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EFFECT OF CULTURAL PRACTICES ON WEEDS COMMUNITY IN FUNCTION OF POTATO YIELD

Olivera Ilić, Ljiljana Nikolić, Žarko Ilin, Andjelko Mišković, Vuk Vujasinović, Branimir Kukić

University of Novi Sad, Serbia

Abstract. In the paper are presented results of three years studies performed in the period 2008–2010 on effects of cultural practices in stands of *Panico-Galinsogetum* Tx. et Beck. 1942. association in conventional potato production on the experimental plots in the vicinity of Becej (Northern Serbia). Composition of association *Panico-Galinsogetum* in experimental control variant builds 31 weed species. From *Panico-Galinsogetum* community, in the variant with one cultivation (with earthing up) without herbicide applying was found 22 weed species, and at the variant with two cultivation without herbicide 17 weed species, respectively. Herbicide treatments of potato crops as well as cultivation led to significant impoverishment of the weed flora, i.e., reduction in number of weed species, their coverage value, as well as the degree of presence in potato crop. Due to reduction of weed infestation, in variants untreated by herbicides, by application of two cultivations, achieved potato yield was for 8% higher in comparison to the variant with one cultivation. In variants treated by herbicides, potato yield was for 32% higher in relation to the yield on untreated experimental variants. The average number of tubers per plant achieved in variants treated by herbicides was for 40% higher in comparison to the number of tubers in untreated variants. In both cases, in comparison to control variant, cultivation resulted in significantly higher number of tubers per plant.

Key words: weed infestation, *Solanum tuberosum* L., conventional production, number of tubers per plant, ass. *Panico-Galinsogetum* Tx. et Beck. 1942

INTRODUCTION

Weed has long been known as a component of agricultural ecosystems and one of the main factors reducing the crop yield [Kołota and Chohura 2008, Týr 2008]. Under-

Corresponding author: Olivera Ilić, University of Novi Sad, Faculty of Agriculture, Department of Field and Vegetable Crops, Dositeja Obradovića 8, 21000 Novi Sad, Serbia, e-mail:oliverai@polj.uns.ac.rs

standing the correlation between crops and weeds in agro ecosystems is very important. Presence, growth, and population density of weed species in each filed is strongly associated with agricultural practices [Hassannejad and Navid 2013]. As reported by Woźniak and Soroka [2015] the number and weight of weeds as well as their species diversity depend on the method and period of cultivating measures applied. Numerous agronomic factors such as crop rotation, tillage systems, crop variety, sowing date, seeding rate, row and plant spacing, irrigation, application of cultivation and fertilization management have been evaluated for their potential to manage weeds [Conley et al. 2001, Filizadeh et al. 2007, Erfanifar et al. 2008, Hamouz et al. 2014, Woźniak and Soroka 2015a].

Damages caused by weeds in potato crops can be severe, diverse and permanent [Uremis et al. 2009, Boydson 2010]. The composition of weed flora in a potato crop is the result of abiotic environmental factors, specific microclimate formed by plants of potato, and human activity which determines the growing conditions, intensity and quality of agricultural measures applied [Eberlein et al. 1997, Vrbnicanin et al. 2009]. Cultural practices reduce weed infestation of the crop, depending upon intensity of their application, the character of weed infestation, agro-meteorological conditions [Djukic et al. 2000, Boydston and Vaughn 2002, Hagman et al. 2009]. According to Ajder [1992], in addition to high efficiency in weed control, herbicide application can lead to a number of consequences, including changes in floristic composition and structure of weed communities. Besides of that, majority of weeds have become resistant to herbicides thus researchers used new methods for weeds control which are included mechanical and integrated methods [Gruszecki et al. 2015, Makarewicz et al. 2015]. In this respect, the aim of these studies was to present how effects of cultural practices influence the composition of weed flora, phytocoenological relations and distribution of weed plants in potato crop in conventional production, i.e. manners in which populations of weed plants can be reduced by combination of mechanical weed control (by cultivation with earthing up) and by herbicide application to the level of minimal inconvenient effects to potato production, in function of the potato yield increase.

