Agronomy Research **7**(Special issue I), 430–435, 2009

Cultivation possibilities for Thyme, an important medicinal plant, in Western Lithuania

R. Nekrošienė

Botanical Garden of Klaipėda University, Kretingos 92, LT–92327 Klaipėda, Lithuania;
tel. + 370 46 398833, fax. + 370 46 398837; e-mail: rita_nekrosiene@mail.ru

Abstract. The cultivated medicinal plant production covers only 4–6% of the demand for raw material of the pharmaceutical industry in Lithuania, suggesting that medicinal plant cultivation may be an alternative business for organic farming. Phenology and biological parameters (plant height in flowering phase, number of twigs, air-dry mass), occurrence of diseases and pests of some medicinal plants, as *Thymus serpyllum, T. pulegioides* and *T. vulgaris* were studied in the field collection at the Botanical Garden of Klaipeda university (Western Lithuania) in 2001–2006. It was established that the beginning of the vegetation period of *T. pulegioides* was the same in different years. The amount of precipitation and average air temperature at the beginning of vegetation had influence on the preparation time of medicinal material by thyme, especially *T. pullegioides* and *T. vulgaris*. Air-dry mass of *T. pulegioides* was by 4–18 g m^{-2} more than the mass of *T. serpyllum* and *T. vulgaris*. Pests infected *Thymus* by 4.5–8.8%; severity of diseases varied from 0.5 to 4.5% in different years.

Key words: medicinal plants, *Thymus,* cultivation, vegetation period, growth phase, biological characteristics, pests, diseases

INTRODUCTION

Medicinal plants are clearly an important global resource in terms of healthcare but are also a significant economic resource, traded extensively on local to international scales. Internationally, the trade in medicinal plants is estimated to be worth $60 billion per year, increasing at a rate of 7% a year (Hawkins, 2008). Very little of the raw material to supply this demand is from cultivated sources. Of the 3,000 or so species known to comprise the international trade (Schippmann et al., 2006), there are approximately 900 for which commercial cultivation is underway or in development (Mulliken & Inskipp, 2006). About 20,000 tons of medicinal plants worth $18–20 million are traded every year in Nepal alone, and about 90% are harvested in uncontrolled fashion by landless, resource-poor mountain farmers for whom the harvest and trade in medicinal plants constitutes their only form of cash income. The imported raw material mainly supplies the demands of the pharmaceutical industry in Lithuania. The cultivated production covers only 4–6% of the demand for raw material. Wild plant material represents about 29% of the total volume used in pharmaceutics (Radušienė & Janulis, 2004).

Thyme is reputed to be an especially valuable medicinal herb. Since 2003, the drug has been listed in the European Pharmacopoeia. Only two species – *Thymus* *serpyllum* and *T. pullegioides* are native in Lithuania; they are found in many locations, but their projection coverage is rather small (Radušienė & Janulis, 2004). *Thymus vulgaris* is native to the Mediterranean region and also grows in northern Africa.

Cultivation of common thyme (*Thymus vulgaris*) is an interesting possibility in certain parts of Switzerland, essentially in mountainous regions. Such cultivations can provide additional income to mountain farmers (Rometsch, 2002). The influence of nitrogen fertilizers on the crop yield, as well as on the production and composition of the essential oil and some other chemical characteristics of thyme, were investigated at the Lithuanian Institute of Horticulture. Different levels of fertilizers were applied. It was found that fertilizers increase the thyme crop (Baranauskienė et al., 2003). In 2005–2006 the experiments were carried out in five different locations in Poland. The main aim of field experiments was to investigate yield and quality of organically produced raw material of thyme (Seidler-Łożykowska et al., 2008).

The aim of this research was a bio-ecological and cultivation assessment of different species of thyme in Western Lithuania.

MATERIALS AND METHODS

The experiments were carried out in the Botanical Garden of Klaipėda University (West Lithuania) in 2001–2006. This paper provides data for the two stages of the research for the years 2001–2003 and 2004–2006. The experiments were established in a randomized complete block design in three repetitions. Each plot had 10 m^{-2}. The soil of the experimental site was *Epihypogleyic Cambisols*, sod gleyic light loam. The agrochemical characteristic of the plough layer before trial establishment was as follows: pH_{KCl} 5.10–5.80, humus 1.80–2.10%, available P_2O_5 79.3–145.5 mg kg^{-1}, available K_2O 125.0–150.4 mg kg^{-1} (A-L method). The herbs were regenerated every three years. Thyme was planted early in autumn in 2000 and 2003 at the distance of 25 cm between plants. Previous soil was composted 10 kg m^{-2}. At the end of the growing period thyme plants were covered with peat mulch. At the end of June-beginning of July raw material was collected by hand from each plot. The herbs were dried in natural conditions, in shaded and well ventilated places. The following traits were estimated: thyme height, number of generative twigs, yield of dried herb.

