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Studies on Introduction of Weed-Control and Soil Tillage in *Solanum Tuberosum* L. Cultivation in Poland

Hanna Klikocka and Marian Wesolowski [1]

Abstract

The work refers to the influence of different methods of weed- control and soil tillage on introduction of first and secondary infestation in potato cultivation. The experiment is dedicated to study the effect of cultivation - mechanical and chemical (after planting: herbicide Afalon 50 WP [Hoechst]-linuron, 2 l/ha, after germination: herbicide Sencor 70 WP [Bayer]-metribuzin, 0.75 l/ha). Half plots with chemical cultivation was treated with herbicides, half plots was treated with herbicides plus adjuvants - Citowett AL (100 % of alciloarylopoliglicol ether) [BASF] and the soil tillage (conventional with pre-winter ploughing; with autumn ridge tillage; simplified soil tillage - without pre-winter ploughing).

In canopy of *Solanum tuberosum* L. at first and secondary infestation es there were 20 and 23 species of weeds. Species composition, number and air-dry mass of weeds was determined with the effect of the soil tillage and cultivation. In first infestation the most species of weeds grew on plots with simplified soil tillage and mechanical cultivation. In secondary infestation the most species of weeds was on plots with conventional soil tillage and mechanical cultivation. Afalon 50 WP [Hoechst] in first infestation radical reduced first weed frequency (fivefold) and with adjuvant - Citowett AL. [BASF] - eightfold. Sencor 70 WP [Bayer] in secondary infestation reduced weed frequency twice and half and with Citwett AL. [BASF] ca. fivefold. Air-dry mass of weeds was reduced by herbicides and adjuvant. The majority of weeds belonged to the following species was: *Echinochloa cruss-galli* (L.)P.B., *Galinsoga parviflora,* Cav. and *Chenopodium album* L.

Key Words: potato, cultivation, soil tillage, weed-control, adjuvant

Zusammenfassung

Studien über den Einsatz von Unkraut-Kontrolle und Bodenbearbeitung in *Solanum tuberosum* L. in Polen

Die Arbeit befaßt sich mit dem Einfluß verschiedener Methoden der Unkrautkontrolle und der Bodenbearbeitung sowie dem primären und sekundären Unkrautbefall bei dem Anbau von Kartoffeln. Mit dem Experiment wird beabsichtigt, den Effekt der mechanischen und chemischen Bearbeitung (nach dem Pflanzen: Herbizid Afalon 50 WP-linuron, [Hoechst] 2 l/ha; nach dem Auflaufen: Herbizid Sencor 70 WP-metribuzin, [Bayer] 0,75 l/ha) zu untersuchen. Die Hälfte der Flächen wurden mit Herbiziden behandelt, die andere Hälfte mit Herbiziden plus Adjuvanten (Citowett AL (100 % Alciloarylopoliglicoläther [BASF]). Die Bodenbearbeitung erfolgte konventionell mit dem „autumn ridge"-Verfahren (mit Vorwinter-Pflügen) und mit vereinfachter Bodenbearbeitung (ohne Vorwinter-Pflügen).

Zwischen den Pflanzen der *Solanum tuberosum* L. wurden während des ersten und zweiten Unkrautbefalls 20 bzw. 23 Unkrautspezies gefunden. Ihre Zusammensetzung, Anzahl und Trockenmasse wurden auf den Flächen mit vereinfachter Bodenbearbeitung und mechanischer Bearbeitung bestimmt. Beim ersten Auflaufen der meisten Unkrautspezies traten diese vermehrt auf den Flächen mit konventioneller Bodenbearbeitung und bei mechanischer Bearbeitung auf. Der Einsatz von Afalon 50 WP [Hoechst] verminderte den Unkrautbefall mit dem Faktor 5, mit dem Adjuvant Sencor 70 WP mit dem Faktor 8. Sencor 70 WP [Bayer] - während des zweiten Auflaufens eingesetzt - führte zu einer Verminderung mit dem Faktor 2,5. Citowett AL [BASF] führte zu einer Verminderung zirka um das fünffache. Die Trockenmasse der Unkräuter wurde ebenfalls durch Herbizide und Adjuvanten reduziert. Die Mehrzahl der Unkräuter gehörte zu folgenden Spezies: *Echinochloa cruss-galli* (L.)P.B., *Galinsoga parviflora* Cav. und *Chenopodium album* L.