MATERIALS AND METHODS

In the period 2008–2010, on experimental plots in Backo Petrovo Selo, Vojvodina, the Republic of Serbia (45°40’15”N; 20°04’44”E) studies were performed in order to evaluate the effects of cultural practices on weed control and potato yield in conventional production. The experiment was conducted in split-plot design in 5 replications, and the plot area was 25 m^2. In the study was used Aladdin cultivar. The planting material was of the class A-original, with the fraction of 35–50 mm in diametar. Tubers for planting were previously germinated with the total germination length of five weeks. Planting was accomplished mechanically at a depth of 8–10 cm, with forming of banks. Inter-row distance was 70 cm, and distance between plants within a row was 30 cm. In all three years of the study, previous crop to potato was wheat. Planting was performed on 20th March 2008, 28th March 2009 and 29th March 2010. Tillage, fertilization and soil preparation for planting, application of mineral fertilizers, planting, followed by

corresponding cultural practices and herbicide application were conducted in the usual manner for conventional way of potato growing and production. In potato crops, after emerging, and before inter-row cultivation, elementary parcels of 5 × 5 m in size, in 5 replications with two protective rows were marked. In each year of study, before the start of the growing season of potato, the chemical analysis of soil (0–30 cm depth) were carried out. Soil of the experimental plots was sandy loam with moderately alkaline pH value (pH_{H2O} = 8.55), low to medium content in humus (1.92%), medium nitrogen content (total N = 0.165%), optimal content of phosphorus (P_2O_5 = 22.3 mg 100 g^{-1}) and potassium (K_2O = 20.1 mg 100 g^{-1}), with content $CaCO_3$ in the soil 7.98%. Results of the analysis were used to choice the of formulation and the amount of required nutrients. For basic fertilization were used: Yara Mila 13:13:21 (420 kg – in the spring seedbed preparation), Yara Mila Cropcare 11:11:21 (120 kg – an intense increase in plant height 15 cm), AN (Amonium nitrate) (100 kg – an intense increase in plant height 25 cm).

Experimental variants. On experiment plots two-factorial experiment was set up: 1st factor **(A)** was based on two levels: a_1 – conventional potato production with herbicide application, a_2 – conventional potato production without herbicide use; 2nd factor **(B)** was based on three levels: b_1 – control variant (soil tillage and planting, without cultivation and weed protection measures), b_2 – conventional potato production with one inter-row tillage (with earthing up), b_3 – conventional potato production with two inter-row tillages (with earthing up). In all three years of studies on the marked plots, the first inter-row tillage with earthing up was accomplished a month and the other two months (± 5 days) after planting. Herbicides that represented combination of active ingredients pendimethalin (Stomp: 5 l ha^{-1}), metribuzin (Sencor: 0.5 kg ha^{-1}) and fluazifop-p-butyl (Fusilade forte: 1.5 l ha^{-1}) were used on treated plots. The samples for analysis of the yield components were taken each 15 days from the beginning of June of every year of the study, and during last taking of the samples, total yield of tubers was measured.

Plant material and phytocoenological parameters. Collection of plants for herbarium and determination of weed species was performed in Laboratory for the Study of Plant Material at the Faculty of Agriculture in Novi Sad. Determination of plant material was performed according to Josifovic [1970–1977] and Tutin et al. [1960–1980]. Nomenclature and taxonomy were provided according to Josifovic [1970–1977]. Phytocoenological research of weed plants on experimental plots were performed according to the method of Braun-Blanquet [1964]. Degree of presence of weeds occurrence was evaluated using the following scale: V – permanent species that occur in 80–100% of the examined plots, IV – frequent species (60–80%), III – moderately frequent species (40–60%), II – not-frequent species (20–40%), and I – rare or poradically occurring species (<20%). Abundance, coverage and sociability of each species was measured by Braun-Blanquet scale (from "+" to "5").

Phytocoenological screenings were made three times during potato growing season, in all plots that were 25 m^2 in size, and comprised all crop rows, including the first screening at the beginning of potato flowering, the second a month later and the third a week before harvest. Examination of vegetation units, as well as syntaxonomic position of determined communities was established according to the Kojic et al. [1998].

Statistical analysis. The obtained results are given in tables and graphics with integrated statistical analysis of the presented parameters. Basic data were processed by use of statistical methods of variance analysis, regressive and correlative analysis (statistical software GenStat 12th Edition; experiment version).

