PHENOLOGICAL STAGES OF *SPIRAEA X VANHOUTTEI* ACCORDING TO BBCH CODE

STADIILE FENOLOGICE ALE SPECIEI *SPIRAEA X VANHOUTTEI* CONFORM CODULUI BBCH

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Abstract. *Phenological observations of deciduous shrubs with ornamental role in urban spaces could provide a better understanding of stress condition that affect plant growth. Researchers, especially in Europe, are suggesting that using a common language as BBCH code can be helpful when describing, collecting and sharing phenological data. Using BBCH code to describe the seasonal development of ornamental plants can be an instrument in understanding the way that plants can be affected by the environment .It also could provide information that can be employed to improve the management and maintenance of urban green spaces due to the extensive data that can be collected around the world, especially in Europe, using the same way to codify phenological information. An application of the BBCH code is the description of phenological stages of Spiraea x vanhouttei.*
Key words: *phenology, BBCH code, Spiraea x vanhouttei*

Rezumat. *Observațiile fenologice efectuate asupra arbuştilor foioşi cu rol decorativ în spațiile urbane pot furniza informații care să ajute la o mai bună înțelegere a condițiilor de stres care afectează creşterea plantelor. Cercetătorii, mai ales în Europa, propun utilizarea unui sistem comun de codificare a informațiilor fenologice cum este codul BBCH. Utilizarea acestui cod poate fi un instrument util în înțelegerea modului în care mediul afectează dezvoltarea plantelor şi poate furniza informații car pot fi utilizate la întreținerea şi managementul spațiilor verzi datorită numeroaselor date care pot fi adunate din întreaga lume utilizând acest limbaj comun. Stabilirea stadiilor fenologice ale speciei Spiraea x vanhouttei constituie o exemplificare a modului de aplicare a acestui cod.*
Cuvinte cheie: *fenologie, codul BBCH, Spiraea x vanhouttei*

INTRODUCTION

Data about plant development cycles and the relations between vegetation and the environment has been recorded since the Antiquity even though there was no systematic data collection (Schwartz, 2003). Once the data collection of phenological observations expanded on global scale and recording became continuous, by the mid of XX century, phenology has transformed from a discipline which had applications almost exclusively in the agricultural field to one which has an interdisciplinary character, the book „*Phenology. An Integrative environmental science*" edited by M.D. Schwartz supporting this.

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During the last decades, even if there is a strong evidence of agricultural application research predominance (Chmielewski, 2003), due to the obvious relationship between plant development and environment the observation of plant species which have certain peculiarity which makes them appropriate for use as environmental markers (spontaneous flora plants that can become guide species in phenological development for other more important agricultural plants) which are cultivated and observed in the so called Phenological Gardens (Mandrioli, 1993). Meanwhile the observations of vegetation in the urban environment have been focused more on the effects of urbanization over phenological development stages such as flowering, because it is generally considered that climate conditions of urban environment are similar to changing global climate conditions (Kaesha and Jianguo, 2006).

Phenological applications on the field of environmental sciences become more important as time goes by and national and international phenological networks have appeared and developed. The aim of these networks is to provide, by analyzing phenological data, information about global climate change that are ongoing in the last fifty years (Dal Monte, 2007). The creation of phenological databases and their development has generated the need of a common language, a method for coding phenological observations that allows data collection, archiving and analysis can be applied to any plant by anyone. Scientists developed a uniform coding system of similar phenological growth stages, named BBCH - **B**iologishe **B**undesanstalt, **B**undessortenamt and **Ch**emical industry. Following other methods of codifying phenological data such as Flekinger's code for pome fruit or Zadoks's code for cereals, BBCH code was created on the purpose of describing any mono- and dicotyledonous plant development during the crop year (Meier et. al., 2009).

MATERIAL AND METHODS

Spiraea x vanhouttei is a common species very much used on green spaces design in Cluj-Napoca city (Constantinescu and Szilagyi, 2002) especially in the form of hedges and less as isolated shrubs. Observations were conducted during four years especially in spring and summer. The phenological development of ornamental shrubs located on green urban spaces, placed along the east-west city axis, situated in urban climate, more precisely the microclimate of west, central and east quarters (Moldovan and Fodorean, 2002) was monitored.

