BOOK OF PROCEEDINGS

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PREFACE

Dear Colleagues,

In your hands are the *Proceedings* of the 7th International Scientific Agricultural Symposium "AGROSYM 2016", which I hope you will find useful in your research, education and professional activities and endeavors.

AGROSYM 2016 themes cover all branches of agriculture and are divided into seven sessions: 1) Plant production, 2) Plant protection and food safety, 3) Organic agriculture, 4) Environmental protection and natural resources management, 5) Animal husbandry, 6) Rural development and agro-economy, and 7) Forestry and agroforestry.

Keynote papers dealt with organic agriculture from different perspectives as well as international cooperation in agricultural and rural development, climate change and forestry. Organic farming is a holistic production management system of agricultural, food and other products, combining good agricultural practices, a high degree of biodiversity, conservation of natural resources, and application of high standards of animal welfare.

Food production, food security and production of raw materials for other industries determine multiple environmental, economic and social roles of agriculture (including crop production, animal husbandry, forestry and fisheries) in all countries, both developed and developing ones, as well as its multi-functionality; including its contribution to rural development. This is clearly highlighted in the numerous contributions included in these *Proceedings* alongside the challenges that agriculture sector is facing and the negative impacts of industrial agriculture on the environment.

I do believe that the research results reported here will be significant in the dissemination of knowledge to the wider audience about the importance of agriculture as a strategic sector in many countries.

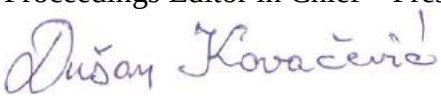
AGROSYM 2016 made an important contribution to the agriculture theory, knowledge and practice in different areas. During the four-day symposium on October 6-9, 2016, over 1100 contributions were presented (either as oral or poster presentations) to more than 1000 participants representing 78 countries.

The *Proceedings* comprise an edited selection of the papers submitted to the symposium. Each paper included in the *Proceedings* was positively reviewed by referees.

AGROSYM 2016 was made possible through the commitment and contributions of a wide range of partners and sponsors. Many thanks to all authors, reviewers, session moderators and colleagues for their help in editing these *Proceedings*. Special thanks go to all co-organizers for their unselfish collaboration and comprehensive support.

East Sarajevo, 05 October 2016

Prof. Dušan Kovačević, Faculty of Agriculture, University of Belgrade
Proceedings Editor in Chief – President of the Scientific committee of AGROSYM 2016



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Regional Rural Development Standing Working Group (SWG) in Southeastern Europe

Introduction to SWG GIZ project 2970

1. PLANT PRODUCTION

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CHARACTERISATION OF ECONOMICALLY IMPORTANT MEDICINAL AND AROMATIC PLANTS BELONGING TO THE LAMIACEAE FAMILY DISTRIBUTED IN THE RIZE PROVINCE, TURKEY

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Abstract

Regarding biodiversity the Black Sea region belongs to one of the richest regions of Turkey. Totally 2239 species are present in the East Black Sea region, 514 of them are endemic and the endemism ratio is ca. 23 %. More than half of the plants distributed at the East Black Sea region are present in the Rize province. 70 % of the plants are of medicinal and aromatic value. 4 Mentha species, 3 Origanum species, 3 Thymus species, 2 Salvia species, 2 Stachys species and 1 Calamintha species were collected from 19 different localities in Rize during 2015. A field nursery was established using collected material. Traits like plant height, number of branches, stem diameter, leaf area, dry drog weight, fresh drog weight, dry drog yield, fresh drog yield, seed weight and essential oil yield were determined. Principal Component Analysis was performed to assess the diversity regarding with the investigation of characters. Based on obtained data large diversity could be determined. Collected materials can be used as genetic resources for further investigations.

Keywords: *Lamiaceae, medicinal and aromatic plants, characterization.*

Introduction

Natural environment has been a sourceof medicinal agents for thousand of years, since healing wih plants dates back probably to the evolution of mankind (Mathe, 2015). As well known about 80 % of human in the World rely mainly on traditional medicines for their primary health care, while medicinal plants continue to play an important role in the health care systeme of the remaining 20 %. Partly based onther use in traditional medicine, an impressive number of modern drugs have also been isolated from natural plant species. Remarkably, even today there is no realdefiniion fro this special group of plants that has been accompanying mankind through history. Medicinal and aromatic plants form a numerically large group of economically important plants which provide basic raw materials for medicines, perfumes, flavours and cosmetics. These plants and their products not only serve as valuable source of income for small land holders farmers and entrepreneurs but also earn valuable foreign exchange by way of export facilities.