RESULTS AND DISCUSSION

Floristic-phytocoenological analysis of weed species in conventional potato production in experimental control variant showed that determined compositions belong to the association of *Panico-Galinsogetum* Tx. et Beck. 1942 [Kojic et al. 1998], alliance *Polygono-Chenopodion* (Koch 1926. em Sissingh 1946), order *Chenopodietalia albi* (Tx., Lohm. et Prsg. 1950) and to the class *Stellarietea mediae* (Tx., Lohm. et Prsg. 1950). Determined community is the most typical segetal weed community in Serbia [Kojic and Janjic 1994]. Regional characteristics of the association are results of geographic, ie climatic and edaphic differences, and especially growing conditions which is consistent with the statements of the Silc et al. [2009]. Similar to other segetal communities of a row character, the association *Panico-Galinsogetum* is exposed to strong human interventions, leading to its impoverishment.

Floristic composition, i.e. qualitative and quantitative participation of weed species in association *Panico-Galinsogetum*, in experimental control variant (**CNT**) is given in synthetic phytocoenological table (tab. 1). Composition of association *Panico-Galinso--getum* in potato crop builds 31 weed species. Relative floristic poverty is the consequence of numerous cultural practices and intensive herbicide application. In relation to this, many characteristic species of the association, row and class are less represented or completely absent [Knezevic and Baketa 1990]. Also, the results of our study are compatible with earlier results which are related to the floristic composition and structure of weed community in the potato crop [Týr 2008, Ilic and Nikolic 2011, Nikolic et al. 2013].

Both of the characteristic species, *Panicum crus-galli* and *Galinsoga parviflora*, showed significant presence in associations of this community and provide it basic characteristic. It is important to point out significance of the species *Panicum crus-galli*, which is, despite strong anthropogenic effect in this community represented in great abundance and high degree of presence (1235 or 21.5%). Similar results are recorded and Kojic et al. [1993], which stated that *Panicum crus-galli* occurs in all stands in ass. *Panico-Galinsogetum*, with the degree of the presence of V and IV and with cover values from 117 to 1567, which in some cases represents over 17% compared to covered values of all types of communities.

The other characteristic species, *Galinsoga parviflora*, is somewhat less distributed due to higher herbicide susceptibility. From the same reasons, relatively small number of the species builds characteristic association: *Amaranthus retroflexus*, *Panicum crus-galli*, *Polygonum convolvulus*, *Cirsium arvense*, *Sorghum halepense*, *Convolvulus arvensis* (presence degree V), *Polygonum persicaria*, *P. lapathifolium* and *Solanum nigrum* (IV), and these species in potato crops were also recorded by Sinzar et al. [1992].

Table 1. The association of *Panico-Galinsogetum* in conventional potato production

	Experimental variants*	CNT	1cNT	2 cNT	CT	1cT	2 cT
Characteristic species of the association *Panico-Galinsogetum* Tx. et Beck. 1942	*Panicum crus-galli* L.	V+-3	IV+-2	III+-1	III+-1	II+	–
	Galinsoga parviflora Cav.	III+-1	I+	II+-1	–	–	–
Characteristic species of the alliance *Polygono-Chenopodion* Koch 1926. em Sissingh. 1946	*Setaria glauca* P.B.	III+-1	II+	II+-1	–	–	–
	Digitaria sanguinalis Scop.	II+	II+	–	I+	–	–
Characteristic species of the order *Chenopodietalia albi* Tx., Lohm. et Prsg. 1950	*Amaranthus retroflexus* L.	V+-3	IV+-2	IV+-2	II+-1	II+-1	II+
	Polygonum lapathifolium L.	IV+-2	IV+-1	IV+-1	–	I+	I+
	Solanum nigrum L.	IV+-2	IV+-1	III+-1	III+	–	–
	Chenopodium album L.	II+	II+	III+	II+	I+	I+
	Capsella bursa-pastoris (L.) Med.	II+	–	–	–	–	–
	Sonchus oleraceus L.	I+	–	–	–	–	–
	Chenopodium hybridum L	I+	I+	I+	–	–	–
Characteristic species of the class *Stellarietea mediae* Tx., Lohm. et Prsg. 1950	*Sinapis arvensis* L.	II+	III+-1	II+-1	–	I+	I+
	Stellaria media L.	II+	I+	–	–	–	–
	Erigeron canadensis L.	I+	I+	I+	–	–	–
	Sonchus arvensis L	I+	I+	–	–	–	–
Accompanying species	*Polygonum convolvulus* L.	V+-1	IV+-1	IV+-2	II+	–	–
	Sorghum halepense L	V+-2	IV+-2	III+-2	II+	–	–
	Convolvulus arvensis L.	V+-2	III+-1	IV+-1	II+	II+	II+
	Cirsium arvense (L.) Scop.	V+-3	V+-2	IV+-1	II+-1	II+-1	I+
	Polygonum persicaria L.	IV+-2	III+	I+	–	–	–
	Matricaria chamomilla L.	III+-1	–	–	–	–	–
	Agropyrum repens (L.) Beauv.	II+-1	II+	I+	I+	I+	–
	Ambrosia artemisiifolia L.	II+	–	I+	–	–	–
	Matricharia inodora L.	II+-1	–	–	–	–	–
	Portulaca oleracea L.	I+	–	–	–	–	–
	Cynodon dactylon (L.) Pers.	I+	II+	–	–	–	I+
	Xantium strumarium L.	I+	II+	–	I+	–	–
	Cuscuta epithymum L.	I+	–	–	–	–	–
	Senecio vulgaris L.	I+	II+	–	–	–	–
	Polygonum aviculare L.	I+	–	–	–	–	–
	Datura stramonium L.	I+	–	–	–	–	–
Total		31	22	17	11	8	7

