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COVER CROPS AND SOIL-BORNE FUNGI DANGEROUS TOWARDS THE CULTIVATION OF SALSIFY (*Tragopogon porrifolius* var. *sativus* (Gaterau) Br.)

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Abstract. Salsify has a remarkable taste and nutritious values. It is a rich source of inulin – a glycoside which has a positive effect on human and animal organisms. The paper presents studies on the species composition of soil-borne fungi infecting the roots of *Tragopogon porrifolius* var. *sativus* cultivated with the use of oats, tansy phacelia and spring vetch as cover crops. In a field experiment the cover crops formed abundant green mass before winter and it constituted a natural mulch on the surface of the plough land. It was managed in two ways: 1) mixed with the soil as a result of spring ploughing, or 2) mixed with the soil as a result of pre-winter ploughing. The conventional cultivation of salsify, i.e. without cover crops, constituted the control. The studies established the number and health status of four-week-old salsify seedlings and roots with necrotic signs. A laboratory mycological analysis made it possible to determine the quantitative and qualitative composition of fungi infecting the underground parts of *Tragopogon porrifolius* var. *sativus*. The emergences and the proportion of infected salsify seedlings varied and depended on the species of the mulching plant. The smallest number of infected seedlings was obtained after the mulch with oats, slightly more after the application of spring vetch or tansy phacelia as cover crops, and the most in the control. Regardless of the species of the mulching plant, the following were frequently isolated from the diseased seedlings and roots of salsify: *Alternaria alternata, Fusarium culmorum, Fusarium oxysporum, Penicillium* spp*., Rhizoctonia solani* and *Sclerotinia sclerotiorum. Rhizoctonia solani* and *Sclerotinia sclerotiorum* proved to be the most harmful towards the roots of salsify. The system of cultivation, i.e. performing spring or pre-winter ploughing, had no significant effect on the total population of fungi.

Key words: oat, phacelia, spring vetch, mulch, salsify phytopathogens

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INTRODUCTION

Tragopogon porrifolius var. *sativus* (Gaterau) Br. is also called the goatsbeards. It was used in folk medicine as early as in ancient times. In Europe the cultivation of salsify spread in the 15th and 16th centuries [Hardenburg et al. 1986, Muller-Lemans 1991]. In Poland it is still little known and rarely cultivated. Salsify has a remarkable taste and nutritious values. Its edible part is the taproot, which in taste reminds the parsley root [Mencarelli 2007]. It is a rich source of calcium, iron, phosphorus, carotene, vitamins (C, B_1, B_2, PP) and inulin – a glycoside which has a positive effect on human and animal organisms [Kierstan 1978, Mencarelli 2007]. Inulin can replace sugar and fats and it can enrich the food with fibre [Robertfroid 1993, Hofer and Jenewein 1999, Lutomski 2001]. It reduces the energetic value of food and improves the composition of *Enterobacteriaceae* sp. [Teeuwen et al. 1992, Lutomski 2001].

Cover crops, which fulfil an important protective and conserving function, are more frequently used in an integrated field cultivation of different plants [Masiunas 1998, Kęsik et al. 2000, Konopiński et al. 2001, Pięta and Kęsik 2007]. These plants can be used as green manure, which – after ploughing in – provide the organic mass and mineral elements to the soil. They exert different effects on the cultivation environment, i.e. weed infestation, the physico-chemical properties of the soil as well as the plants' growth, their healthiness and yielding [Konopiński 1997, Konopiński et al. 1999, Adamczewska-Sowińska 2004, Kęsik and Błażewicz-Woźniak 2010]. Cover crops left in the field for winter and used as mulch protect the soil from erosion, excessive surface flow of the water, washing away the nutritious elements, and they increase the biological activity of the soil [Masiunas 1998, Boumann et al. 2000, Kęsik et al. 2000, Thomas et al. 2001, Erenstein 2002] and can protect cultivated plants from soil-borne plant pathogens [Roe et al. 1994, Leary and DeFrank 2000, Jamiołkowska and Wagner 2003, Pięta and Kęsik 2007].