Schlüsselwörter: Kartoffel, Anbau, Bodenbearbeitung, Unkrautkontrolle, Adjuvanten

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1 Introduction

Weeds should be killed in initial phase of potato growth because in later vegetation season it is obstructed. Effectiveness of weed-killing measures is a result of co-operation of herbicide and soil-atmospheric conditions and developmental phase of weeds (3).

However, as research of Green (2) and Ramsdale and Nalewaja (8) and van der Schans and van Zeeland (10) show, that the use of adjuvants in chemical weed control, thanks to increasing biological activity of herbicides, enables to decreasing dose of preparation and cost of treatment and its negative influence on environment. Effectiveness of precise adjuvant also depends on active substance and formulation of herbicide, species of controlled weed and - as it was mentioned - environmental conditions. The purpose of investigations was to estimate the influence of Citowett AL [BASF] (100 % of alciloarylopoliglicol ether) on effectiveness combined usage with linuron (before seedlings) and metribuzin (after seedlings) in conditions of using different methods of soil tillage.

2 Material and methods

In autumn 1996, in Malice - a village near Zamosc (Poland) - there was started a two-factorial field experiment by split-plot method in four replications. The experiment was carried out on leached brown soil, formed from light loamy silty soil (texture: sand -57 %, silt -28 %, clay -15 %), poor soil with 1.65 % of humus. pH in the topsoil was 6.3 and 5.9 in the subsoil.

In such characterized object there were marked 36 plots with an area of 30 m^2 each destined to *Solanum tuberosum* L. cv. Mila. The forecrop for *Solanum tuberosum* L. was *Triticosecale* Witt. cv. Migo.

The experiment has had two factors: 3 methods of soil tillage and 3 methods of weed control in *Solanum tubersum* L.

I Factor - methods of weed control

A. Mechanical-chemical - mechanical treatments from potato planting until germination, harrowing with a spring - light weeder, weeding and earthing up. In short time after germination - herbicides (Sencor 70 WP [Bayer]-metribuzin in the dose of 0.75 l/ha). Half plots was treated with herbicides, half plots was treated with herbicides plus adjuvants - Citowett AL. [BASF] (100 % of alciloarylopoliglicol ether), without other treatments.
B. Mechanical - mechanical treatments with generally available cultivation implements from potato planting until germination. Harrowing with a spring - light harrow until first plants will appear. After germination weeding and earthing up - until furrows will be dense.
C. Chemical - after planting - herbicide (Afalon 50 WP [Hoechst]-linuron, 2 l/ha), after germination - herbicide (Sencor 70 WP [Bayer]-metribuzin, 0.75 l/ha). Half plots was treated with herbicides, half plots was treated with herbicides plus adjuvants - Citowett AL [BASF]. (100 % of alciloarylopoliglicol ether).

Factor I - soil tillage:

1 - Conventional soil tillage
2 - Autumn ridge tillage
3 - Spring simplified soil tillage

Mineral fertilization in kg/ha was N -100, P_2O_5 -100, K_2O -180. 44000 tubers/ha. Detailed methods of investigations were published in the work of Klikocka (4).

Total rainfalls in the seasons 1999-2000 have been higher than the long-term sum by 74 and 105 mm. Only May and July 1999 and August 2000 have been dry, but other months of two years had higher rainfalls; particularly - June 1999 and July 2000. Generally rainfalls in particular months of shown vegetation seasons were regular and did not differentiate growth phases of potatoes. The month averages of the air temperatures in the vegetation season in 1999-2000 were much higher than in a long term. June, July and August were particularly hot months. Generally, we can say that the vegetation seasons 1999-2000 were very warm and wet.