Experimental variants*: CNT – control, no herbicide treatment; 1cNT – one cultivated, no herbicide treatment; 2cNT – two cultivated, no herbicide treatment; CT – control, herbicide treatment; 1cT – one cultivated, herbicide treatment; 2cT – two cultivated, herbicide treatment; presence degree: I–V

In control, untreated experimental variant, two species from *Polygono-Chenopodium* alliance, *Setaria glauca* and *Digitaria sanguinalis* had lower degree of presence (III and II). For seven found species characteristic for the order *Chenopodietalia albi*, three of them, *Amaranthus retroflexus*, *Polygonum lapathifolim* and *Solanum nigrum* had higher degree of presence, belonging to the characteristic group. Four species, characteristic for *Stellarietea mediae* class were present with low values of coverage and degree of presence. Accompanying species were numerous, with degree of presence V

(*Polygonum convolvulus*, *Cirsium arvense*, *Sorghum halepense*, *Convolvulus arvensis*), IV (*Polygonum persicaria*) and III (*Matricaria chamomilla*), increasing community floristic richness (tab. 1).

Three years of phytocoenological studies revealed that stands of *Panico-Galinsogetum* association in the experimental variant of one cultivation (earthing up) without herbicide application (**1cNT**) led to occurrence of 22 weed species. Two characteristic species were present in associations *Panicum crus-galli* and *Galinsoga parviflora*. Relatively low number of species builds characteristic composition: *Cirsium arvense*, *Amaranthus retroflexus*, *Panicum crus-galli*, *Polygonum convolvulus*, *P. lapathifolium*, *Sorghum halepense* and *Solanum nigrum* (IV).

Results obtained from three years study suggest that stands of the association *Panico-Galinsogetum* in the experimental variant with two cultivations (earthing up) without herbicide use in potato crop (**2cNT**) built 17 weed species. Despite application of these cultural practices, community still retained its basic characteristic. Both of the characteristic species, *Panicum crus-galli* and *Galinsoga parviflora*, were present in stands of the association. Characteristic stand built species *Amaranthus retroflexus*, *Polygonum convolvulus*, *P. lapathifolium*, *Cirsium arvense* and *Convolvulus arvensis* (IV).

Results of the study proved that application of cultivation (with earthing up) as mechanical weed control measure in potato crop showed satisfactory efficiency, i.e. in these experimental variants participation of weeds was per 29%, i.e. 45% lower in comparison to the control. These cultural practices have resulted in reduction of a certain number of weeds, as well as on coverage and sociality of present weeds, but at a lower degree. However, in addition to the effect of these cultural practices, although reduced weed community maintained its basic syntaxonomic feature. The reason for this is in shorter effect of this cultural practice on weeds, due to which weed community is quickly renewed by emergence of new plants, but also because of the increased participation of perennial weeds (geophytes).