Turkey is one of the countries with richest plant diversity in the Mediterranean (Davis 1965-1986; Davis *et al*., 1988; Guner *et al*., 2001). A number of human races and tribes have settled here during different periods bringing in different cultures and customs. As a result of this we come across a great accumulation of knowledge of traditional medicine in the country. A recent survey of traditional and folk medicine in Turkey has revealed that most of these plants are still in use by the local inhabitants (Yesilada and Sezik, 2003).

Turkey is located in three biogeographical regions: Anatolian, Mediterranean, the Black Sea region, and their transition zones. Its climatic and geographical features change within short

intervals of space due to the country's position – a bridge between two continents. Thanks to its location, Turkey's biological diversity can be compared to that of a small continent: the country's territory consists of forests, mountains, steppe, wetlands, coastal and marine ecosystems and different forms and combinations of these systems. This extraordinary ecosystem and habitat diversity has produced considerable species diversity (Kahraman *et al*., 2011; Kahraman *et al*., 2012). Regarding biodiversity the Black Sea region belongs to one of the richest regions of Turkey. Totally 2239 species are present in the East Black Sea region, 514 of them are endemic and the endemism ratio is ca. 23 %. More than half of the plants distributed at the East Black Sea region are present in the Rize province. 70 % of the plants are of medicinal and aromatic value.

4 Mentha species, 3 Origanum species, 3 Thymus species, 2 Salvia species, 2 Stachys species and 1 Calamintha species were collected from 19 different localities in Rize during 2014. Different traits were determined, but only the differences between these species based on their essentail composition will be discussed.

Materials and methods

The research material was collected during 2015 in the Rize province (Turkey). The collected species, the localities and the altitudes are given in Table 1.

Table 1: Collected species and thEir localities

Species	**Collected locality**	**Altitude**	**Species**	**Collected locality**	**Altitude**
Mentha aquatica	Handüzi route	455 m	***Thymus longicaulicus***	Anzer	1534 m
	Ormanlı	160 m		Anzer	2106m
Mentha puligeum	Hamidiye	33 m		Cimil	2145 m
	Hamidiye	41 m		Cimil	2154 m
	Orta Mahalle	350 m	***Thymus praecox* subsp. *caucasicus***	Çağırankaya	2038 m
	Subaşı	300 m		Çağırankaya	2122 m
	Şehitlik	500 m	***Thymus praecox* subsp. *caucasicus* var *caucasicus***	Anzer	1534 m
Mentha x piperita	Şehitlik	450 m		Anzer	1750 m
Mentha longifolia* subsp. *longifolia	Anzer	1533 m		Anzer	2106 m
	Anzer	1800 m		Polovit	2400 m
	Anzer	**2075 m**	***Thymus praecox* subsp. *grosheimii* var. *grosheimii***	Cimil	2145 m
	Anzer	2139 m		Cimil	2154 m
	Amlakıt	1901 m		Çağırankaya	2122 m
	Amlakıt	1998 m		Handüzü	1833 m
	Anzer	2106 m	***Thymus praecox* subsp. *grosheimii* var. *medwedewii***	Başyayla	2558 m
	Cimil	1819 m	***Salvia glutinosa***	Çat	1295 m
	Cimil	2145 m	***Salvia verticillata*** subsp. ***verticillata***	Anzer	1533 m
	Çamlıhemşin	1838 m		Anzer	1533 m
	Çat	1299 m		Anzer	1800 m
Origanum vulgare* subs. *hirtum	Çat	1209 m		Anzer	1850 m
Origanum vulgare* subsp. *viride	İkizdere	314 m		Anzer	1850 m
	İkizdere	787 m		Cimil	2099
	İkizdere	1533 m		Çat	1321
	Uğrak	496 m		Çat	1412 m
Calamintha nepata subsp. **glandulosa**	Amlakıt	1900 m			
Stachys anuua subsp. ***annua*** var. annua	Anzer	1533 m			

Essential oil analysis:

The essential oil composition of collected samples was done using an SHİMADZU GC/MS device. An 30 m column and related detection programme was used.