Both the Polish and foreign literature lacks information concerning plant pathogens which are dangerous to the cultivation of *Tragopogon porrifolius* var. *sativus* (Gaterau) Br.). Only Dellavalle et al. [1999] report that the aboveground parts of salsify are infected by TSWV virus (Tomato spotted wilt virus). According to Mencarelli [2007], the healthiness of the aboveground parts of this plant is decreased by fungus *Albugo tragopogonis* DC. (Gray), causing white blister rust of salsify. Namesny-Vellespir [1996] informs about *Erysiphe cichoracearum* DC., causing powdery mildew of salsify, while Biller and Draper [2001] report on *Sclerotinia sclerotiorum* (Lib.) de Bary, causing sclerotinia rot of this plant. On the other hand, there is no information concerning the role of soil-borne fungi in infecting the underground parts of salsify. The authors' own studies Patkowska and Konopiński [2008b] showed that among soil-borne fungi *Rhizoctonia solani* Kühn, *Sclerotinia sclerotiorum* (Lib.) de Bary and *Pythium irregulare* Buisman proved to be the most pathogenic towards salsify seedlings in growth chamber conditions, whereas *Altenaria alternata* (Fr.) Keissler and *Fusarium culmorum* (W. G. Sm.) Sacc. were the least harmful.

In view of the lack of information on the role of different ways of managing plant mulches in the cultivation of salsify, the authors undertook studies signaled in the title. Their purpose was to establish the species composition of soil-borne fungi infecting the

underground parts of *Tragopogon porrifolius* var. *sativus* cultivated with oat, tansy phacelia and spring vetch as cover crops.

MATERIALS AND METHODS

Field experiment. A field experiment was conducted in the years 2006–2007 at the Experimental Station of Felin belonging to the University of Life Science in Lublin. The object of the studies were the plants of salsify cv. 'Mamut', which was sown in the first 10 days of May. The experiment took into consideration mulching the soil with cover crops such as oats (*Avena sativa* L.), tansy phacelia (*Phacelia tanacetifolia* B.) and spring vetch (*Vicia sativa* L.). Those plants produced an abundant yield of green mass before winter. It was a natural mulch on the surface of the land which was managed in a two-fold way: 1) pre-winter plough, or 2) spring plough. The control was a conventional cultivation of salsify, i.e. without cover crops. The experiment was set up in a split-plots scheme in four repetitions. The area of each plot was 15 m^2. Meteorological data from the region of studies were analyzed on the basis of information obtained from the Chair of Agrometeorology of the University of Life Sciences in Lublin.

Laboratory Mycological Analysis. In each studied year the number and healthiness of four-week-old salsify seedlings were established. Ten seedlings with necrotic symptoms were taken from each experimental combination with the aim of conducting a laboratory mycological analysis of the infected roots. After the harvest (the second 10-day's period of October), a mycological analysis was carried out of 10 randomly chosen roots with necrotic symptoms. The mycological analysis was made according to the method described by Kućmierz and Bartyńska [1988]. The infected parts of plants were rinsed for 30 minutes under running tap water, after which they were disinfected in 0.1% sodium hypochlorite. The plant material disinfected on the surface was rinsed three times in sterile distilled water, 3 minutes in each. 3-milimetre fragments were made from so prepared plant material and 10 of them were put on each of the Petri dishes on solidified mineral medium with the following composition: 38 g saccharose, 0.7 g NH_4NO_3, 0.3 g KH_2PO_4, 0.3 g $MgSO_4 \times 7\ H_2O$, 20 g agar and trace quantities of $FeCl_3 \times 6\ H_2O$, $ZnSO_4 \times 7\ H_2O$, $CuSO_4 \times 7\ H_2O$ and $MnSO_4 \times 5\ H_2O$. The whole was filled up with distilled water up to 1000 ml and was sterilized in an autoclave for 20 minutes at the temperature of 121°C under the pressure of 1 atmosphere. 100 fragments of infected seedling roots and plants after the harvest were examined for each of the experimental combinations.