In potato agro-phytocoenosis, in variants with herbicide treatment and without cultivation (earthing up) (CT), 11 weed species were found. Relative floristic poverty is above all the consequence of herbicide application. Numerous results of other authors suggest that continuous application of herbicide causes a significant impoverishment of the weed flora and leads to changes in composition and structure of weed community [Knezevic and Baketa 1990, Ajder 1992, Boydston and Vaughn 2002].

Also, as the result of herbicide use, degree of presence and values of weed coverage were extremely low. The most represented annual plants were *Panicum crus-galli* and *Solanum nigrum*, and the most represented perennial plants were *Cirsium arvense*, *Convolvulus arvensis* and *Agropyrum repens* to which herbicides showed lower effect. In reduced weed community of the association *Panico-Galinsogetum*, characteristic species *Panicum crus-galli* was presented with lower degree of presence (III) and low coverage value that was even 94% lower in comparison to control variant. From the alliance *Polygono-Chenopodion* only one species, *Digitaria sanguinalis* had the presence degree I. Three characteristic species of the order *Chenopodietalia albi* occurred, of which only one (*Solanum nigrum*) had presence degree III. From the category of accompanying plants, only 6 species had low degree of presence (II and I) indicating floristic poverty of the stand (tab. 1).

In potato agro-phytocoenosis, in variants with herbicide treatment and one cultivation (1cT), 8 weed species were found. That is, the experimental variants with herbicide treatments and two cultivations (earthing up), resulted with establishment of only 7 weed species (2cT). Low abundance, coverage and sociality of present weeds in community are the consequence of herbicide application, as well as of cultivation, i.e. earthing up.

Results of the study suggest that herbicide treatments, as well as cultivation (earthing up) significantly impoverished weed florae on the studied plots, i.e. in this part of the experiment a higher number of weed species was reduced, and weed distribution in potato was lower. Herbicide use controlled 65% of present weed species, and combinations of cultivation (earthing up) and herbicides, 74%, i.e. 77% weed species, in comparison to control (tab. 1). Due to this it can be freely concluded that *Panico-Galinsogetum* association in experimental variants with herbicide use was significantly reduced and lost its basic synmorphological characteristics, therefore for these variants real alliances of the given association cannot be discussed.

Number of tubers per plant. Herbicide treatments of potato crops and cultivation had significant effect on the number of tubers per plant (tab. 2).

Table 2. Number of tubers per plant depending on no. of cultivations and herbicide application

Number of cultivations (B)		2008–2010			
		herbicides (A)			average (B)
		untreated		treated	
Control		11.4		16.1	13.7
1 cultivation with earthing up		14.1		19.2	16.6
2 cultivations with earthing up		14.3		20.4	17.3
Average (A)		13.3		18.6	15.9
	A	1.2		A	1.7
LSD	B	1	LSD	B	1.4
0.05	A × B	1.1	0.01	A × B	1.8
	B × A	1.7		B × A	2

The average number of tubers per plant achieved in variants with herbicide treatment was for 40% higher in comparison to the number of tubers in untreated variants, and difference was highly significant. The highest number of tubers per plant was obtained in variant with two cultivations being for 4% higher in relation to the variant with one cultivation. In comparison to the control variant, in both cases cultivation resulted in significantly higher number of tubers per plant, and differences were highly significant. The results obtained in accordance with the results of other authors [Bugarcic et al. 2000, Djukic et al. 2000].

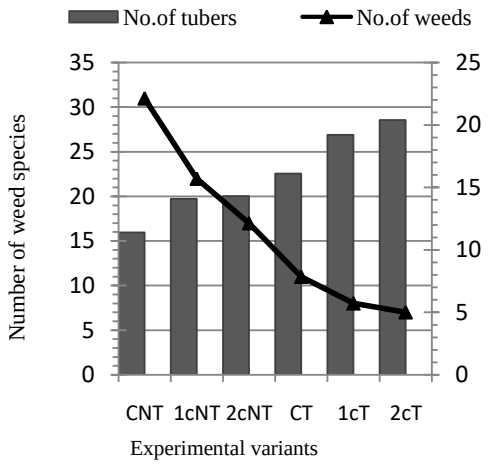

Fig. 1. Dependence of number of tubers per plant and number of weed species

The Figure 1 presented dependence of number of tubers per plant and presence of weed species per experimental variant suggest that decrease in weed infestation led to significant increase in number of tubers per plant. On untreated variants with cultivation, number of tubers per plant increased for 24–25%, and on treated variants increase was 68% (1cT), i.e. 79% (2cT) in comparison to the control.