Statistical analysis:
Principal component and Biplot analysis was used to distinguiSh the collected samples regarding their essentail oil composition (Backhaus et al, 1989). Principal component and Biplot analysis was performed using XLSTAT2016 Trial Version. The collected samples were diversificated using all essential oil components, in Biplot only highly detected essential oil components were used. The calculated first two Principal Components are corresponding in % to the present variation regarding investigated trait.

Results and discussion

1. **Mentha species:** Fig.1 shows the distribution of investigated Mentha species based on most detected essential oils.

As can be seen in Fig. 1 Mentha species collected from different localities and altitudes showed different essential compositions. Specially in *M. longifolia* subsp. *longifolia* large varation was detected. The same can be sayed for *M. puligeum* collected from different localities and altitudes.

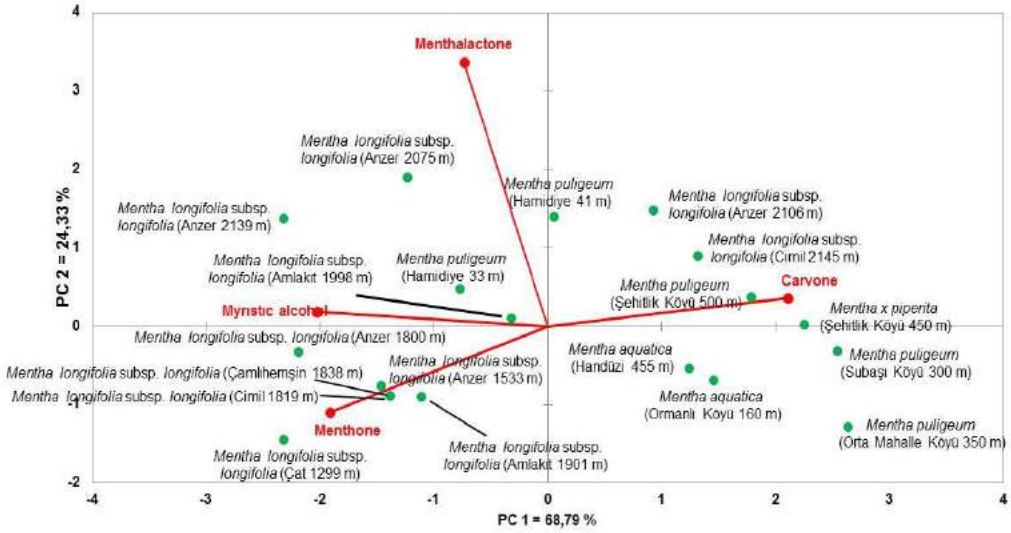


Fig. 1: Biplot analysis of Mentha species based on differentiating essential oils

The essentail oil menthone was detected specially in M. *longifolia* subsp. *longifolia*. Carvone, myristic alcohol and menthalactone was useful in seperating the other collected samples.

1. Origanum species: Fig.2 shows the distribution of investigated Origanum species based on most detected essential oils. *Origanum vulgare* subsp. *viride* samples collected from different altitudes of İkizdere and from Uğrak showed ifferent essential oil composition compared with the other Origanum species. Specially *Origanum vulgare* subs. *vulgare* collected from Cimil and *Origanum vulgare* subsp. *hirtum* collected from Çat showed different essentail oil compositions. *Origanum vulgare* subsp. *hirtum* collected from Çat and *Origanum vulgare* subsp. *viride* collected from İkizdere at 1533 altitude could be differentiated from other samples regarding Carvacrol.
Origanum vulgare subsp. viride collected from İkizdere at 787 altitude and from Uğrak could be seperated from other collected samples regarding the compounds İsoborneol and Myristic.

Origanum vulgare subsp. *vulgare* collected from Cimil stand out regarding Tymol from the other samples; *Origanum vulgare* subsp. *viride* collected from İkizdere at 314m altitude showed differences regarding Hmachalene alpha. The compund linaool was useful to separate all investigated samples.