The Petri dishes together with the plant material on them were incubated in a thermostat for 7 days at the temperature of 23°C. Fungi colonies grown from the infected plant fragments were taken to test tubes for slants with maltose medium (a ready-made product by bio Merieux company). The isolated fungi were marked for the species.

Results concerning the emergences and healthiness of salsify seedlings were statistically analyzed using variance analysis. The significance of differences between the means was established using Tukey's confidence intervals [Oktaba 1987]. Statistical calculations were carried out using Statistica program, version 7.1.

RESULTS AND DISCUSSION

Field experiment. Considering thermal conditions, the year 2006 was a period conducive to the emergencies of salsify plants. The mean temperature in May was higher by 0.6°C than the mean value of many years. Successive months, until the harvest, were also characterized by higher temperatures than the mean temperatures of many years, in June by 0.4°C, in July by 4.0°C, in August by 0.1°C, in September by 2.8°C, and in October by 2.2°C (tab. 1).

The year 2007, like the previous one, was also one of favourable thermal conditions for salsify cultivation. Since the beginning of plants' vegetation, throughout the following months of the cultivation and until September, the mean temperatures of each month were higher than the mean temperatures of many years, in May by 2.0°C, in June by 1.6°C, in July by 1.3°C, in August by 1.1°C and in September by 0.1°C. The mean temperature in October was lower by 0.3°C than the mean value of many years.

Considering the precipitation, the year 2006 was a very unfavourable period for the emergencies and growth of salsify. In May, the monthly sum of precipitation was higher than the many-years' sum only by 2.0% (tab. 1). The two successive months, June and July, were a period of sporadic rainfalls, whose monthly sums considerably differed from the mean values of many years. In June, the studies found out by 42.4% less, and in July by 91.3% less rainfalls as compared to the many-years' mean values. In August, the monthly sum of precipitation was higher than the many-years' sum by 184.5%. The following two months, September and October, were dry ones. In September and October, the mean sums of rainfalls were lower than the sums of many years, by 78.9% and 64.8%, respectively.

The beginning of the vegetation period in 2007 was favourable considering the rainfalls. The monthly sums of rainfalls in May, June and July were higher than the mean values of many years. In May, they were higher by 39.8%, in June by 33.4% and in July by 15.4%. In August, definitely less rainfalls were observed. The monthly sum in that month was lower than the many-years' sum by 46.1%. The situation improved only in September. The sum of rainfalls was higher than the sum of many years by 149.1%. In October, less rainfalls were observed and their sum was lower than the mean sum of many years by 56.1%.

Basing on the results presented in table 2, a tendency for better emergencies of salsify in the objects with the cultivation of tansy phacelia and the applied pre-winter ploughing was observed. Covering the biomass formed before winter with the soil resulted in a higher number of salsify plants on the plots (73.2 plants$\cdot$m^{-2}), as compared to the other cultivation combinations. Good emergencies of plants were also observed in the objects with the cultivation of oats, which was managed in spring when the medium ploughing was performed. This cultivation created equally good conditions for the growth of salsify. The number of plants in that combination was, on average, 68.0 per m^2.

The smallest density of plants (47.1 per m^2) was found in objects where the oat biomass was covered with the soil in the pre-winter period.

Mulching the soil with oats and spring vetch, with the application of spring plough, showed a tendency to a favourable effect on the density of salsify plants per one unit of area. In the case of tansy phacelia, on the other hand, better conditions for the growth of

Table 1. Meteorological data for the period May – October of 2006 and 2007 as compared to the mean from the period 1963–1992
Tabela 1. Dane meteorologiczne za okres maj – październik w latach 2006–2007 w porównaniu ze średnią za okres 1963–1992

Month Miesiąc	Mean from the period 1963–1992 Średnia wieloletnia za okres 1963–1992		Difference of mean temperature in comparison with long-term period Różnica temperatury powietrza w porównaniu ze średnią wieloletnią		Percentage of the average annual rainfalls Procent normy opadów	
	mean temp. średnia temp. °C	precipitation total opady ogółem mm	2006	2007	2006	2007
May – Maj	13.0	58.3	+0.6	+2.0	102.0	139.8
June – Czerwiec	16.5	65.8	+0.4	+1.6	57.6	133.4
July – Lipiec	17.9	78.0	+4.0	+1.3	8.7	115.4
August – Sierpień	17.3	69.7	+0.1	+1.1	284.5	53.9
September – Wrzesień	12.9	52.1	+2.8	+0.1	21.1	249.1
October – Październik	7.9	40.3	+2.2	-0.3	35.2	43.9

