

THE EFFECT OF WEATHER CONDITIONS IN 2014 ON MOISTURE OF SOIL PLANTED WITH HERBS, UNDER ORGANIC AND CONVENTIONAL PRODUCTION SYSTEMS

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SUMMARY

The effects of weather conditions (precipitation and average daily air temperatures) during the 2014 vegetation period on the moisture of soil planted with pot marigold (*Calendula officinalis* L.), peppermint (*Mentha x piperita* L.) and basil (*Ocimum basilicum* L.) under organic and conventional production system were analyzed. The analyses were carried out at the experimental fields of the Institute of Field and Vegetable Crops from Novi Sad; Alternative Crops and Organic Production Department in Bački Petrovac. Except for May, the temperatures were higher than for the multi-year average, which contributed to the increased plant evapotranspiration. The frequent precipitation moderately satisfied plant water requirements during the vegetation period. Soil moisture in the rhizosphere zone was generally at sufficient level of water supply. However, in the mid June and during the July soil moisture was at the level which requires irrigation. In organic production, due to better plant development and higher water consumption, occasional lower humidity of the soil was registered, when irrigation would be desirable. Although the sum of precipitation was higher in 2014 compared to the multi-year average, the results confirmed the importance of proper distribution of precipitation in order to maintain normal plant growth and development. **KEYWORDS:** average daily air temperatures, conventional production, medicinal plants, organic production, precipitation, soil moisture

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INTRODUCTION

Many parameters affect the success of plant production; most importantly the soil and weather conditions, grown hybrids or cultivars, and cultivation practices that are applied properly, timely and fully. Among the above, weather conditions are the most variable and the less predictable, however with significant effect on plant production. By analyzing weather conditions, we can explain the success of plant production to a great extent (Dragović et al., 2005), incidence of diseases and pests etc. (Kos et al., 2013; Škrinjar et al., 2013; Maksimović et al., 2014). Applying irrigation in order to regulate the water and therefore the nutrient regime of the cultivated plants can improve production conditions and yields (Dragović et al., 1999; Maksimović & Dragović, 2002).

The aim of this research was to examine the effect of precipitation and average daily air temperatures on the moisture of the soil planted with plant species: pot marigold (*Calendula officinalis* L.), peppermint (*Mentha x piperita* L.) and basil (*Ocimum basilicum* L.), which were grown in the conditions of organic and conventional production.

MATERIAL AND METHODS

The effects of the sum and the distribution of precipitation and average daily air temperatures during the 2014 vegetation period (April - September) on the moisture of the soil planted with pot marigold (*Calendula officinalis* L.), peppermint (*Mentha x piperita* L.) and basil (*Ocimum basilicum* L.) were studied. The analyses included crops under organic and conventional production regime. Soil samples were collected with a probe to the depth of 40 cm, twice a month during the studied period. Moisture was calculated using thermo-gravimetric method, by drying the samples at 105°C to a constant mass.

The experimental plots were located at the Institute of Field and Vegetable Crops from Novi Sad; Alternative Crops and Organic Production Department in Bački Petrovac (N 45°20', E 19°40', 82 m elevation). Data regarding precipitation and temperatures were collected from a Third order meteorological station located in the Department.

RESULTS AND DISCUSSION

The values of the average daily air temperatures during the 2014 vegetation period were higher than for the long-term average (Table 1), except for May and August. Although 2014 was slightly warmer comparing to long-term average values, temperature extremes and heat waves were not recorded; therefore it could be concluded that

temperatures did not significantly affect or disturb the growing season.

Sum of winter precipitation was 156.5 mm for the 2013/2014 hydrological year, which is 102.4 mm (39.6%) lower than for the long-term average (258.9 mm). The root system of the examined plant species is generally shallow, about 40 cm. At the beginning of the vegetation period, i.e. at the beginning of April, soil water reserves in the rhizosphere were insufficient. During the vegetation (except for June), monthly precipitation were above long-term averages. In May, July and September sums of precipitation were even two to threefold higher in comparison to the long-term averages. Total precipitation in the 2014 vegetation period was 605.5 mm, being the second highest in 30 years of monitoring in the Bački Petrovac meteorological station. Precipitation was higher only in 2010, when 636.1 mm was recorded.