In year 1999 and 2000, in vegetation season (II decade of May) and before harvesting (II decade of August), - by botanical-gravimetric method - there were determined: number, species composition and dry mass of weeds, on test areas of 0.5 · 1m, in two random places of each plot.

Obtained findings were fixed with statistic method calculating lowest significant differences (a=0.05) with the TUKEY-test.

3 Results and discussion

In cornfields of potatoes, in case of primeval weeding, there were 20 species of weeds, including 14 species belonging to short-lived and 6 ones to perennial (Tab. 1 and 2). Decidedly, predominant species were: *Echinochloa crus-galli* (L.)P.B. (61.9 %), *Chenopodium album* L. (21.4 %) and *Galinsoga parviflora* Cav. (8.2 %). These species made 91.5 % of total weeding. Palys (7), investigating primeval weeding, stated that there are 55 species of weeds, where predominant were: *Agropyron repens* (L.) P.B., *Avena fatua* L. and *Veronica sp* L. They made 77 % of primeval weeding.

On plots with mechanical weed control (without herbicides) one observed existing 14 species of weeds area unit - 374.7 pieces/m^2. In objects, where Afalon 50 WP [Hoechst]-linuron was applied, in the dose of 2l/ha, there were 18 species of weeds, but their number was limited to

69.0 pieces/m² (82 %). Additive of adjuvant - Citowett AL. [BASF] (100 % of alciloarylopoliglicol ether - to herbicide caused removal of six taxa (*Amaranthus retroflexus* L., *Tripleurospermum inodorum* (L.) Schutz-Bip., *Anagalis arvenis* L., *Artemisia vulgaris* L., *Cirsium arvense* (L.) Scop. and *Convolvulus arvensis* L.). Weeds number was decreased by 33 %. Gruczek (3) proved that Afalon 50 WP effectively controls *Chenopodium album* L. However it is not effective in *Echinochloa crus-galli* (L.)P.B. and *Viola arvensis* Murr killing. He also noticed that maximum effectiveness of Afalon 50 WP was 78 %. Herbicide action in growing season of 1975 was highly limited because of spring's drought and that is why mechanical weed control was more effective.

In case of ploughing, one stated existing of 16 species (11 short living and 5 perennial). They were in amount of 162.7 pieces/m². Introduction of soil tillage with autumn forming ridges influenced increasing taxa by 3 short-living species (*Viola arvensis* Murr, *Tripleurospermum inodorum* (L.) Schutz-Bip. and *Anagalis arvenis* L.) and 1perennial one (*Convolvulus arvensis* L.). In this case *Galeopsis tetrahit* L. and *Cirsium arvense* (L.) Scop. were removed. Weeds number was significantly decreased by 17 %. The use of simplified spring tillage (without prewinter ploughing) eliminated next short-living species (*Amaranthus retroflexus* L., *Veronica arvensis* L., *Viola arvensis* Murr. and *Anagalis arvensis* L.) and 1 perennial species (*Equisetum arvense* L.). However this tillage caused to renewed settling plots by *Cirsium arvense* (L.) Scop. Number of taxa in this object was highest and predominated by 28 % with reference to discussed cultivations. Bujak (1) says that simplifying soil tillage (after harvesting forecrop) causes growth tendency of weeding, particularly with such taxa as: *Agropyron repens* (L).P.B., *Chenopodium album* L., *Geranium pusillum* L. and *Equisetum arvense* L.