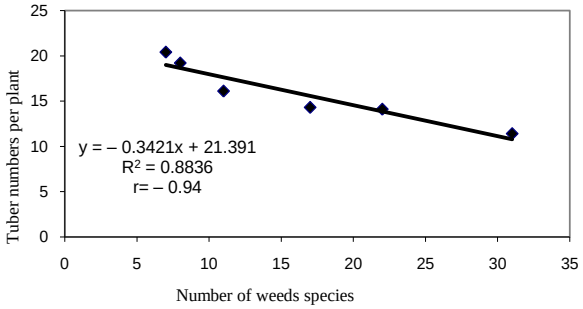

Fig. 2. Correlation of number of tubers per plant and number of weed species

The Figure 2 is presented strong negative linear correlation (r = -0.94) between number of weed species and number of tubers per plant, i.e. with reduction in number of weed species, number of tubers increased. This correlation was statistically significant on the significance threshold $\alpha = 0.01$. Dependence of number of tubers was explained with 88.4% ($R^2 = 0.8836$) by influence of number of weed species, and with 11.6% by influence of other, unstudied factors.

Potato yield. Potato crop treatment by herbicides and cultivation (with earthing up) led to reduction of weed infestation in potato, which significantly reflected to the yield and potato yield components, depending upon the experimental variant (tab. 3).

Table 3. Potato yield (t ha^{-1}) depending upon number of cultivations and herbicide use

No. of cultivations (B)		2008–2010			
		herbicides (A)			average (B)
		untreated		treated	
Control		34.03		44.05	39.04
1 cultivation with earthing up		41.16		52.5	46.83
2 cultivations with earthing up		42.53		58.76	50.65
Average (A)		39.24		51.77	45.51
	A	3.63		A	5.11
LSD	B	3.01	LSD	B	4.01
0.05	AXB	4.95	0.01	AXB	5.73
	BXA	4.33		BXA	6.62

The average potato yield on the experimental variants with herbicide treatment was for 32% higher in comparison to the yield in the untreated variants, and difference was statistically significant, which fully confirms the results of Hamouz et al. [2005] and Uremis et al. [2009]. Irrespective of herbicide use, the highest potato yield was achieved by two cultivations and it was for 8% higher in relation to the variant with one cultivation, and difference was statistically significant. In comparison to the control variant, in both cases, cultivation resulted in significantly higher potato yield, and differences were highly significant. The results are compatible with results Eberlein et al. [1997] and Hagman et al. [2009], which stated that in conditions of low weed infestation, mechanical weed control and earthing up potatoes, it is possible to realize the yield of potatoes as variants which include herbicide application.

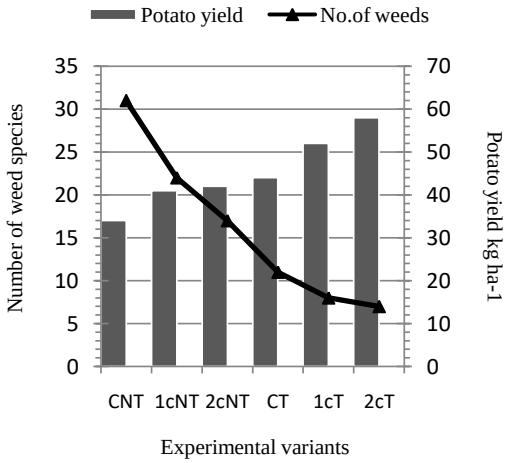

Fig. 3. Dependence of potato yield and number of weed species per experimental variants

The Figure 3 is presented dependence between number of weed species and potato yield, with a significant reduction in number of weed species depending upon the applied cultural practices with concurrent increase in potato yield, in relation to the experimental variant. In untreated variants yield was for 21%, i.e. for 24% higher in comparison to the control, while in the treated variants increase in yield was 29% (CT) to 72% (2cT).