Although precipitation was frequent, with 9 rainy days in June, 19 in July, 10 in August, and 15 in September, daily sums of precipitation were often low and therefore the daily plant water requirements were barely satisfied (Table 2). Soil moisture was at the 16% w/w level and even lower, indicating deficit of plant available water (Table 3). Periodically, drought affected all the three plant species in both organic and conventional production. It was more frequent in organic production, due to better plant development and therefore higher water consumption. The

Table 1. Average daily air temperatures and sum of precipitation, Bački Petrovac meteorological station, for 2014 and long-term (1984-2012) average

Period	Temperatures (°C)		Precipitation (mm)	
	2014	1984-2012	2014	1984-2012
Winter precipitation	-	-	156.5	258.9
April	13.6	12.2	88.0	46.2
May	16.9	17.8	178.5	61.4
June	21.1	20.5	23.2	82.6
July	22.4	22.2	146.0	63.4
August	21.2	22.0	53.8	51.8
September	17.5	16.8	116.0	48.0
Vegetation period	18.8	15.2	605.5	353.4
Hydrological year	-	-	762.0	612.3

Table 2. Daily precipitation (mm) for the 2014 vegetation period, Bački Petrovac meteorological station

Date	Month			
	June	July	August	September
1	0.4	8.2	2.0	8.5
2	0.2	-	-	6.8
3	-	1.4	-	26.0
4	-	1.0	0.9	1.6
5	-	-	-	1.7
6	-	2.2	18.8	-
7	-	-	-	-
8	-	-	15.6	-
9	-	-	-	-
10	-	16.0	-	4.7
11	-	10.4	-	15.7
12	0.2	9.5	-	4.1
13	-	-	-	3.5
14	-	3.3	-	19.2
15	-	-	0.8	7.5
16	-	2.6	-	-
17	2.8	13.8	4.5	-
18	1.4	3.8	-	-
19	-	4.3	-	-
20	0.1	0.1	-	8.4
21	-	-	0.1	3.6
22	-	-	0.2	3.9
23	-	3.6	-	-
24	-	1.4	6.8	-
25	9.5	-	-	0.8
26	7.8	-	-	-
27	0.8	5.2	-	-
28	-	8.8	4.1	-
29	-	27.4	-	-
30	-	-	-	-
31	/	23.0	-	/

Table 3. Soil moisture (% w/w; up to 40 cm depth) in medicinal plant organic (O) and conventional (C) crops, for 2014 vegetation period

Date	Crops					
	Pot marigold (C)	Pot marigold (O)	Peppermint (C)	Peppermint (O)	Basil (C)	Basil (O)
April 1	-	-	19.77	16.21	-	-
April 14	-	-	15.86	11.14	-	-
May 13	17.32	19.21	16.15	15.48	-	-
June 3	16.84	15.62	17.94	19.67	21.25	17.85
June 18	15.42	14.06	17.44	15.72	17.55	16.62
July 1	15.65	12.83	18.05	16.51	19.60	15.65
July 14	18.53	15.52	20.03	18.23	20.69	18.37
August 5	17.48	17.43	19.41	16.45	17.54	17.84
August 15	18.28	15.94	18.02	20.84	19.90	18.49
August 29	14.67	16.60	14.78	14.65	15.36	16.18
September 18	-	-	22.05	21.80	24.07	23.83