BBCH is a decimal code which divides the plant development in principal growing stages (using numbers from 0 to 9) that indicate clearly recognizable, long lasting development phases like leaf development, flowering or fruit development and secondary development stages (also codified using numbers from 0 to 9) which indicate a precise moment during the plant evolution within the main development stage. The numbers in the secondary development stage correspond to the respective ordinal numbers or percentage values (e.g. 2 can represent 2nd true leaf or 2nd node or 20% of the flowers open or 20% of the final size typical of the species) (Hack et al., 1992).

The adaptability of this code to various species is exemplified by the many papers in the scientific literature like those that can be found in the "*Growth stages of mono- and dicotyledonous plants – BBCH Monograph"* (ed. Meier, 2001). One of the most important example for this research is the adaptation of BBCH code for the woody vegetation (Finn et

al., 2007). The codification proposed by Finn *et al*. emphasises those growing stages that are typical for the morphology and biology of woody plants like shoot development and fruits and discards stages like formation of side shoots or development of harvestable vegetative plant parts or vegetatively propagated organs.

This study proposes an adaption of the method used by Saskia and Kuzovina for the species of *Salix* genus (Saska and Kuzovina, 2010) which describes more accurately and detailed the phase of flower development and renounce to the description of stages referring of fruit development and ripening because *Spiraea x vanhouttei* fructification isn't important for ornamental purposes.

RESULTS AND DISCUSSION

The paper aims to present the phenological development of a very common species used in landscape design in Romania based on the BBCH code. Following other examples found in the scientific literature, this study tries to adapt the code to the peculiarities of *Spiraea x vanhouttei*.

Phenological stages of *Spiraea x vanhouttei* according to the BBCH code are presented as follows. Usually they are accompanied by images which illustrates the most important stages (figure 2).

Principal growth stage 0: Bud development
00 Dormancy: buds covered with scales
01 Buds begin to swell and change colour
05 Buds break, scales are open
09 Green tips can be observed

Principal growth stage 1: Leaf development
10 Leaves are completely green, still attached one to another
11 First leaves are completely separated
13 More leaves are separated
15 Majority of leaves are completely separated without reaching their final size, shoot emergence
19 Leaves get the typical variety size and shape

Principal growth stage 3: Stem elongation
30 Stem elongation visible
31 Stem about 10% of final length
35 Stem about 50% of final length
39 Stem about 90% of final length. Stem growth ends

Principal growth stage 5: Inflorescence emergence
50 Inflorescence buds can be observed
51 Inflorescence take shape
53 Inflorescence growth
55 Floral cluster growth
57 Floral buds become white
59 Floral buds are white and still closed

Principal growth stage 6: Flowering
60 First flowers open
61 Beginning of flowering: 10% of flowers open
65 Full flowering: at least 50% of flowers are opened, first flowers begin to fade
67 Majority of flowers have faded
69 End of flowering: All flowers have faded or have fallen
Principal growth stage 9: Senescence
90 Stem growth completed; foliage still green and buds developed
91 Beginning of leaf discoloration
93 Beginning of leaf fall
99 End of leaf fall

Because the aspects regarding flowering are considered very important for *Spiraea x vanhouttei* species, detailing the stages of inflorescence formation and development was considered more important than a percentage evaluation of inflorescence growth. Because fruits are insignificant describing principal growth, stages 7 and 8 (fruit development and ripening) was dropped out. The 2nd (formation of side shoots) and 4th principal growth stages (booting / development of harvestable vegetative plant parts or vegetatively propagated organs) have been discarded also.

Difficulties in evaluation of principal growth stage number 3 appeared because observations conducted *in situ* were affected by the frequent and inopportune cuttings on hedges.

During summer time, more exactly at the beginning of summer, buds were emerging at the leaves axil. At the end of the season they measured 1-1,5 mm. Branch development took place while inflorescence was emerging and continued during the mid summer.

