Modern Phytomorphology **8**: 55–60, 2015

THE ANNUAL BIOLOGICAL CYCLES OF *TEUCRIUM POLIUM* L. AND *THYMUS SIBTHORPII* BENTHAM (LAMIACEAE)

Artemios M. Bosabalidis

Abstract. *Teucrium polium* appears in winter as a cluster of short shoots with small leaves (chamaephyte). In early spring, shoots progressively elongate until in late spring shoot elongation ceases. At the tip of each shoot, an inflorescence (dichasium with apical racemes) is developed which completes pollination by the end of July. Summer leaves are about 10-fold larger than winter leaves. In November, summer leaves are shed and the leaf-naked shoots later become dried and abscise. In winter, the dormant buds at the base of the plant break dormancy and generate many short shoots forming a claster.

Thymus sibthorpii is also chamaephyte. In early spring, the short winter shoots start increasing in length and by the end of April shoot elongation becomes completed. On the tip of each shoot an inflorescence (raceme) is developed which completes pollination by the end of May. In summer, plants consist of leaf-bearing shoots only (inflorescence axes dry and then drop down). In November, all leaves are shed and small shoots sprout out from dormant buds at the base of the plant.

Key words: *Teucrium polium, Thymus sibthorpii*, biological cycles, chamaephytes

Department of Botany, School of Biology, Aristotle University, Thessaloniki 54124, Greece; artbos@bio.auth.gr

Introduction

Teucrium polium L. (c.n. germander, Lamiaceae) is a perennial subshrub which grows wild principally in Northern Africa, Southern Europe, and South-Western Asia. It is well-adapted to the Mediterranean climate with hot arid environments. *T. polium* has healing virtues and is traditionally used in various pathological disorders such as inflammation, diabetes, rheumatisms, hypotension, etc. (Gharaibeh. *et al.* 1988; Suleiman *et al.* 1988; Bahramikia & Yazdanparast 2012). It also exhibits antioxidant activities (Tepe *et al.* 2011) and exerts a significant action against human prostate cancer (Kandouz *et al.* 2010), as well as human lung cancer (Haidara *et al.* 2011).

Thymus sibthorpii Bentham (c.n. thyme, Lamiaceae) is also a perennial subshrub which grows wild more or less in the same regions with those of *T. polium*. Extracts of the plant were found to develop antimicrobial, antioxidant, and anticancerous activities (Amirghofran *et al.* 2006; Erdemoglu *et al.* 2006; Askun *et al.* 2013).

Though a great deal of research has been conducted on the phytochemistry, essential oils, and medicinal properties of *T. polium* and *Th. sibthorpii*, data on the annual biological cycles of these plants are missing. The present work constitutes a contribution to bridging this gap of information.

Material and methods

The annual biological cycle of *T. polium* was studied in a region of Ormylia Chalkidiki, Northern Greece (40°16'53'' N, 23°31'44'' E, altitude 48 m a.s.l.) *Th. sibthorpii* was studied in a nearby region (40°16'53'' N, 23°31'43'' E, altitude 51 m a.s.l.). The meteorological data in the study regions during 2009-2011 are reported in Tab. 1. The data were provided by the Regional Center for Plant Protection and Quality Control, Thermi, Thessaloniki, Greece.

Results and discussion

Teucrium polium

T. polium appears in winter as a chamaephyte, i.e. as a cluster of densely-arranged short shoots

Tab. 1. Meteorological data in the study regions during 2009-2011.

Average daily values	Winter months	Spring months	Summer months	Autumn months
Air temperature (°C)	7.3	13.4	24.3	15.7
Air humidity (%)	78.0	69.4	63.3	75.7
Rainfall (mm)	1.9	1.1	1.0	1.0

Tab. 2. Leaf parameters measured during the biological cycles of *Teucrium polium* and *Thymus sibthorpii*.

Average values	*T. polium*		*Th. sibthorpii*	
	winter leaves	summer leaves	winter leaves	summer leaves
Leaf length (mm)	7.8	21.1	6.9	16.6
Leaf width (mm)	1.3	5.2	1.6	3.1
Leaf surface area (per blade side, mm^2)	9.2	89.8	12.0	33.5

(average length 7 cm) closed to the soil surface (Fig. 1 A). These shoots have been described by ORSHAN (1963) as "temporary brachyblasts" and bear small leaves (Tab. 2).

