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Weed flora of potato crop in Kosovo

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Abstract

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This study investigates the weed flora in potato crop in the area of the Republic of Kosovo. The weed flora in potato crop in Kosovo has not been studied in detail in the past; thus, data are insufficient and incomplete. In 2014, 100 plant relevès with a standard plot size of 25 m² were recorded in potato crop. To avoid edge effects, the minimum distance of each plot to the field border was 10 m. A total number of 67 species were documented, which were grouped into 58 genera and 26 families. In the flora of potato crop, representatives of the families *Asteraceae*, *Poaceae* and *Lamiaceae* are predominant. Species numbers per field ranged from 3 to 24 species per 25 m². Regarding plant life-forms, therophytes prevailed with 59.0%, followed by hemicryptophytes with 26.8% and geophytes with 11.2%, and others (3.0%) are less common. The phytogeographical analysis shows the dominance of Eurasian (22%), sub-Eurasian (18%) and cosmopolitan (18%) floristic elements. Relatively high species numbers and high proportions of perennial plants in the recorded fields may result from low levels of herbicide application in potato crop. Nevertheless, annual weeds predominate on potato crop, which, in general, is typical for cultivated arable land.

Keywords: potato; weeds; Kosovo
Abbreviations: Eurasian (Eur.); Sub-Eurasian (Subeur.); Cosmopolitan (Cosmo.); Adventive (Adv.); Sub Middle European (Subme.); Submediterranean (Subm.); Circumpolar (Circ.); Sub-Atlantic Submediterranean (Subatl.-subm.); Sub-Pontic Submediterranean (Subpont.-subm.); Sub Southsiberian (Subj.-sib.); Pontic East Submediterranean (Pont.-is.-subm); Middle European (Me.); Sub circumpolar (Sub.-circ.)

Introduction

In respect of the geographical position of Kosovo, edaphic, climatic and various anthropogenic influences have conditioned the formation of weed flora on arable lands. Weeds cause major problems in potato crop, thus significantly reducing its production. The study of weed flora and the presence of certain species as well as the phytocenological ratio between them constitute the basis for finding adequate, efficient and rational measures with which to protect crops from weeds. Potato (*Solanum tuberosum* L.) is one of the most important crops in the world. Potato is cultivated in and around Kosovo and the cultivated area comprises approximately 3,795 ha, with an average yield from 26 t/ha (Kosovo Agency of Statistics, 2017). The most spread weeds in potato crop in Kosovo are as follows:

Echinochloa crus-galli, Elymus repens, Amaranthus retroflexus, Setaria glauca, Chenopodium album, Cirsium arvense, Cynodon dactylon, Polygonum persicaria (Mehmeti, 2004). Almost the same dominant species were also reported in neighbouring countries (e.g. Jovovič et al., 2011; Trajčevski et al., 2001) and in Turkey (Kiliç, 2016).

According to Mehmeti et al. (2009), approximately 235 plant species occur in agricultural crops in Kosovo. Studies

of the weed flora in potato crop in Kosovo in the past are missing; thus, data are insufficient and incomplete. Around 30 to 40 years ago, the vegetation of Kosovo's arable land, meadows and orchards ('cultivated land') was documented in comprehensive studies (Laban, 1972; Banjska, 1977; Lozanovski et al., 1980; Kojić and Pejčinović, 1982; Pejčinović, 1987; Shala, 1987; Pejčinović and Kojić, 1988). According to these authors, the vegetation of cultivated land was species-rich at both plot and regional scales. Some recent comparative studies conducted in potato, wheat and vineyards in Kosovo (Mehmeti et al., 2013, 2015a; Fetahaj et al., 2017; Mehmeti et al., 2018) clearly exemplify a reduction in species richness resulting from herbicide application. Moreover, the aim of the research was the weed flora of potato crop in Kosovo to be presented related to floristic, ecological and phytogeographical aspects.

Material and Methods

In 2014, a total number of 100 plant relevès with a standard plot size of 5x5 m (25 m²) were sampled during vegetation in potato crop in three main localities wherein potato is cultivated. The location of each plot was recorded with the help of a GPS using the UTM system. The occurrence of vascular plants was estimated based on a modified Braun-Blanquet scale (Barkman et al., 1964). To avoid edge effects, the minimum distance of each plot to the field border was 10 m. For each plot, soil types were documented. Vegetation was surveyed between June and July. Weeds were determined in the laboratory of the Plant Protection Department in the Faculty of Agriculture and Veterinary of Prishtina University by using an atlas (Demiri, 1979; Mehmeti et al., 2015b), life forms, floristic elements, and nomenclature, as taken from Ellenberg et al. (1992), Gajić (1980) and Wisskirchen and Haeupler (1998).