Diseases and pest assessment

Foliar diseases and pest assessments on thymes were carried out every year at the beginning of the flowering phase. In each area under assessment 10 plants were randomly chosen and ten top green leaves were assessed per plant.

Disease / pest incidence, i.e. per cent of disease / pest affected leaves (P) was calculated according to the formula:

$$P = \frac{n}{N} \cdot 100,$$

where n – number of affected leaves,
N – number of assessed leaves.

Disease severity (R) was calculated according to the formula, having added per cent of affected leaf area of each leaf and having divided the sum by the number of assessed leaves:

$$R = \frac{\sum(n \cdot b)}{N},$$ where ∑(n·b) – sum of product of the number of leaves with the same percent of severity and value of severity,
N – number of assessed leaves.

Meteorological conditions

Lithuania Western regions are strongly affected by the maritime climate: in winter it is warmer, in summer it is cooler than in eastern regions. The weather conditions were rather diverse during the experimental period: the precipitation rate was especially varied. In 2001 the spring was late, with mild humidity. Humid, mild warmth predominated in summer. Spring 2002, especially May, was warm, but dry. The summer weather was unsettled – hot and and very dry in June, and especially in August, and hot and humid in July. Spring 2003 was cold. The beginning of summer was cool, precipitation, modest. July was hot and dry. In 2004 the spring was warm, dry. Cold, dry weather predominated in May–June. July–August were moderately warm, but very humid. In 2005, at the beginning of thyme growing season, chilly and dry weather prevailed. However, in the first ten-day period of July the mean daily air temperature exceeded the long-term mean by 1.8°C, and the amount of rainfall totalled 36 mm. In 2006 the spring was late and dry. Heavy rainfall occurred only in the third ten-day period of May. The high temperature and shortage of rainfall in the second half of June created conditions for the development of drought that lasted until the middle of August. The amount of precipitation from the start of the growing period of thymes until intense flowering was: in 2001 – 152.9 mm; in 2002 – 76.6 mm; in 2003 – 111.8 mm; in 2004 – 97.8 mm; in 2005 – 88.0 mm; in 2006 – 81.2 mm. Average air temperature from the start of the growing period until intense flowering was: in 2001 – 10.3ºC; in 2002 – 13.8ºC; in 2003 – 11.3ºC; in 2004 – 11.0ºC; in 2005 – 11.2ºC; in 2006 – 10.9ºC.

The experimental data were calculated by the methods of variance (*V*, %) and regression analysis using the standard statistical package STATISTICA of Stat for Windows.

RESULTS AND DISCUSSION

Phenological observation of thyme enabled estimating the influence of precipitation quantity and air temperature upon the length of growth phases of the herbs. The growing period of *Thymus serpyllum* and *T. pulegioides* during all research years started almost at the same time, in the first decade of April (04 05±5 days), despite different air temperature and amount of precipitation; the exception, 2003, was exceptionally unfavourable for growing herbs. In spring 2003 *Thymus pullegioides* and *T. vulgaris* were frostbitten. The plants were damaged by the lowest temperature during the experimental period, which reached -25ºC for several days in January. The growing period started notably late and led to the shortest growing period of all experimental species of thyme. Temperature below zero on 20 October followed by early snow terminated the growing period. During the experimental period the starting date of the growing period of *Thymus vulgaris* ranged from 5 April, 2005 until 22 April, 2003 (Table 1). According to the experiments carried out in Germany, the date for the beginning of flowering of *Thymus vulgaris* was heterogeneous yearly (Mewes et al., 2008).

Table 1. The characteristics of the vegetation period of thymes.

Thyme species	Year of inves-tigations	Growth phase (month, day)						Growth period in days
		Start of growth	Pre-flowering	Begin-ning of flowering	Intense flower-ing	End of flower-ing	End of growth	
Thymus serpyllum	2001	04 10	05 20	06 01	06 12	07 05	11 04	208
	2002	04 05	05 20	06 05	06 15	07 02	10 30	209
	2003	04 20	05 31	06 10	06 13	07 10	10 25	188
	2004	04 02	05 25	06 05	06 15	07 08	11 06	218
	2005	04 08	05 20	06 02	06 10	07 10	11 10	216
	2006	04 09	05 30	06 02	06 08	07 15	10 30	204
Thymus pule-gioides	2001	04 05	05 25	06 04	06 10	06 31	10 31	209
	2002	04 06	05 22	06 06	06 12	07 01	10 30	207
	2003	04 11	06 01	06 10	06 16	07 06	10 20	192
	2004	04 05	05 25	06 05	06 10	07 01	11 06	216
	2005	04 02	05 27	06 01	06 09	06 30	11 02	214
	2006	04 02	05 23	05 30	06 07	06 30	10 28	210
Thymus vulgaris	2001	04 12	05 23	06 07	06 20	06 30	10 25	196
	2002	04 15	05 20	06 05	06 18	07 02	10 24	192
	2003	04 22	05 31	06 12	06 25	07 10	10 15	176
	2004	04 10	05 25	06 10	06 20	07 01	11 01	205
	2005	04 05	05 25	06 05	06 15	06 25	10 25	204
	2006	04 10	05 30	06 07	06 18	07 05	10 20	193