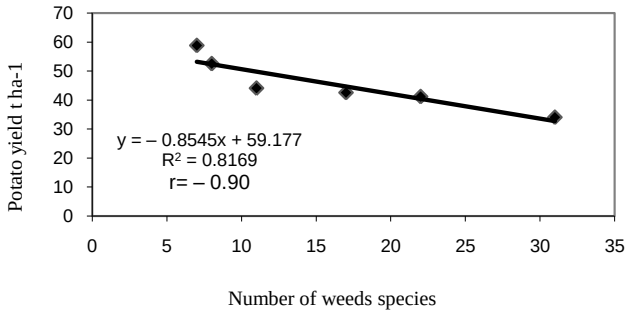

Fig. 4. Correlation dependence of potato yield (t ha^{-1}) on number of weed species

Dependence of potato yield and number of weed species per experimental variants (average for three years of the study) was also established by correlation analysis (fig. 4). Strong negative linear correlation (r = -0.90) was established between present weed species and the potato yield (t ha^{-1}), i.e. reduction in weed number resulted in yield increase. This correlation was statistically significant on the significance threshold $\alpha = 0.05$. Dependence of potato yield was explained with 81.7% ($R^2 = 0.8169$) by the influence of present weed species, and with 18.3% by the influence of other, unmeasured factors, which is consistent with the statements of the Jaiswal [1994].

CONCLUSION

Floristic-phytocoenological analysis of weed plants revealed that established association *Panico-Galinsogetum* belongs to the alliance *Polygono-Chenopodion*, the order *Chenopodietalia albi* and the class *Stellarietea mediae*. Both characteristic species, *Panicum crus-galli* and *Galinsoga parviflora*, have a significant presence in the community and give it basic feature, and relatively small number of species build characteristic groups. In experimental variants with cultivation and herbicide application, association stands suffered significant impoverishment, and therefore typical stands of this association cannot be discussed.

The average potato yield achieved in variants with herbicide application was for 32% higher in comparison to the average yield in untreated experimental variants. Therefore, cultivation that reduced weed infestation showed positive effect to the potato yield. Thus, compared to the control variant, in both cases cultivation led to a significantly higher potato yield.

Despite high efficiency in weed control achieved by herbicide application, we concluded that even simple mechanical weed control gave acceptable results, enabling us higher possibility and wider use of these cultivation practices in alternative systems of weed control for herbicide reduction and obtaining of healthy food with energy preservation and environmental protection.

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WPŁYW PRAKTYK UPRAWOWYCH NA ZBIOROWISKO CHWASTÓW W PLONIE ZIEMNIAKA

Streszczenie. Praca przedstawia rezultaty trzech badań przeprowadzonych w latach 2008–2010 i dotyczących wpływu praktyk uprawowych na stanowiskach *Panico-Galinsogetum* Tx. et Beck. 1942 w konwencjonalnej produkcji ziemniaka na poletkach doświadczalnych w pobliżu Becej (Północna Serbia). Skład *Panico-Galinsogetum* w wariancie

kontroli doświadczenia obejmował 31 gatunków chwastów. W wariancie z jednym zabiegiem (z przysypywaniem ziemią) bez herbicydu znaleziono 22 gatunki chwastów z *Panico-Galinsogetum*, a w wariancie z dwoma zabiegami bez herbicydu stwierdzono 17 gatunków. Zastosowanie herbicydów w uprawie ziemniaka doprowadziło do znacznego zubożenia flory chwastów, tzn. do redukcji liczby chwastów, ich wartości rozprzestrzeniania się oraz obecności w uprawie ziemniaka. Dzięki zmniejszeniu zachwaszczenia w wariantach bez herbicydów zastosowanie dwóch zabiegów doprowadziło do plonu ziemniaka o 8% większego w porównaniu z wariantem z jednym zabiegiem. W wariantach z herbicydami plon ziemniaka był o 32% większy w porównaniu z plonem w wariantach bez zabiegów. Średnia liczba bulw na roślinę w wariantach z herbicydami była o 40% większa w porównaniu z liczbą bulw w wariantach bez zabiegów. W obydwu przypadkach zabieg dał istotnie większą liczbę bulw na roślinę w porównaniu z kontrolą.

Słowa kluczowe: zachwaszczenie, *Solanum tuberosum* L., produkcja konwencjonalna, liczba bulw na roślinę, ass. *Panico-Galinsogetum* Tx. et Beck. 1942

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