Meteorological conditions

The climate of Kosovo is moderate continental with warm summers and cold winters. In some years, summers are very hot and dry, and the winters may be extremely cold. Air temperature may range from -20°C to 35°C. About 170-200 days per year are frost-free.

The mean annual rainfall is about 650 mm. However, in the western part of Kosovo, the annual rainfall is higher (about 780 mm) and the frost-free period is longer (up to 225 days) than in the eastern part, indicating pronounced Mediterranean climate influence. The elevation ranges from 265 m to 2656 m above sea level. The data for meteorological conditions were taken from the nearest weather forecast station of the studied localities.

During the research in 2014, air temperatures were slightly higher in July and August in both regions (Table 1), but the average temperature and the amount of rainfall were higher in the region of Prishtina (Table 2).

Results and Discussion

A total number of 67 weed species were documented. Most of the species (60) belong to broad-leaved species, while grasses comprised only seven weed species. Weeds largely depend on the type of soil. The soils of the investigated plant relevès belonged to seven soil types and the main soil types were fluvisol and vertisol, this also had an impact in the composition of weed flora in potato crop.

Table. 1. Mean air temperature (°C) in Prishtina and Ferizaj, 2014

Month												
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Average
Prishtina												
2.9	6.6	8.3	10.5	14.5	18.6	20.7	21.9	15.5	10.9	8.1	1.8	11.7
Ferizaj												
3.0	5.6	7.8	10.1	14.1	17.6	20.0	20.9	15.6	10.8	7.0	1.9	11.2

Source: Hydrometeorology Institute of Kosovo

Table. 2. Rainfall (mm) in Prishtina and Ferizaj, 2014

Month												
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Prishtina												
10.9	2.2	50.1	219	71.0	88.7	76.8	9.0	153	63.7	82.4	58.6	885.4
Ferizaj												
20.8	4.1	44.9	161	45.9	102	112	22.2	154	60.9	78.1	57.1	863.0