Table 2. Dependence of the beginning of thyme intense flowering (y, in days) upon the amount of precipitation (x, mm) and average air temperature (x, ºC) during the vegetative period until intense flowering. Average data of 2001–2006 ($P < 0.05$)

Thyme species	Regression equation	
	Dependence upon the amount of precipitation	Dependence upon the average air temperature
Thymus serpyllum	$y = 84.991 + 0.99$ x; $r = 0.454$	$y = 71.639 – 0.01$ x; $r = –0.341$
Thymus pulegioides	$y = 30.404 + 3.49$ x; $r = 0.968$	$y = 79.182 – 0.05$ x; $r = –0.923$
Thymus vulgaris	$y = 86.443 – 24.43$ x; $r = 0.658$	$y = 63.081 + 0.03$ x; $r = –0.469$

During all experimental years the growth period of thyme was lengthy: this period for *Thymus serpyllum* and *T. pulegioides* exceeded the regular period of growers in maritime climate by 9–22 days, and *T. Vulgaris,* by 5–17 days. *Thymus pulegioides* had the longest growth period of all experimental species: average 212±5 days; *T. vulgaris* had the shortest; 194±15 days. The longest growth period of all experimental species occurred in 2004 (Table 1), when the warm season was unsually long: average air temperature in November was 2.1ºC, and 2.0ºC in December.

For the preparation of medicinal material, it is crucial that the herbs be harvested at the time of intense flowering. All our experimental thyme started flowering in the first decade of June, although the length of the flowering period differed. *Thymus serpyllum* was in flowering stage for 33 days on average; *T. pulegioides* for 25 days, and *T. vulgaris* for 24 days. Hence at least two species of thyme allow a sufficient time frame for harvesting, therefore can be cultivated at the same time. It was deduced that the start of intense flowering, especially of *T. pulegioides* and *T. vulgaris,* depended upon average air temperature and quantity of precipitation at the beginning of their growth periods until intense flowering of the herb (Table 2). *Thymus pulegioides* and *T. vulgaris* came to flower 10 days earlier when the temperature was higher than usual at the start of growth period, i.e. years 2002, 2003, 2004, 2005, whereas the start of intense flowering was delayed for 5 days on average when there was more precipitation at the beginning of the growth period. The final result of any farming activity is the amount of marketable output, which is determined by the range of biological parameters of the herb: height, coverage, number of stems, etc. Our data states that the greatest height during the flowering period was reached by *Thymus vulgaris* in comparison to other species of thyme. However, *Thymus pullegioides* generated 24–30% more generative twigs. *Thymus pullegioides* yield was by 1.3 times higher compared with the yield of *T. serpyllum* and by 1.1 times higher than *T. vulgaris* (Table 3).

Table 3. Biological characteristics of thyme. Average data of 2001–2006, $x \pm Sx$ ($P < 0.05$).

Thyme species	Plant height in flowering phase cm	Number of generative twigs by units per plant	Air-dry mass (medicinal material) g m^{-2}
Thymus serpyllum	11.5±2.25 (*V*=6.6)	22.2±5.52 (*V*=7.6)	126.9±8.61 (*V*=8.6)
Thymus pulegioides	17.2±0.72 (*V*=2.4)	39.8±4.54 (*V*=5.0)	165.5±6.76 (*V*=6.9)
Thymus vulgaris	21.5±3.56 (*V*=5.8)	25.5±1.92 (*V*=0.9)	151.1±9.22 (*V*=11.4)

In the first year of cultivating, the herb yield was 1.2–1.3 less than in the second-third years. According to the experiments carried out in Poland, the yield of dried *Thymus vulgaris* herb varied from 120.1 to 1150.0 g m^{-2} and depended upon thyme cultivars (Seidler-Łożykowska et al., 2008). It was noted that *Thymus pullegioides* grew faster during the first two years in comparison to *T. vulgaris* and especially to *T. serpyllum.* In the second year a single *Thymus pullegioides* individual covered 970.3±12.2 cm^{-2} space on an average. A single *Thymus serpyllum* individual planted at the same time reached coverage from 450.0–620.5 cm^{-2}, but by the third year *Thymus serpyllum* had already covered the plots. Due to the increased coverage, a larger quantity of medicinal material was received than in previous years. At the same time coverage of *Thymus pullegioides* increased insignificantly, but it was discovered that this species of thyme can be used for a longer period of time: up to 20% fewer unsuitable, thin and woody three-year individuals were found in *Thymus pullegioides* individuals than among *T. serpyllum.* Thyme has a few pest and disease problems (Rometsch, 2002). Observation of disease and pest spread is significantly positioned in research of medicinal herbs. Medicinal herbs can not be treated with chemicals; on the other hand produce damaged by pests loses its marketable value. According to the data of our investigation most thyme damaged by pests were detected in 2002 and 2005 – from 8.50 up to 8.85% of thyme; there were twice fewer damaged plants in 2003 and 2004 (Table 4).