Describing with accuracy the phenological development of *Spiraea x vanhouttei* is useful when the management plan for intervention on hedges is made. An association between 3rd and 5th principal growth stages and aphids apparition was observed. That drives people to wrongfully take action by cutting hedges before flowering which deprives the users of one of the most aesthetic characteristic of the species - the arching branches full of white flowers (fig. 1).

Fig. 1 - *Spiraea x vanhouttei* hedges (photo by Raluca Toma, 2014)

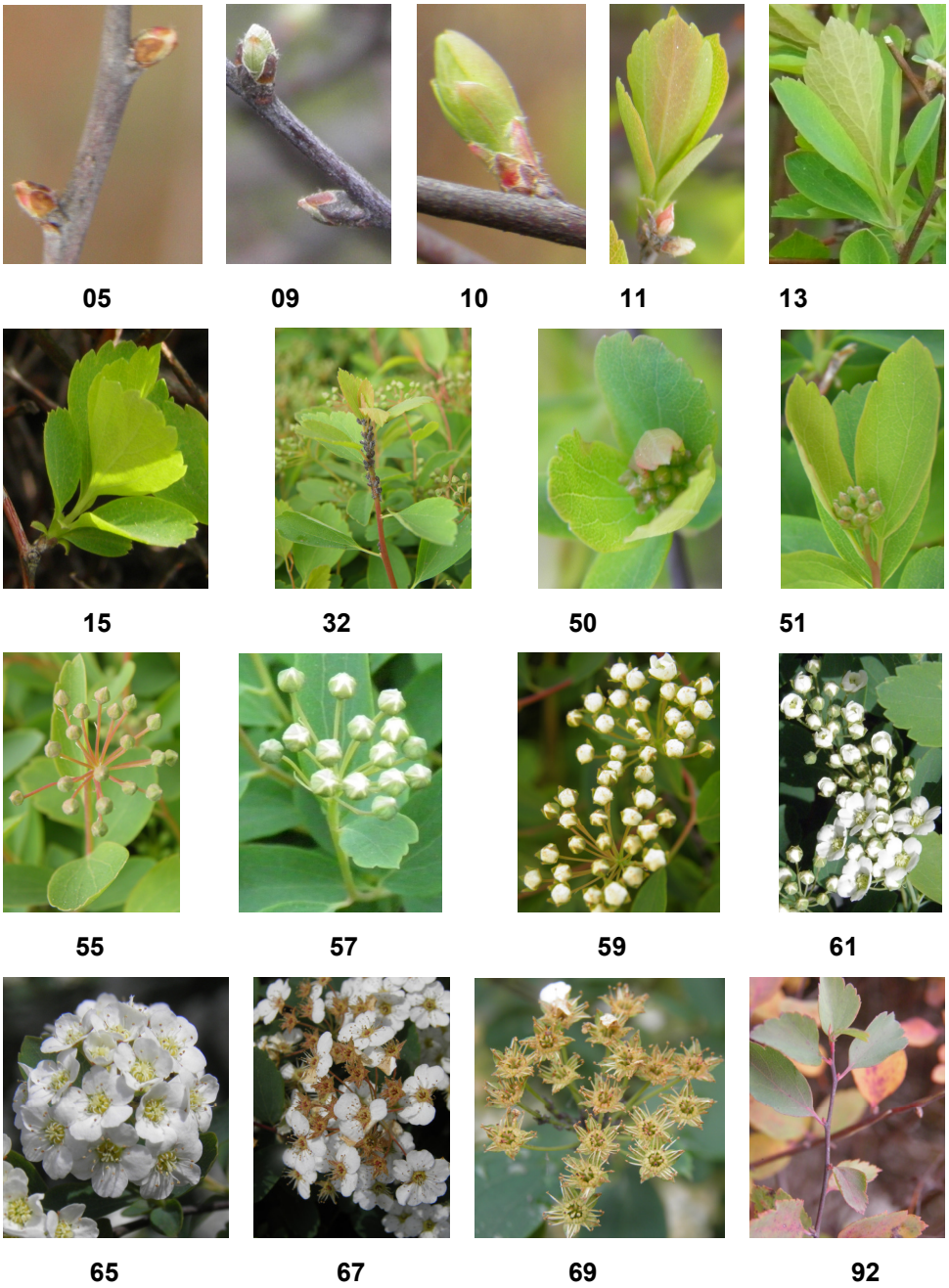

Fig. 2 - Phenological stages of *Spiraea x vanhouttei* (photo by Raluca Toma, 2014)