Source: Hydrometeorology Institute of Kosovo

Table. 3. The review of the weed flora of potato crop in Kosovo

Life forms	Weed species	Floral element
	1. Fam. *AMARANTHACEAE*	
T	*Amaranthus blitoides* S.Wats.	Adv.
T	*Amaranthus retroflexus* L.	Adv.
	2. Fam. *APIACEAE*	
T	*Bifora radians* M.Bieb.	Subm.
H	*Daucus carota* L.	Subeur.
	3. Fam. *ARISTOLOCHIACEAE*	
H	*Aristolochia clematitis* L.	Subm.
	4. Fam. *ASTERACEAE*	
T	*Ambrosia artemisifolia* L.	Adv.
T	*Anthemis arvensis* L.	Subse.
H	*Carduus acanthoides* L.	Subse.
T	*Centaurea cyanus* L.	Subm.
G	*Cirsium arvense* (L) Scop.	Subeur.
T, H	*Erigeron canadensis* L.	Adv.
T	*Galinsoga parviflora* Cav.	Adv.
T	*Matricaria chamomilia* L.	Eur.
H	*Sonchus oleraceus* L.	Subeur.
G, H	*Sonchus arvensis* L.	Eur.
H	*Tanacetum vulgare* L.	Eur.
H	*Taraxacum officinale* F.H. Wigg	Eur.
H	*Tragopogon pratensis* L.	Eur.
T	*Xanthium strumarium* L.	Adv.
	5. Fam. *BORAGINACEAE*	
H, G	*Symphytum officinale* L.	Subse.
	6. Fam. *BRASSICACEAE*	
T	*Capsella bursa-pastoris* (L.) Medik.	Cosmo.
T	*Diplotaxis muralis* L.	Subm.
T	*Sinapis arvensis* L.	Subeur.
	7. Fam. *CAROYPHYLLACEAEE*	
T	*Gypsophila muralis* L.	Eur.
H, C	*Silene vulgaris* Moench.	Subeur.
	8. Fam. *CHENOPODIACEAE*	
T	*Chenopodium album* L.	Cosmo.
T	*Chenopodium polyspermium* L.	Eur.
	9. Fam. *CONVOLVULACEAE*	
G, Hli	*Calystega sepium* L.	Eur.
G, Hli	*Convolvulus arvensis* L.	Cosmo.
	10. Fam. *EQUISETACEAE*	
G	*Equisetum arvense* L.	Circ.
	11. Fam. *EUPHORBIACEAE*	
T	*Euphorbia helioscopia* L.	Subeur.
	12. Fam. *FABACEAE*	
G, Hli	*Lathyrus tuberosus* L.	Subj.-sib.
C, H	*Trifolium repense* L.	Subeur.
	13. Fam. *GERANIACEAE*	
T	*Geranium molle* L.	Subeur.
	14. Fam. *LAMIACEAE*	
T, H	*Lamium purpureum* L.	Subpont.-subm.
G, H	*Mentha arvensis* L.	Circ.
H	*Prunella vulgaris* L.	Subeur.
T	*Stachys anua* L.	Subpont.-subm.
G	*Stachys palustris* L.	Circ.
	15. Fam. *MALVACEAE*	
T	*Hibiscus trionum* L.	Pont.is-subm.
	16. Fam. *PAPAVERACEAE*	
T	*Papaver rhoeas* L.	Subeur.
	17. Fam. *PLANTAGINACEAE*	
T	*Kickxia elatine* L.	Subatl.-subm.
T	*Kickxia spuria* L.	Subatl.-subm.
H	*Plantago lanceolata* L.	Eur.
H	*Plantago major* L.	Eur.
	18. Fam. *POACEAE*	
T	*Alopecurus mysourides* Huds.	Eur.
G	*Elymus repens L.*	Eur.
T	*Echinochloa crus-galli* L. P. Beau	Cosmo.
T, H	*Poa annua* L.	Cosmo.
T	*Setaria glauca* Poir.	Cosmo.
T	*Setaria viridis* L.	Subeur.
H	*Sorghum halepense* (L.) Pers.	Subeur.
	19. Fam. *POLYGONACEAE*	
Tli	*Fallapia convolvulus* (L.) A. Löve	Subeur.
T	*Polygonum aviculare* L.	Cosmo.
T	*Persicaria lapathifolia* Opiz.	Subcirc.
T	*Persicaria maculosa* Gray	Eur.
	20. Fam. *PORTULACACEAE*	
T	*Portulaca oleraceae* L.	Cosmo.
	21. Fam. *PRIMULACEAE*	
T	*Anagalis arvensis* L.	Cosmo.
	22. Fam. *ROSACEAE*	
z, li	*Rubus caesius* L.	Subj.-sib.
	23. Fam. *RUBIACEAE*	
Tli	*Galium aparine* L.	Eur.
	24. Fam. *SCROPHULARIACEAE*	
G, H	*Linaria vulgaris* Mill.	Subse.
H	*Veronica agrestis* L.	Me.
T	*Veronica hederifolia* L.	Subse.
T	*Veronica persica* Poir.	Adv.
	25. Fam. *SOLANACEAE*	
T	*Datura stramonium* L.	Cosmo.
T	*Solanum nigrum* L.	Cosmo.
	26. Fam. *VIOLACEAE*	
T	*Viola arvensis* L.	Eur.

Legend: T: therophyte; G: geophyte; H: hemicryptophyte; z: chamaephyte; li: liane

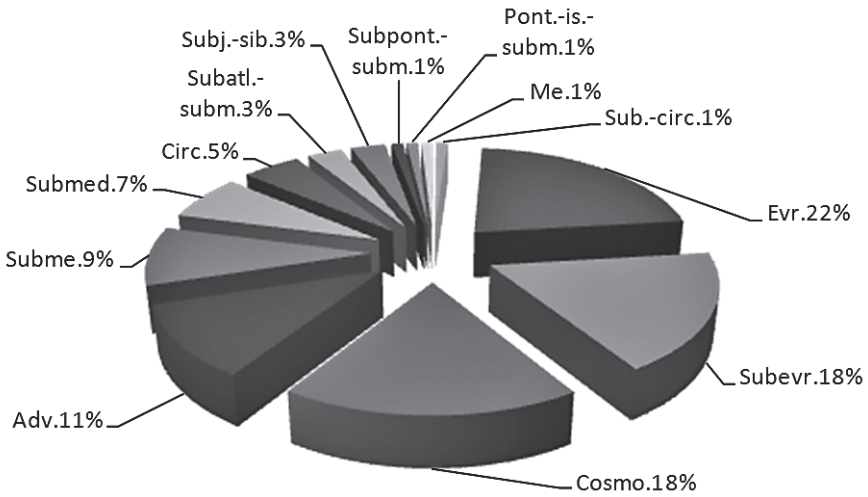

Fig. 1. Floral elements in the potato crop weed flora of Kosovo (%)

However, if we compare the results for the number of weed species with the researches carried out by Nikolić et al. (2013), who found 39 weed species in potato crop, and Pawlonka et al. (2015), who found 31 species, the number of species in our country is higher.