Table 2. Field stand and healthiness of salsify seedlings
Tabela 2. Obsada i zdrowotność siewek salsefii

Experimental combination Kombinacja doświadczenia	Field stand per 1 m^2 Obsada na 1 m^2			Percentage of diseased seedlings (%) Udział porażonych siewek (%)		
	2006	2007	mean średnia	2006	2007	mean średnia
Oats mulch + spring ploughing Mulcz z owsa + orka wiosenna	74.0 ab	62.0 c	68.0 bc	12.4 a	15.7 a	14.0 a
Oats mulch + pre-winter ploughing Mulcz z owsa + orka przedzimowa	53.6 a	40.6 bc	47.1 a	11.9 a	16.0 a	13.9 a
Tansy phacelia mulch + spring ploughing Mulcz z facelii + orka wiosenna	69.6 ab	48.6 bc	59.1 b	19.4 bc	24.2 b	21.8 b
Tansy phacelia mulch + pre-winter ploughing Mulcz z facelii + orka przedzimowa	90.0 c	57.6 bc	73.2 c	20.0 c	23.4 b	21.7 b
Spring vetch mulch + spring ploughing Mulcz z wyki siewnej + orka wiosenna	72.0 ab	49.0 bc	60.5 b	16.6 bc	20.3 a	18.5 ab
Spring vetch mulch + pre-winter ploughing Mulcz z wyki siewnej + orka przedzimowa	80.6 bc	26.6 a	53.6 ab	15.8 ab	19.4 ab	17.6 ab
Conventional cultivation (Control) Uprawa tradycyjna (Kontrola)	76.8 b	37.0 ab	56.9 ab	31.5 d	34.3 c	32.9 c

* Means in columns followed by the same letters are not significantly different at $P \leq 0.05$
* Średnie w kolumnach oznaczone tymi samymi literami nie różnią się istotnie przy $P \leq 0,05$

salsify were created by the pre-winter ploughing. As compared to the traditional cultivation (without cover plants), the combinations enumerated above created better conditions for the emergencies and growth of plants.

During the observations conducted four weeks after the emergence of salsify, yellowing plants of inhibited growth and development were noticed on the plots of particular combinations. After those plants were dug out, brown necrotic spots could be seen (phot. 1). The rot and the powder of mycelium hyphas were also observed on the roots after the harvest of salsify (phot. 2 and 3).

Phot. 1. Necrosis on the roots of salsify seedlings (photo by E. Patkowska)
Fot. 1. Nekroza na korzeniach siewek salsefii (fot. E. Patkowska)

The proportion of infected salsify seedlings varied and – depending on the year – it ranged from 11.9% to 34.3% (tab. 2). It was observed that the cultivation system had no significant effect on this feature of *Tragopogon porrifolius* var. *sativus* seedlings. The greatest number of infected seedlings occurred on the plots where salsify was cultivated conventionally, i.e. without cover crops (31.5% and 34.3%, depending on the year of studies). A less diseased seedlings were found after mulching the soil with tansy phacelia (on average, 21.8% and 21.7%) or spring vetch (on average, 18.5% and 17.6%, depending on the system of cultivation). The smallest number of infected seedlings was observed after mulching the soil with oats (on average, 14.0% and 13.9%). Studies conducted by Patkowska and Konopiński [unpublished data] also pointed to a positive effect of oats and spring vetch on the emergences and healthiness of other species of