In March, winter brachyblasts of germander start to progressively elongate until by the end of May they become erect and reach a maximum length of about 20 cm ("dolichoblasts"). During this time, on the tip of each shoot an inflorescence (dichasium with apical racemes) is formed (Fig. 1 B). Inflorescences have a length of about 7 cm, consist of white flowers, and conclude their development on early July. Spring leaves are significantly larger than winter leaves and they follow along the shoots the pattern of decussate phyllotaxy. Leaves obtain their maximum size in middle of July (Tab. 2). Summer leaves have an oblong shape (METCALFE & CHALK 1979) and their margins are toothed with rounded apices (Fig. 3 A). Leaf petioles are very small (appr. 1 mm long). A comparative appearance of winter and summer leaves of *T. polium* is illustrated in Fig. 3 A.

By the end of July, pollination has completed and flowers become dried and fall (Fig. 1 C). Shortly later in middle August, the axes of the inflorescences also fall. In November, the summer leaves are shed down, so that plants consist of leaf-naked shoots only (Fig. 1 D). These may remain on the plants or become abscised by the wind. In winter, the dormant buds at the base of germander receive a stimulus of low temperatures and short photoperiod, break dormancy, and start sprouting short "temporary brachyblasts", which are typical for the winter plants (Fig. 1 A, D).

Thymus sibthorpii

Th. sibthorpii forms its winter shoots when photoperiod is short (8 h light, 16 h dark) and temperature low (below 10 °C). In winter, thyme is a chamaephyte with densely-arranged short shoots (average length – 9 cm), initiating from dormant basal buds (Fig. 2 A). These "temporary brachyblasts" are primary shoots and bear on their nodes remarkably shorter secondary shoots (average length – 1 cm). Along the primary and secondary shoots, small leaves emerge. (Tab. 2).

During early spring (March), temporary brachyblasts gradually elongate and by the end of April they reach a length of 12-15 cm ("dolichoblasts"). On the tip of each spring shoot an inflorescence axis develops (1-7 cm long) which terminates in a raceme inflorescence (Fig. 2 B). Thus, by the end of April, the cumulative length of shoots and inflorescences together is about 20 cm. Flowers have a dark-pink to violet colour. On the nodes of the spring shoots and later of the summer shoots, large leaves having maximum expansion appear (Tab. 2). The petiole of the leaves is short and the blade (lamina) has a lanceolate shape (Fig. 3 B). Leaf phyllotaxy