The mean species number per plot was 9.3 species. However, Mehmeti et al. (2008) showed that weed flora in potato crop in Kosovo is species-poor at the field scale (around 8.0 weed species per 25 m^2). The comparison of families' presence highlights the predominance of *Asteraceae* (with 13 genera and 14 species), *Poaceae* (with six genera and seven species), and *Lamiaceae* (with four genera and five species). These results in respect of the dominance of *Asteraceae*, *Lamiaceae* and *Poaceae* weed species in potato crop are in accordance with Nikolić et al. (2013) and Stešević and Jovović (2002). The most frequent species were *Convolvulus arvensis* L., *Fallopia convolvulus* L., *Echinochloa crus-galli* L.P.Beauv., *Cirsium arvense* (L.) Scop., *Datura stramonium* L., *Persicaria lapathipholia* L., *Chenopodium album* L., *Amaranthus retroflexus* L., *Equisetum arvense* L., and *Lathyrus tuberosus* L. However, in potato crop, some farmers use herbicides and some of them mechanical measures to combat weeds. These herbicides and mechanical measures affect the weed flora and yield in potato crop in different ways. This was reported by Uremis et al. (2009), Mehmeti et al. (2015a) and Hagman et al. (2009). Furthermore, herbicide treatments, as well as cultivation (earthing up) significantly impoverished weed flora of potato crop (Ilić et al., 2016).

Regarding plant life-forms, therophytes prevailed with 59.0%, followed by hemicryptophytes with 26.8% and geophytes with 11.2%, and others (3.0%) are less common. Moreover, the weed flora in potato crop was largely identical between the plots in this study (Table 3).

These results in relation to the life form of therophytes are matching the research conducted by Mehmeti (2004), in the southeastern part of Kosovo, but not of hemicryptophytes (1.3%), which were less important in the southeastern part of Kosovo. This difference may be explained by the fact that our research was conducted with several different types of soil, and management, while the research in 2004 was conducted in small, experimental potato fields.

However, given this result, the proportion of annual species was 67%, while that of perennial species was relatively high (33%). Moreover, the results are in line with Mehmeti et al. (2014), who showed that some perennial species were frequent on arable land, indicating a low 'intensity' of arable cultivation. Moreover, regarding the results of Pejčinović (1987), who analysed the weed vegetation in cultivated arable fields of Kosovo with respect to life forms, proportions of therophytes were low in row crops (29-66%), whereas proportions of hemicryptophytes were high in row crops (15-52%). Furthermore, it is important to mention that the number of weed species belonging to the hemicryptophytes and geophytes are quite higher. The floristic analysis showed that weed flora of potato crop is dominated by plants from Eurasian (22%), sub-Eurasian (18%) and cosmopolitan (18%) floristic elements.

However, if we compare floristic elements with the results of Nikolić et al. (2013), it is noticed that cosmopolitan species have the highest percentage in conventional potato crop. Furthermore, Stešević and Jovović (2005) studied the potato crop weed flora in Montenegro in respect of floristic

elements and predominance in the number of species as well as in quantitative presence belonging to the Eurasian area group, which are in line with our results.

Knowing the weed flora composition along with the application of modern agricultural techniques, appropriate soil cultivation, and the use of combining herbicides for potato crop, the weed threshold can be reduced to a reasonable and tolerant measure.

Conclusions

In potato crop we found 67 weed species from 120 genera and 26 families. The dominant weed species in potato crop were *Convolvulus arvensis* L., *Fallopia convolvulus* L., *Echinochloa crus-galli* L.P. Beauv and *Cirsium arvense* (L) Scop., *Datura stramonium* L., *Persicaria lapathipholia* L., *Chenopodium album* L., *Amaranthus retroflexus* L., *Equisetum arvense* L., and *Lathyrus tuberosus* L.

Regarding the floristic spectrum of potato crop weed flora, the *Asteraceae* family predominates, followed by *Poaceae* and *Lamiaceae*.

With regard to the plant life-forms, therophytes prevailed with 59.0%, followed by hemicryptophytes with 26.8%, geophytes with 11.2%, and others (3.0%) are less common.The phytogeographical analysis shows the dominance of Eurasian (22%), sub-Eurasian (18%) and cosmopolitan (18%) floristic elements.

The application of herbicides and agricultural technical measures impacts upon the weed flora of potato crop; however, the 'intensity' of arable cultivation is obviously still low.

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