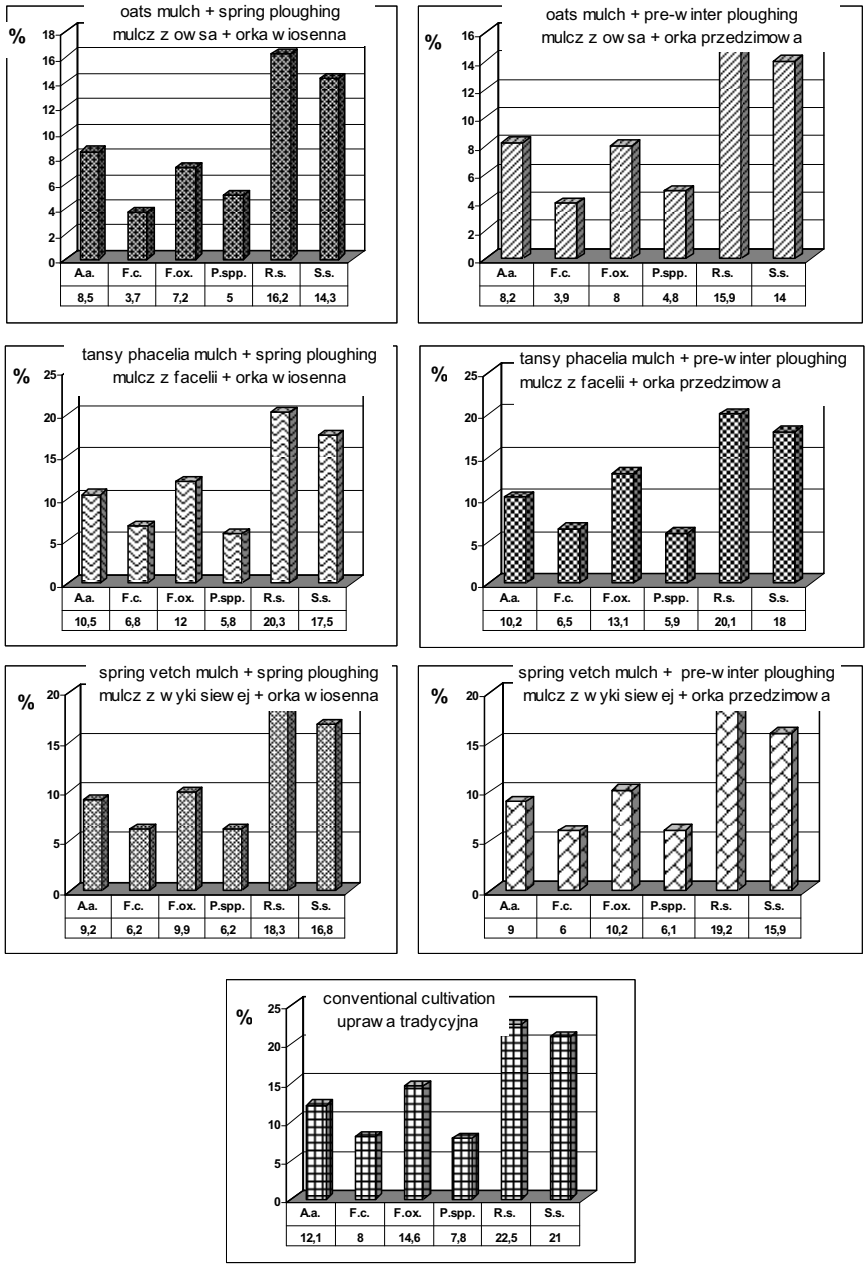
Phot. 2. Deformation and rot of a salsify root (photo by E. Patkowska)
Fot. 2. Deformacja i zgnilizna korzenia salsefii (fot. E. Patkowska)

high-inulin plants. Besides, information available in literature confirms the positive effect of mulch of cover crops on the emergences, healthiness and yielding of a lot of cultivated plants. Kęsik et al. [2000] found out a positive effect of rye on the emergences and yielding of onion cultivated from sowing. On the other hand, Błażewicz-Woźniak [2005] reports on the positive effect of mulch of oats and tansy phacelia on the emergences and yielding of root parsley.