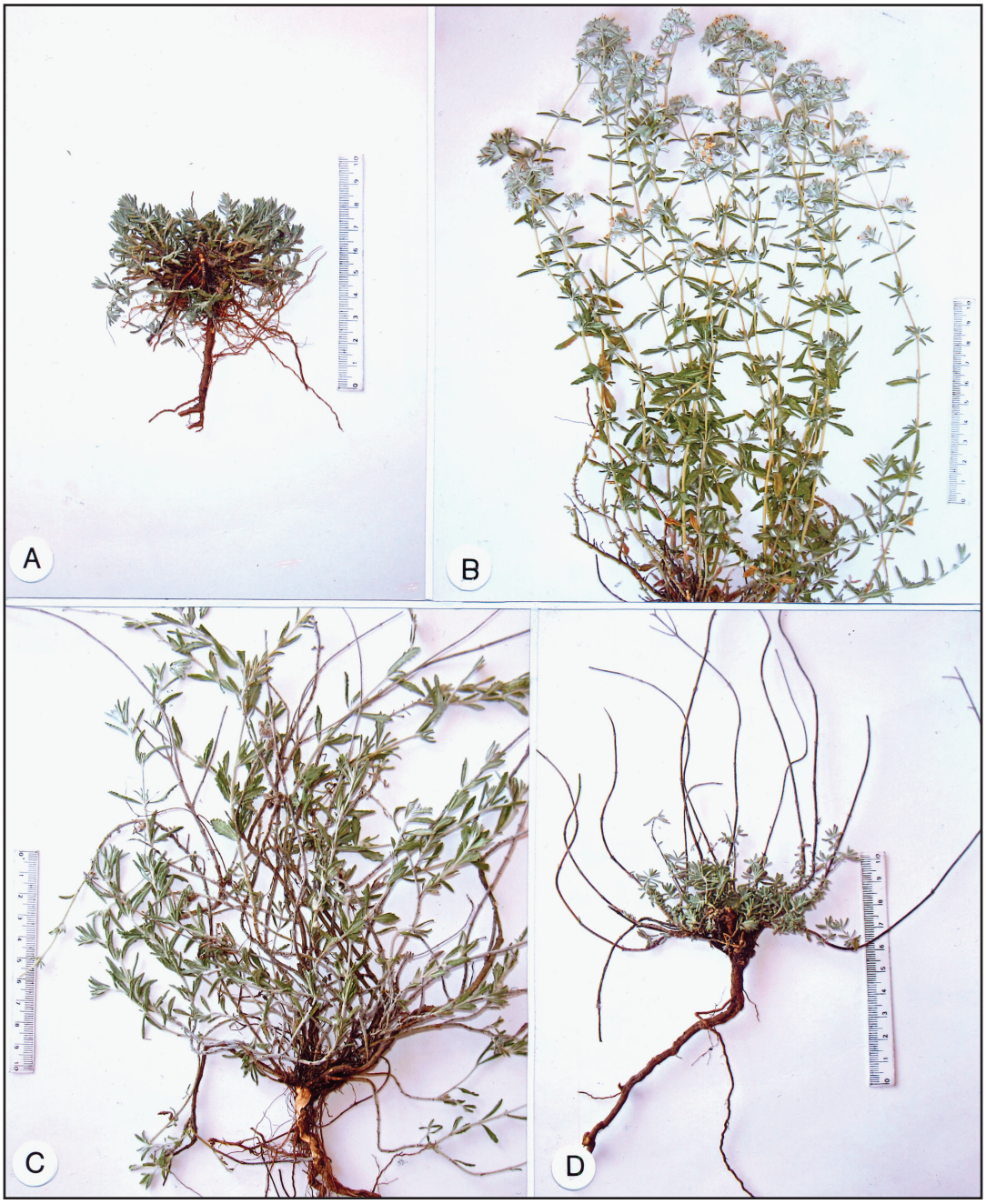
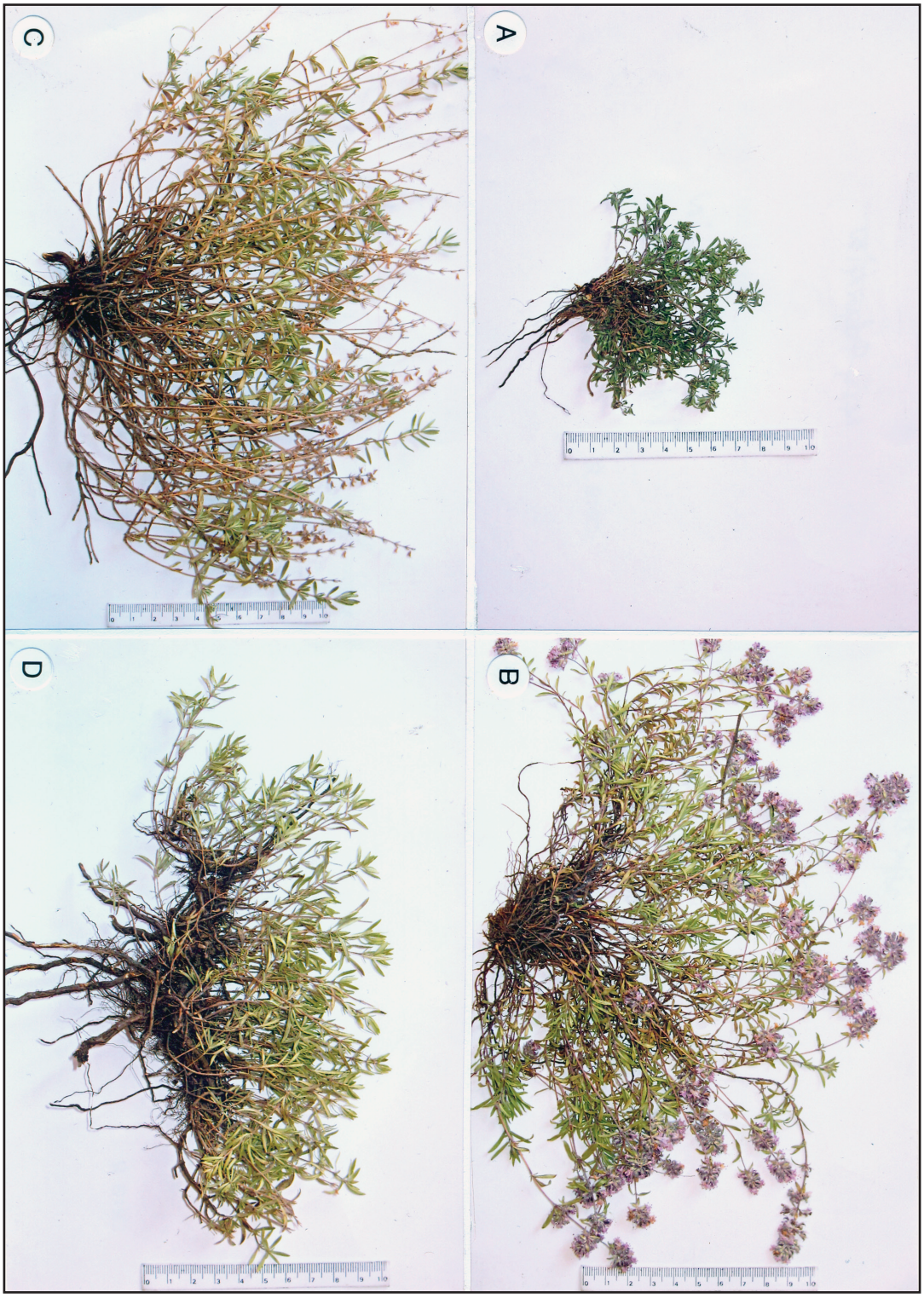