The biggest number of taxa was in object with simplified spring tillage cultivated mechanically (474.0 pieces/m²), the smallest one - in case of using tillage with autumn forming ridges, cultivated with Afalon 50 WP with additive of adjuvant. Air-dry mass significantly depended on factors of experiment (Tab. 2). The smallest mass of weeds

Tab. 1
Species composition and number (pieces/m²), on first infestation of potatoes (with linuron) (Ø 1999-2000)

Lp.	Dominat weed species	1				2				3				Average			
		A	B	C	Ave-rage	A	B	C	Ave-rage	A	B	C	Ave-rage	A	B	C	
1	Echinochloa *crus-galli* (L.)P.B.	200.0	60.0	50.0	103.3	200.0	40.0	20.0	86.7	260.0	50.0	30.0	113.3	220.0	50.0	33.3	
2	*Chenopodium album* L.	100.0	2.0	2.0	34.7	2.0	2.0	2.0	2.0	200.0	4.0	-	38.0	100.7	2.7	1.3	
3	Galinsoga *parviflora.* Cav	-	6.0	4.0	3.3	100.0	4.0	-	34.7	4.0	-	2.0	2.0	34.7	3.3	2.0	
4	*Polygonum convolvulus* L.	4.0	2.0	2.0	2.7	2.0	1.0	1.0	1.3	4.0	-	1.0	1.7	3.3	1.0	1.3	
5	*Sinapis arvensis* L.	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.3	-	2.0	-	0.7	1.3	1.7	1.0	
6	*Polygonum nodosum* Pers	-	-	2.0	0.7	6.0	-	2.0	2.7	-	1.0	-	0.7	2.0	0.3	1.7	
7	Vicia *hirsuta* (L.)S.F.Gray	6.0	2.0	2.0	3.3	1.0	1.0	2.0	1.3	2.0	-	1.0	1.0	3.0	1.0	1.7	
-	Residual (7)	6.0	6.0	2.0	4.6	4.0	4.0	2.0	3.4	2.0	1.0	2.0	1.3	4.0	3.6	1.7	
-	Annual	318.0	80.0	66.0	154.7	317.0	53.0	30.0	133.8	472.0	58.0	36.0	188.7	369.0	63.7	44.0	
1	Agropyron *repens* (L.)	8.0	2.0	-	3.3	-	1.0	1.0	0.7	-	2.0	2.0	1.3	2.7	1.7	1.0	
2	Equisetum *arvense* L.	4.0	2.0	2.0	2.7	1.0	1.0	-	0.7	-	-	-	-	1.7	1.0	0.7	LSD
-	Residual (4)	2.0	2.0	2.0	2.1	-	3.0	-	0.9	2.0	3.0	-	1.6	1.4	2.6	0.7	(0.05)
-	Perennial	14.0	6.0	4.0	8.0	1.0	5.0	1.0	2.3	2.0	5.0	2.0	3.0	5.7	5.3	2.3	=
-	TOTAL	332.0	86.0	70.0	162.7	318.0	58.0	31.0	135.7	474.0	63.0	38.0	191.7	374.7	69.0	46.3	21.8
	Secondary infestation of potatoes (with metribuzin) (Ø 1999-2000)																
1	Echinochloa *crus-galli* (L.)P.B.	9.5	7.5	2.5	6.5	16.3	5.5	3.0	8.3	7.0	3.0	2.0	4.0	10.9	5.3	2.5	
2	Galinsoga *parviflora.* Cav	9.0	3.5	1.5	4.7	10.0	3.0	1.5	4.8	4.5	2.5	1.5	2.8	7.8	3.0	1.5	
3	*Chenopodium album* L.	4.3	1.5	1.0	2.3	4.5	2.5	1.0	2.7	5.5	1.0	0.5	2.3	4.8	1.7	0.8	
4	*Galium aparine* L.	2.0	1.0	1.0	1.3	2.0	1.0	1.0	1.3	1.5	1.0	0.5	1.0	1.8	1.0	0.8	
-	Residual (14)	17.3	6.5	-	7.7	14.5	3.5	0.5	6.0	9.5	4.0	2.8	5.6	13.6	4.7	1.2	
-	Annual	42.0	20.0	6.0	22.7	47.3	15.5	7.0	23.3	28.0	11.5	7.3	15.6	39.1	15.7	6.8	
1	*Equisetum arvense* L.	8.5	1.0	1.5	3.7	1.0	0.5	0.5	0.7	1.0	1.0	0.5	0.8	3.5	0.8	0.8	
2	*Agropyron repens* (L.)	2.0	0.5	1.0	1.2	1.5	1.0	1.0	1.2	1.0	0.5	2.5	1.3	1.5	0.7	1.5	LSD
-	Residual (3)	1.5	0.5	-	0.7	3.5	1.5	0.5	1.9	1.5	1.0	1.5	1.3	2.2	1.0	0.7	(0.05)
-	Perennial	12.0	2.0	2.5	5.5	6.5	3.0	2.0	3.7	3.5	2.5	4.5	3.5	7.2	2.5	3.0	=
-	TOTAL	54.0	22.0	8.5	28.2	53.3	18.5	9.0	26.9	31.5	14.0	11.8	19.1	46.3	18.2	9.8	5.45