Laboratory mycological analysis. The mycological analysis showed a varied quantitative and qualitative composition of fungi colonizing the roots of infected salsify seedlings. Regardless of the species of the mulching plant, the following fungi considered as potential pathogens were obtained from the diseased seedlings of salsify: *Alternaria alternata* (Fr.) Keissler, *Fusarium culmorum* (W. G. Sm.) Sacc., *Fusarium oxysporum* Schl., *Penicillium* spp., *Rhizoctonia solani* Kühn and *Sclerotinia sclerotiorum* (Lib.) de Bary. The most of fungi were obtained from salsify seedlings cultivated conventionally, i.e. without cover crops. Their proportion was, respectively, 12.1%, 8.0%, 14.6%, 7.8%, 22.5% and 21.0% (fig. 1). The smallest number of fungi was isolated from the seedlings of *Tragopogon porrifolius* var. *sativus* cultivated after mulching the soil with oats, and slightly more after using spring vetch or tansy phacelia as cover

crops. The system of cultivation, i.e. spring or pre-winter ploughing, had no significant effect on the population of fungi isolated from the examined seedlings of salsify. *Rhizoctonia solani* and *Sclerotinia sclerotiorum* proved to be the most harmful towards the roots of salsify. Their proportion in colonizing the diseased seedlings (depending on the experimental combination) ranged, respectively, for *Rhizoctonia solani* from 15.9% in combination with oats mulch to 22.5% control combination and *Sclerotinia sclerotiorum* from 14.0% in combination with oats mulch to 21.0% control combination (fig. 1). *Fusarium oxysporum* and *Alternaria alternata* also posed a big danger in the cultivation of the studied plant as their proportion, respectively, ranged for *Fusarium oxysporum* from 7.2% in combination with oats mulch to 14.6% control combination and *Alternaria alternata* from 8.2% in combination with oats mulch to 12.1% control combination (depending on the experimental combination). The smallest proportion was characteristic of the isolates of *Fusarium culmorum* (from 3.7% to 8.0%) (fig. 1). Studies conducted by Patkowska and Konopiński [2008b] in the conditions of a growth chamber also pointed to the negative effect of the enumerated fungi on the healthiness of salsify seedlings. Pathogenicity tests confirmed that the seedling necrosis and the root rot of *Tragopogon porrifolius* var. *sativus* are caused by *A. alternata, F. culmorum, F. oxysporum, Pythium irregulare, R. solani* and *S. sclerotiorum.* Among the studied fungi, the isolates of *R. solani* and *S. sclerotiorum* proved to be the most pathogenic towards salsify seedlings, whereas *A. alternata* and *F. culmorum* – the least. Besides, Biller and Draper [2001] point to *S. sclerotiorum* as the cause of salsify diseases.