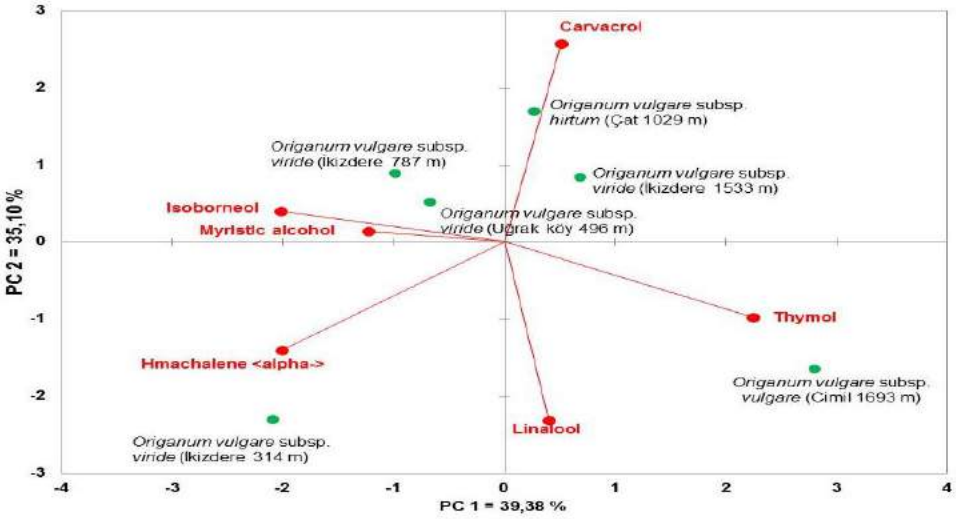


Fig. 2: Biplot analysis of Origanum species based on differentiating essential oils

2. Thymus species: Fig. 3 shows the Biplot analysis of collected Thymus samples based ontheir essential oil composition.

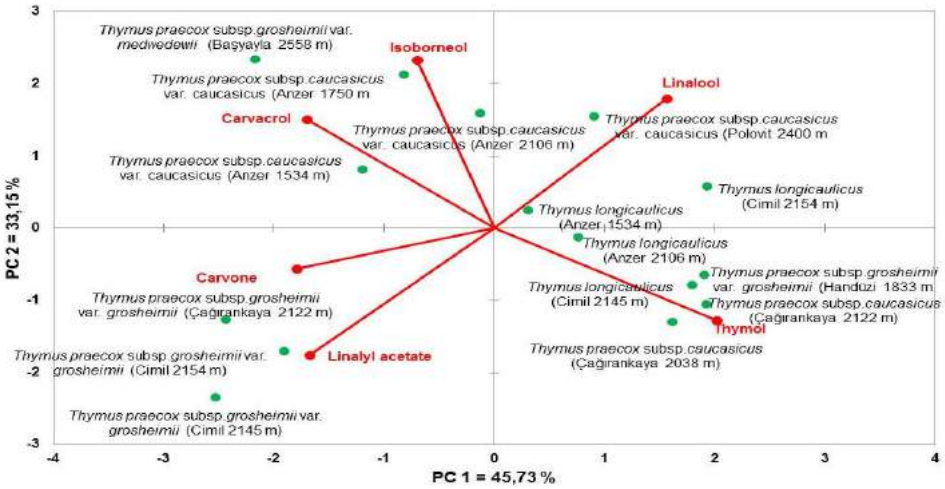


Fig. 3: Biplot analysis of Mentha species based on differentiating essential oils

T. praecox subsp. *grosheimii* var. g*rosheimi* samples collected from Cimil and Çağırankaya showed similar essentail oil compositions. Only the same species collected from Handüzi displayed similar composition with the species *T. longicaulicus* and *T. praecox* subsp. *caucasicus*. Further, *T. praecox* subsp. *grosheimii* var. *medwedewii* showed similar essentail oil composition with *T. praecox* subsp. *caucasicus* var. *caucasicus* samples collected from Polovit and different altitudes of Anzer.

T. praecox subsp. *grosheimii* var. *medwedewii* collected from Baş Yayla, *T. praecox* subsp. *caucasicus* var. *caucasicus* collected from Anzer and Polovit and T. *longicaulicus* collected

from Cimil and Anzer 1534 showed differentiation from the other samples regarding the essetial oil compounds Linalool, İsoborneol and Carvacrol.
Carvone and linalyl acetate were helpful to seperate *T. praecox* subsp. *grosheimii* var. *grosheimii* collected from Cimil and Çağırankaya from the other species. *T. Longicaulicus*collected from Cimil, *T. praecox* subsp. *caucasicus* collected from Çağırankaya and *T. praecox* subsp. *grosheimii* var. *grosheimii* collected from Handüzi were different from the other samples regharding Thymol.