was on plots where Afalon 50 WP with adjuvant was used. In objects with Afalon 50 WP only, the mass of weeds did not change significantly. However, mechanical cultivation without herbicides increased dry mass of weeds by 3.5 times. In investigations of Wesolowski and Kacuga (11) dry mass of weeds decreased from 22 to 10g/m^2 (by 54.2 %) under the influence of Afalon 50 WP.

In case of soil tillage methods, the smallest dry mass was on plots where autumn ridge tillage was used. The smallest dry mass of weeds mass of weeds was on plots where autumn ridge tillage was used. Significant growth of dry mass, over twice higher, was observed during conventional tillage.

Weeds during conventional tillage in connection with mechanical weed control formed the bigger mass. The smallest one was in simplified spring tillage cultivated with Afalon 50 WP with additive of adjuvant.

One stated positive correlation between number of weeds and their dry mass (r = 0.9940).

Potatoes, in case of repeated weeding, were settled by 23 species of weeds including 18 short-living species and 5 perennial ones (Tab.1 and 2).

In reference to primeval weeding one noticed appearing: *Filago arvensis* L., *Polygonum aviculare* L., *Vicia tetrasperma* (L). Schreber, *Sonchus asper* (L.) Hill, *Apera spica-venti* (L.)P.B., *Erigeron canadensis* L., and removing *Convolvulus arvensis* L.

Decidedly predominant species in repeated weeding were: *Echinochloa crus-galli* (L.)P.B. (25,3 %), G*alinsoga parviflora* Cav. (16,6 %), *Chenopodium album* L. (9,8 %) and *Equisetum arvense* L. (7,0 %). These species were in 58.7 % of total weeding.

On plots with mechanical weed-control (without herbicides), one observed existing 22 species of weeds on area unit (46,3 pieces/m^2). In objects, where Sencor 70 WP [Bayer]-metribuzin in dose of 0.75 l/ha was applied, number of short-living taxa was limited to 14. There were removed: *Polygonum aviculare* L., *Vicia tetrasperma* (L). Schreber, *Sonchus asper* (L.) Hill. and *Apera spicaventi* (L.)P.B. However, *Apera spicaventi* (L.)P.B. appeared. Number of species was also significantly limited to 18.2 pieces/m^2 (2.5 times). Additive of adjuvant - Citowett AL. [BASF] (100 % of alciloarylopoliglicol ether) to herbicide, caused removal of next 4 taxa (*Polygonum nodosum*

Tab. 2
Species composition and air-dry weight of weeds (g/m^2) on first infestation of potatoes (with linuron) (Ø 1999-2000)