Fig. 1. The annual biological cycle of *Teucrium polium* at various seasonal phases (herbarium material): **A** – winter (late January); **B** – spring/summer (late May/early July); **C** – summer (late July/middle August); **D** – autumn (late November).

along the shoots follows the decussate pattern. By the end of May, inflorescences have completed pollination and fertilization, and their flowers become dried. Some time later (end of June), the axes of the inflorescences also become dried.

In late July, the inflorescence axes usually abscise and fall from the tips of the shoots. Thus,


C
A
D
B

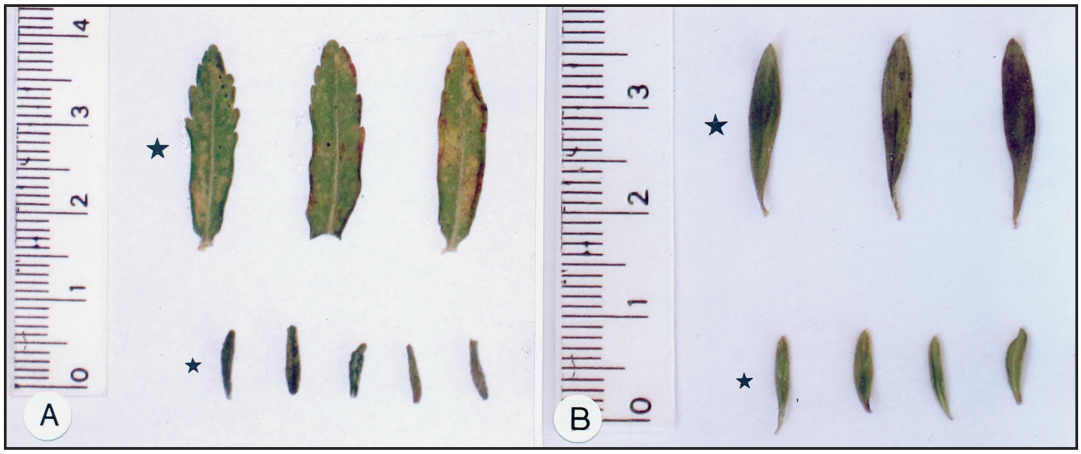


Fig. 3. Comparison of summer leaves (large asterisk) and winter leaves (small asterisk) of *Teucrium polium* (**A**) and *Thymus sibthorpii* (**B**).