CONCLUSIONS

Studying the phenology of ornamental vegetation in urban environment is necessary because the interventions for maintaining a certain aesthetic level of green spaces implies substantial costs for the community due to the fact that landscape and economic value of ornamental vegetation is the result of aesthetic characteristics.

1. Emphasizing the aesthetic qualities of deciduous ornamental woody plants cannot be done without an attentive study of their development during the seasons.

2. Establishing the key moments in phonological development of ornamental plants can improve the efficacy of works necessary for maintaining a high level of aesthetic qualities necessary for the vegetation to be perceived as an ornamental element in the urban landscape.

3. Observing phenological development can help to identify and understand the relations between urban environment and vegetation that affect plant development.

REFERRENCES

1. **Dal Monte G., 2007 –** *An international outlook on phenology.* Journal of Agromereorology, xx xxx (3), pp. 52-58.
2. **Chmielewski F.M., - 2003** – *Phenology and agriculture. Phenology. An integrative environmental science,* Kluwer Academic Publishers, Dordrecht, pp.505-522
3. **Constantinescu M., Szilagyi Camelia, 2002 –** *Spațiile verzi.* Municipiul Cluj-Napoca şi zona periurbană. Studii ambientale. Ed. Accent, Cluj-Napoca pp. 157-166.
4. **Finn G.A., Straszewski A.E., Peterson V., 2007 –** *A general growth stage key for describing trees and woody plants.* Annals of Applied Biology, 151, pp. 127-131.
5. **Hack H. et al. - 1992 –** *The extended BBCH - scale.* În Growth stages of mono- and dicotyledonous plants – BBCH Monograph, pp. 6–12
6. **Kaesha N., Jianguo Wu, 2006 –** *Effects of urbanization on plant flowering phenology. A review.* Urban Ecosystems, 9 (3), pp. 243–257
7. **Mandrioli P., 1993 –** *Una Rete di Giardini Fenologici in Italia: Finalità e criteri*. În Guida al rilevamento dei Giardini Fenologici Italiani. M.I.P.A. Progetto finalizzato "Phenagri: Fenologia per l'Agricoltura", sottoprogetto 2: "Fenologia delle piante arboree, ricerca 2.3: Studio dello sviluppo fenologico di specie guida nei giardini fenologici. Coordinatore generale dott. A. Brunetti, pp. 1-5.
8. **Meier U., Bleiholder H., Buhr Liselotte, Feller Carmen, Hack H., Heß M., Lancashire P.D., Schnock Uta, Stauß R., van den Boom T., Weber Elfriede, Zwerger P., 2009 –** *The BBCH system to coding the phenological growth stages of plants – history and publications.* Journal für Kulturpflanzen, 61(2), pp. 41-52.
9. **Moldovan F., Fodorean I., 2002 –** *Caracterizare climatică.* Municipiul Cluj-Napoca şi zona periurbană. Studii ambientale. Ed. Accent, Cluj-Napoca pp. 49-66.
10. **Saska Margaret. M., Kuzovina Yulia A., 2010 –** *Phenological stages of willow (Salix).* Annals of Applied Biology, 156, pp. 431-437.
11. *****, Schwarz M.D. (ed.), 2003** – *Phenology. An integrative environmental science.* Kluwer Academic Publishers, Dordrecht.
12. *****, Meier U. (ed.), 2001** – *Growth stages of mono- and dicotyledonous plants – BBCH Monograph.* http://www.bba.de/veroeff/bbch/bbcheng.pdf.