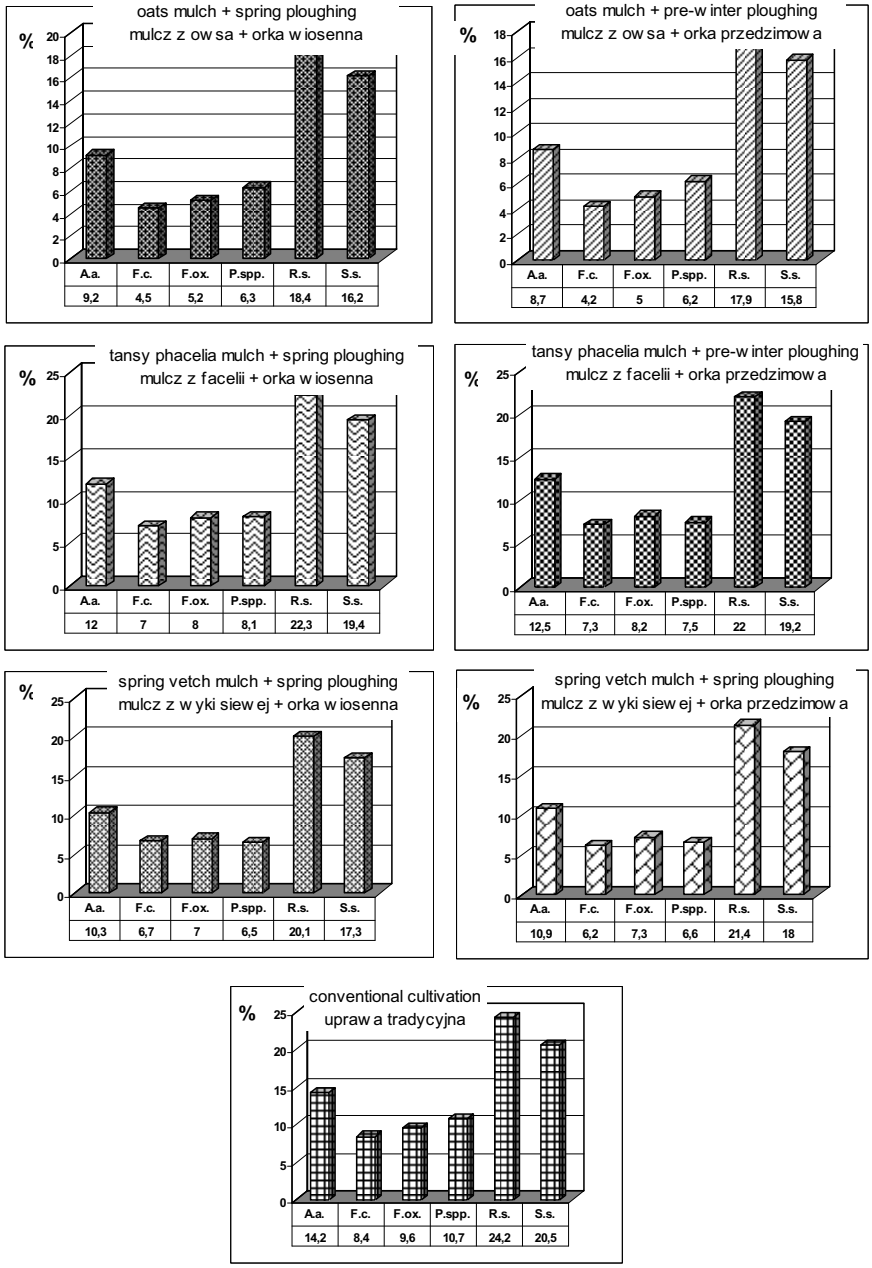
Phot. 3. The rot of salsify roots caused by *Penicillium* spp. (photo by E. Patkowska)
Fot. 3. Zgnilizna korzeni salsefii powodowana przez *Penicillium* spp. (fot. E. Patkowska)



A.a. – *Alternaria alternata*, F.c. – *Fusarium culmorum*, F.ox. – *Fusarium oxysporum*, P.spp. – *Penicillium* spp., R.s. – *Rhizoctonia solani*, S.s. – *Sclerotinia sclerotiorum*

Fig. 1. Fungi most frequently isolated from diseased salsify seedlings (mean from the years 2006–2007)

Rys. 1. Grzyby często izolowane z porażonych siewek salsefii (średnia z lat 2006–2007)



A.a. – *Alternaria alternata*, F.c. – *Fusarium culmorum*, F.ox. – *Fusarium oxysporum*, P.spp. – *Penicillium* spp., R.s. – *Rhizoctonia solani*, S.s. – *Sclerotinia sclerotiorum*

Fig. 2. Fungi most frequently isolated from diseased salsify roots (mean from the years 2006–2007)

Rys. 2. Grzyby często izolowane z porażonych korzeni salsefii (średnia z lat 2006–2007)