plants consist of leaf-bearing shoots only which have an average length of 15 cm (Figs. 2 D). In November, all leaves are shed down. When winter comes, the dormant buds at the base of thyme receive a stimulus of short photoperiod and low temperatures, break dormancy and sprout short shoots with dark-green leaves ("brachyblasts"). These shoots in their entirety will constitute a chamaephyte which is the vegetative form of the plant in winter.

Conclusions

In the studied region, *T. polium* (germander) and *Th. sibthorpii* (thyme) exhibit between them some similarities, but also present some differences during their annual cycles. The striking similarity is that both plants have very small size in winter (chamaephytes) and remarkably larger size in summer. Simultaneously, winter leaves are much smaller than summer leaves. Both species follow along the shoots the pattern of decussate phyllotaxy. Their germander shoots reach the final size on May, whereas thyme shoots – on April. Germander plants are taller than thyme plants. In both plants, inflorescences are racemes and develop on the tips of the shoots. In germander, blooming starts by the end of May and terminates by the end of July, whereas in thyme, blooming starts by the end of April and terminates by the end of May. In both plants, leaves are shed in November.

References

Amirghofran Z., Bahman I., Azadmehr A., Javidnia K. 2006. Anticancer effects of various Iranian native medicinal plants on human tumor lines. *Neoplasma* **53**: 428–433.

Askun T., Tekwu E.M., Satil F., Modanlioglu S., Aydeniz H. 2013. Preliminary antimycobacterial study on selected Turkish plants (Lamiaceae) against *Mycobacterium tuberculosis* and search for some phenolic constituents. *BMC Complement. Altern. Med.* **13**: 365.

Bahramikia S., Yazdanparast R. 2012. Phytochemistry and medicinal properties of *Teucrium polium* (Lamiaceae). *Phytother. Res.* **26**: 1581–1593.

Erdemoglu N., Turan N.N., Cakici I., Sener B., Aydin A. 2006. Antioxidant activities of some Lamiaceae plant extracts. *Phytother. Res.* **20**: 9–13.

Gharaibeh M.N., Elayan H.H., Salhab A.S. 1988. Hypoglycemic effects of *Teucrium polium*. *J. Ethnopharm.* **24**: 93–99.

Haidara K., Alachkar A., Al Moustafa A.E. 2011. *Teucrium polium* plant extract provokes significant cell death in human lung cancer cells. *Health* **3**: 366–369.

◂ **Fig. 2.** The annual biological cycle of *Thymus sibthorpii* at various seasonal phases (herbarium material): **A** – winter (late January); **B** – spring (late April); **C** – spring (late May); **D** – summer (late July).

Kandouz M., Alachkar A., Zhang L., Dekhil. H., Chehna F., Yasmeen A., Al Moustafa A.E. 2010. *Teucrium polium* plant extract inhibits cell invasion and motility of human prostate cancer cells via the restoration of the E-cadhedrin/catenin complex. *J. Ethnopharm.* **129**: 410–415.

Metcalfe C.R., Chalk L. 1979. Anatomy of the dicotyledons. Systematic anatomy of the leaf and stem. Vol. **1**. Oxford Sci. Publ., New York.

Orshan G. 1963. The water relations of plants. Blackwell, London.

Suleiman M.S., Abdul-Ghani A.S., Al-Khalil S., Amin R. 1988. Effect of *Teucrium polium* boiled leaf extract on intestinal motility and blood pressure. *J. Ethnopharm.* **22**: 111–116.

Tepe B., Degerli S., Arslan S., Malatyaly E., Sarikurkcu C. 2011. Determination of chemical profile antioxidant, DNA damage protection and antiamoebic activities of *Teucrium polium* and *Stachys iberica*. *Fitoterapia* **82**: 237–246.