Lp. Dominat weed species	1				2				3				Average			
	A	B	C	Aver-age	A	B	C	Aver-age	A	B	C	Aver-age	A	B	C	
1 *Echinochloa crus-galli* (L.)P.B.	25.0	4.7	5.8	11.8	5.5	3.4	3.5	4.1	17.5	3.2	1.5	7.4	16.0	3.8	3.6	
2 *Chenopodium album* L.	5.3	0.2	0.3	1.9	0.4	0.1	0.2	0.2	4.5	0.3	-	1.6	3.4	0.2	0.2	
3 *Galinsoga parviflora*. Cav	-	0.2	0.2	0.1	4.2	0.2	-	1.5	0.6	-	0.2	0.3	1.6	0.1	0.1	
4 *Polygonum convolvulus* L.	-	-	0.2	0.1	0.5	-	0.2	0.2	-	0.2	0.1	0.1	0.2	0.1	0.2	
5 *Sinapis arvensis* L.	0.5	0.9	1.5	1.0	0.2	2.3	0.3	0.9	-	0.9	-	0.3	0.2	1.4	0.6	
6 *Polygonum nodosum* Pers	-	-	0.2	0.1	0.5	-	0.2	0.2	-	0.2	0.1	0.1	0.2	0.1	0.2	
7 *Vicia hirsuta* (L.) S.F.Gray	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	-	0.1	0.1	0.2	0.1	0.1	
Residual (7)	1.0	0.5	0.1	0.6	0.2	0.4	0.3	0.3	0.5	0.1	0.1	0.2	0.2	0.6	0.2	
- Annual	32.6	6.7	8.4	15.9	11.3	6.6	4.7	7.5	24.1	4.7	2.1	10.3	27.7	6.0	5.1	
1 *Agropyron repens* (L.)	1.2	0.2	-	0.5	-	0.1	0.1	0.1	-	2.3	1.9	1.4	0.4	0.9	0.7	
2 *Equisetum arvense* L.	0.8	0.4	0.9	0.7	0.1	0.1	-	0.1	-	-	-	-	0.3	0.2	0.3	LSD
Residual (4)	0.9	0.6	0.1	0.5	-	0.4	-	0.1	0.7	0.8	-	0.4	0.2	0.8	0.0	(0.05)
- Perennial	2.9	1.2	1.0	1.7	0.1	0.6	0.1	0.3	0.7	3.1	1.9	1.9	1.2	1.6	1.0	=
- TOTAL	35.5	7.9	9.4	17.6	11.4	7.2	4.8	7.8	24.8	7.8	4.0	12.2	23.9	7.6	6.1	12.28
Secondary infestation of potatoes (with metribuzin) (Ø 1999-2000)																
1 *Echinochloa crus-galli* (L.)P.B.	26.5	22.8	8.3	19.2	34.3	15.3	6.8	18.8	21.8	9.8	8.5	13.4	27.5	16.0	7.9	
2 *Galinsoga parviflora*. Cav	26.8	10.3	4.8	14.0	30.0	12.5	7.0	16.5	16.0	7.3	6.0	9.8	24.3	10.0	5.9	
3 *Chenopodium album* L.	19.8	8.3	5.8	11.3	20.5	11.0	4.5	12.0	21.8	4.5	2.0	9.4	20.7	7.9	4.1	
4 *Galium aparine* L.	3.9	2.1	2.3	2.8	4.3	2.5	1.0	2.6	3.5	2.3	2.3	2.7	3.9	2.3	1.9	
Residual (14)	30.3	13.9	-	14.6	23.3	6.9	1.0	11.3	14.4	8.4	7.4	10.2	22.8	9.7	2.8	
- Annual	107.0	57.1	21.0	61.7	112.1	48.0	20.2	60.1	77.2	32.2	26.1	45.2	98.8	45.8	22.4	
1 *Equisetum arvense* L.	8.8	2.3	3.5	4.9	1.9	1.0	1.3	1.4	1.3	2.8	1.5	1.9	4.0	2.0	2.1	
2 *Agropyron repens* (L.)	4.1	1.3	2.0	2.5	3.0	2.3	2.3	2.5	2.8	1.8	7.5	4.0	3.3	1.8	3.9	LSD
Residual (3)	4.7	1.8	-	2.2	10.1	4.8	1.8	5.6	5.3	3.1	5.3	4.5	6.7	3.2	2.4	(0.05)
- Perennial	17.5	5.3	5.5	9.4	14.9	8.0	5.3	9.4	9.3	7.5	14.3	10.4	13.9	6.9	8.4	=
- TOTAL	124.5	62.3	26.5	71.1	127.0	56.0	25.5	69.5	86.5	39.7	40.3	55.5	112.7	52.7	30.8	5.13