3. Salvia, Stachys and Calamintha species: Fig. 3 shows the Biplot analysis of collected Salvia, Stachys and Calamintha samples based ontheir essential oil composition.

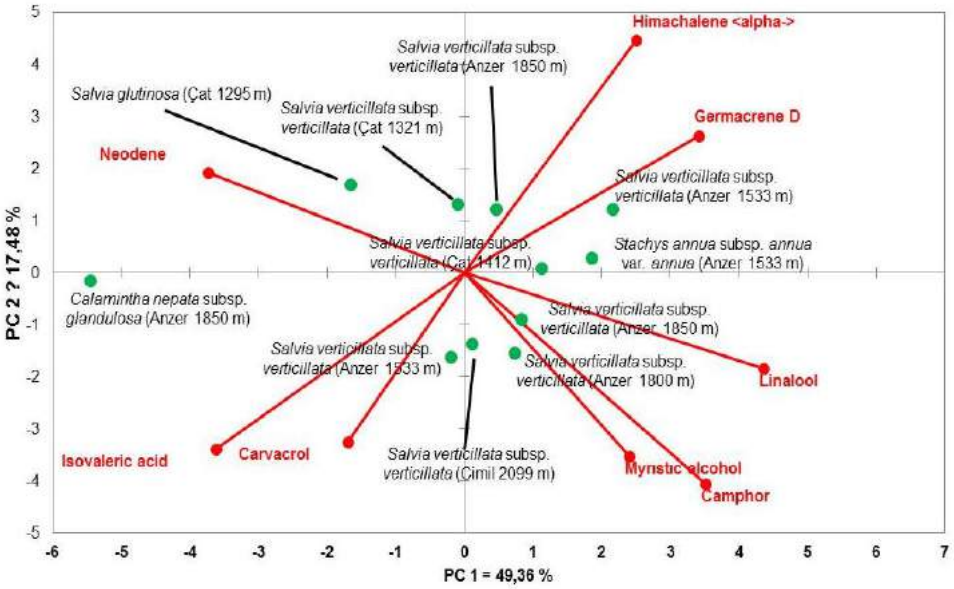


Fig. 4: Biplot analysis of Salvia, Stachys and Calamintha species based on differentiating essential oils

Salvia glutinosa, *Calamintha nepeta* subsp. *glandulosa* and *Stachys annua* subsp. *annua* var. *annua* differed from the other species regarding their essential oil composition. Samples of the species *Salvia verticillata* subsp. *verticillata* showed nearly similar essentail oil compositions.
Calamintha nepeta subsp. *glandulosa* differed from theother samples ragarding neoden, carvacrol and isovaleric acid. Further, *Salvia glutinosa* displayed different neodene composition. *Stachys annua* subsp. *annua* var. *annua* on the other side could be diffentiated based on germacrene D and linaool.
The presence, yield and composition of secondary metabolites in plants, viz. the volatile components and those occurring in essential oils, can be affected in a number of ways, from their formation in the plant to their final isolation (Figueiredo *et al*., 2008). Several of the factors of influence have been studied, in particular for commercially important crops, to optimize the cultivation conditions and time of harvest and to obtain higher yields of high-quality essential oils that meet market requirements.
Knowledge of the factors that determine the chemical variability and yield for each species are thus very important. These include: (a) physiological variations; (b) environmental conditions; (c) geographic variations; (d) genetic factors and evolution; (e) political/social conditions; and also (f) amount of plant material/space and manual labour needs. İn our case it could be stated that different species collected from different localities and altitudes showed variation regarding their essential oil compostion due to environmental conditions, geographic variations and genetic factors, which of course needs further investigation.

Conclusion

Medicinal plants and their various products can be viewed as an important commodity items for sustainable economic development of developing countries. There is globaly also need of organised marketing and trade of medicinal plants and their various products. To meet the internal and international demands, it has now become imperative to produce the quality raw materials in significant quantities. This can only be achieved to promote the domestication and cultivation of medicinal plants which have internal demand in large quantity and have export and import potential. During this study, the essential oil composition of different species of the Lamiaceae family were determined. Obtained data revealed that large variation exists based on the chemical compounds of species collected from different locations and altitudes. The investigated material will serve as genetic material for further breeding purposes.

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