 8 mm (1 to 23 mm).

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