Pers, *Polygonum convolvulus* L, *Veronica arvensis* L and *Filago arvenis* L.). Number of weeds was next significantly decreased by 8.4 pieces/m^2 on average. According to Sawicka and Salski (9) Sencor 70 WP - resistant are the following species: *Setaria glauca, Echinochloa crusgalli* (L.)P.B., *Agropyron repens* (L.)P.B., *Poa annua* L., *Equisetum arvense* L., *Anthemis arvensis* L. and *Polygonum convolvulus* L.

In case of ploughing tillage, one noted existing 22 species (17 short living and 5 perennial). They appeared in amount of 54.0 pieces/m^2. Introduction of tillage with autumn forming ridges influenced elimination of *Erigeron canadensis* L. Number of weeds did not undergo significant changes. Applying of simplified spring tillage (without pre-winter ploughing) caused appearing *Apera spica-venti* (L.)P.B. Taxa number in this object was significantly smaller, by 31 % on average, in reference to discussed cultivations. Lanfranconi, Bellinder and Wallace (6), using reduced methods of soil tillage, say that these techniques without herbicides influence significant growth of weeds number. However, if linuron or metribuzin is used in weed control, weeding significantly decreases and is smaller than in conventional cultivation without herbicides.

The biggest number of taxa was found in object with simplified spring tillage, cultivated mechanically (54.0 pieces/m^2). The smallest one was found in case of using conventional tillage controlled with Sencor 70 WP and adjuvant.

The air-dry mass significantly depended on experiment factors (Tab. 2). The smallest mass of weeds was noticed on plots where Sencor 70 WP with adjuvant was applied. In objects where only Sencor 70 WP was applied, the mass of weeds significantly increased by 71 %. Mechanical cultivation without herbicides increased their dry mass twice. Zarzecka (12), using Sencor 70 WP with additive of Atpol [ZPH Agromix, Niepolomice, Poland] (Atplus 300 F 17 and paraffinic oil 83) in weed control, limited dry mass of weeds by 87 %.

Kowanski (5) found that the use of Sencor 70 WP decreases repeated weeding by 64 % and 73 % for dry mass of weeds, in comparison to full mechanical weed control.

In case of techniques of soil tillage, the biggest dry mass of weeds was found on plots where applied conventional and autumn ridge tillage. Using of simplifications in soil tillage influenced significant decrease of dry mass of weeds, by 21 % on average. Weeds in conventional tillage and autumn ridge tillage, cultivated without herbicide formed the biggest mass. The smallest one was in the same cultivations but controlled with Sencor 70 WP with Citowett AL. Sawicka and Skalski (9) show that effectiveness of Sencor 70 WP is limited during droughts. Moreover, its activity is smaller in acid and humus-rich soils.

One proved positive correlation between number of weeds and their dry mass (r=0.7779).

4 Conclusions

On basis of the results obtained in the following conclusions were drawn:

1. In canopy of *Solanum tuberosum* L. at first and secondary infestation es there were 20 and 23 species of weeds. Species composition, number and air-dry mass of weeds was determined with the effect of the soil tillage and cultivation. In first infestation the most species of weeds grew on plots with simplified soil tillage and mechanical cultivation. In secondary infestation the most species of weeds was on plots with traditional soil tillage and mechanical cultivation.
2. Afalon 50 WP [Hoechst] in first infestation radical reduced first weed frequency (fivefold) and with adjuvant - Citowett AL. [BASF] - eightfold.
3. Sencor 70 WP [Bayer] in secondary infestation reduced weed frequency twice and half and with Citwett AL. [BASF] ca. fivefold.
4. Air-dry mass of weeds was reduced by herbicides and adjuvant.
5. The majority of weeds belonged to the following species was: *Echinochloa cruss-galli* (L.)P.B., *Galinsoga parviflora,* Cav. and *Chenopodium album* L.

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