The spread of pests was more intensive with higher air temperature. Disease severity ranged from 0.5–4.5% from year to year. The most intense incidence of disease was recorded in 2004 and 2005. Direct reliance on incidence of diseases and air temperature and quantity of precipitation was started. *Thymus vulgaris* were damaged by diseases 1.3 times more intensely than *T. pullegioides* and 1.2 times more than *T. serpyllum.*

Table 4. Incidence of pests and diseases on different species of thyme.

Experi-mental years	Affected plants (leaves), %					
	Thymus serpyllum		*Thymus pulegioides*		*Thymus vulgaris*	
	by pests	by diseases	by pests	by diseases	by pests	by diseases
2001	5.00*	10.39*/0.58**	4.56	12.00 / 0.50	4.50	12.45 / 0.77
2002	6.50	10.55 / 0.93	8.85	12.25 / 0.75	4.55	10.15 / 1.12
2003	5.25	20.15 / 1.38	5.55	15.55 / 1.20	4.68	15.75 / 1.65
2004	5.45	20.25 / 3.85	6.95	25.75 / 3.55	4.45	25.52 / 4.50
2005	6.95	22.35 / 3.32	8.50	25.30 / 3.10	4.75	20.25 / 4.00
2006	6.15	20.69 / 1.95	8.00	15.50 / 1.83	4.50	15.45 / 2.35

Note: * pests and diseases incidence, ** diseases severity

Observation of the growth of thymes, investigation of their biological features, as well as incidence of diseases and spread of pests demonstrated all those varieties (including those not self-generating in Lithuania) can be succesfully cultivated on farms.

CONCLUSIONS

Different meteorological conditions had no significant influence on the starting date of growth of *Thymus serpyllum* and *T. pulegioides*. A longer, warmer than average autumn 2004 prolonged the growth period of thyme for 10 days on average. The time for preparation of medicinal material of thyme depended upon the quantity of precipitation and average air temperature at the beginning of the growth period, especially for *T. pulegioides* and *T. vulgaris* (r = –0.923; –0.469 and r = 0.968; 0.658). The *T. pulegioides* herb yield was higher by 1.1–1.3 times compared with other species. *T. vulgaris* was damaged by diseases 1.2–1.3 times more intensely than *T. pullegioides* and *T. serpyllum.*

REFERENCES

Baranauskienė, R., Venskutonis, P.R., Viškelis, P. & Dambrauskienė, E. 2003. Influence of nitrogen fertilizers on the yield and composition of thyme (*Thymus vulgaris*). *Journal of Agricultural and Food Chemistry* **51**, 7751–7758.

Hawkins, B. 2008. *Plants for Life: Medicinal Plant Conservation and Botanic Gardens.* Richmond, 48 pp.

Mewes, S., Krüger, H. & Pank, F. 2008. Physiological, morphological, chemical and genomic diversities of different prigins of thyme (*Thymus vulgaris* L.). *Genetic Resources and Crop Evolution* **55**(8) 1303–1311.

Mulliken, T. & Inskipp, C. 2006. Medicinal plant conservation: scope, scale and diversity. *Proceeding of the 1st International Conference on Organic Wild Production*. IFOAM, Bonn, Germany, pp. 55–58.

Radušienė, J. & Janulis, V. 2004. Improvement of diversity, trade and conservation of medicinal and aromatic plants. *Medicina* **40**(8), 705–709 (in Lithuanian).

Rometsch, S. 2002. Ecology and cultivation assessment of thyme (*Thymus vulgaris* L.) in the Canton Valais, Switzerland. *ISHS Acta Horticulturae* **344,** 411–415.

Schippmann, U., Leaman, D. & Cunningham, A. 2006. Cultivation and wild collection of medicinal and aromatic plants under sustainability aspects. *Medicinal and Aromatic Plants*. Springer, Dordrecht, the Netherlands, pp. 23–45.

Seidler-Łożykowska, K., Golcz, A., Kozik, E. & Wójcik, J. 2008. Quality of thyme herb (*Thymus vulgaris* L.) from organic cultivation. *16th IFOAM Organic World Congress*, Modena, Italy, pp. 14–18.