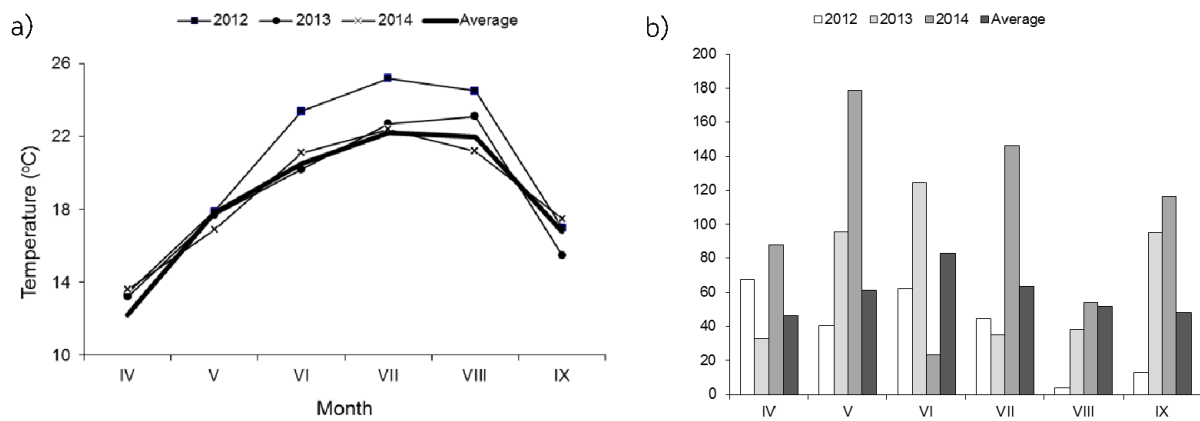


Figure 1. Average daily air temperatures (a) and sum of precipitation (b) at Bački Petrovac, for vegetation period 2012-2013 and long-term (1984-2012) average

highest water deficit was observed in pot marigold, while basil had the most efficient water consumption.

The results of the study indicate the significance of the precipitation distribution; since drought, which was noted periodically besides the overall ample amount of precipitation, decreases plant growth and yield, especially if occurs during the critical stages of plant development.

High discrepancies in monthly and yearly precipitation with respect to long-term values i.e. great variation in precipitation across the years is characteristic of our region (Spasova et al., 1999; Maksimović et al., 2013). Monthly precipitation during the vegetation period, for three consecutive years is shown in Figure 1. The results indicate the need for establishment and use of an irrigation system, in order to compensate the lack of precipitation i.e. its inadequate amount and distribution, as well as to stabilize and increase yields and quality of the grown crops.

CONCLUSION

The results of the analysis of meteorological elements precipitation and average daily air temperatures in the 2014 vegetation period, as the most important parameters influencing yield and quality of agricultural plants, revealed significant discrepancies with respect to long-term precipitation levels. Precipitation in the 2014 vegetation period was the second highest

in the 30-year period of observation in Alternative Crops and Organic Crops Department in Bački Petrovac. However, water requirements of the grown plant species (pot marigold, peppermint and basil) were not always fulfilled because soil water reserves were at the operating minimum or even lower, in shorter time intervals. Lower soil moisture was observed under organic production, which may be due to better development of plants and increased water consumption. Generally, pot marigold consumes the largest amount of water, and basil the lowest.

The effects of the uneven amount and distribution of rainfall during various growing seasons could be successfully regulated by the construction and application of irrigation systems.

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SAŽETAK

UTICAJ VREMENSKIH USLOVA U 2014. GODINI NA VLAŽNOST ZEMLJIŠTA POD LEKOVITIM BILJEM, U ORGANSKOM I KONVENCIONALNOM SISTEMU PROIZVODNJE

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Analiziran je uticaj vremenskih uslova, odnosno padavina i srednjih dnevnih temperatura vazduha, u vegetacionom periodu 2014. godine na vlažnost zemljišta pod mentom, nevenom i bosiljkom gajenih u sistemu organske i konvencionalne proizvodnje. Ispitivanja su vršena na oglednim poljima Odeljenja za alternativne kulture i organsku proizvodnju u Bačkom Petrovcu. Osim majskih, temperature vazduha bile su više od prosečnih višegodišnjih vrednosti, što je uticalo na povećanu evapotranspiraciju biljaka. Učestale padavine delimično su podmirivale potrošnju biljaka u periodu vegetacije. Vlažnost zemljišta u zoni rizosfere bila je najčešće na nivou dobre obezbeđenosti vodom, mada je polovinom juna i tokom jula registrovana vlažnost zemljišta na tehničkom minimumu. U organskoj proizvodnji, zbog bolje razvijenosti biljaka i veće potrošnje vode, povremeno je registrovana niža vlažnost zemljišta, kada bi navodnjavanje bilo poželjno. Iako je suma padavina u vegetacionom periodu 2014. godine bila veća od višegodišnjeg proseka, ponovo je potvrđen značaj rasporeda padavina za normalan rast i razviće biljaka.

KLJUČNE REČI: padavine, temperature vazduha, lekovito bilje, vlažnost zemljišta, organska proizvodnja, konvencionalna proizvodnja