After the harvest of salsify, the mycological analysis was also carried out on he roots where disease symptoms occurred. *A. alternata, F. culmorum, F. oxysporum, Penicillium* spp., *R. solani* and *S. sclerotiorum* were isolated from the infected roots of salsify. The most of fungi were isolated from the roots after the harvest of salsify cultivated conventionally, i.e. without any cover crops (fig. 2). Soil mulching with oats proved to be the most effective in inhibiting the colonization of salsify roots by soil-borne fungi. Besides, mulch of spring vetch had a positive effect on the quantitative composition of soil-borne fungi colonizing the roots of *Tragopogon porrifolius* var. *sativus*. Spring or pre-winter ploughing had not significant effect on the population of fungi isolated from the studied salsify roots, either. *R. solani* and *S. sclerotiorum* proved to be the most dangerous towards salsify roots since their proportion (depending on the experimental combination) ranged for *R. solani* from 17.9% in combination with oats mulch to 24.2% control combination and *S. sclerotiorum* from 15.8% in combination with oats mulch to 20.5% control combination (fig. 2). *F. culmorum* and *F. oxysporum* were characterized by the lowest proportion, which ranged for *F. culmorum* from 4.2% in combination with oats mulch to 8.4% control combination and *F. oxysporum* from 5.0% in combination with oats mulch to 9.6% control combination (depending on the experimental combination).

Soil-borne fungi (including *A. alternata, F. culmorum, F. oxysporum, Penicillium* spp., *R. solani* and *S. sclerotiorum*) can constitute a big danger towards different cultivated plants, throughout the period of vegetation. As facultative pathogens, they inhibit seed germination and cause seedling necrosis and the root rot of older plants. Earlier studies [Patkowska and Konopiński 2008a] showed that oats, spring vetch and tansy phacelia as cover crops considerably reduced the population of fungi pathogenic towards scorzonera. Besides, cover crops used as mulch shape the communities of soil microorganisms, including plant pathogens [Jamiołkowska and Wagner 2003, Pięta and Kęsik 2007, Patkowska and Konopiński 2008a]. Depending on the species, and even the cultivar, the mulching plants – through their root exudates and products of decay of their organic substance – can inhibit the development of plant pathogens and stimulate the growth and development of antagonistic microorganisms [Bendig and Lincoln 2000, Smolińska 2000]. Abdul-Baki et al. [1996] as well as Lemańczyk and Sadowski [2002] report that cover crops can considerably inhibit the activity of plant pathogens in the soil. According to Jamiołkowska and Wagner [2003], mulch of field pea and rye remarkably decreased the population of *Fusarium oxysporum* in the soil environment of tomato. Pięta and Kęsik [2007], found out that the occurrence of *F. oxysporum* in the cultivation of onion was limited through mulching the soil with rye. Roe et al. [1994] report the positive effect of cover crops on decreased infection of bell pepper *Phytophthora capsici.*

The present studies confirmed the fact that cover crops, especially oats, inhibit the development of the population of soil-borne fungi and improve the healthiness of underground parts of *Tragopogon porrifolius* var. *sativus*. This is due to the presence of avenacine in the roots of oats and the former possesses strong fungistatic properties [Lüning et al. 1978].

CONCLUSIONS

1. The emergences and the proportion of infected salsify seedlings depended on the species of the mulching plant.

2. The smallest number of infected seedlings was obtained after the mulch with oats as cover crops.

3. *Rhizoctonia solani* and *Sclerotinia sclerotiorum* proved to be the most harmful towards the studied underground parts of salsify.

4. The system of cultivation had no significant effect on the total population of fungi.

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ROŚLINY OKRYWOWE A GRZYBY GLEBOWE ZAGRAŻAJĄCE UPRAWIE SALSEFII (*Tragopogon porrifolius* var. *sativus* (Gaterau) Br.)

Streszczenie. Salsefia posiada duże walory smakowe i odżywcze. Jest bogatym źródłem inuliny – glikozydu korzystnie oddziałującego na organizmy ludzi i zwierząt. Praca przedstawia badania dotyczące składu gatunkowego grzybów glebowych porażających korzenie *Tragopogon porrifolius* var. s*ativus* uprawianej z zastosowaniem owsa, facelii i wyki siewnej, jako roślin okrywowych. W doświadczeniu polowym rośliny okrywowe wytworzyły przed zimą obfity plon zielonej masy, stanowiącej naturalny mulcz na powierzchni roli, który był zagospodarowany w dwojaki sposób: 1) wymieszany z glebą w wyniku orki wiosennej lub 2) wymieszany z glebą w wyniku orki przedzimowej. Kontrolę stanowiła tradycyjna uprawa salsefii, tj. bez roślin okrywowych. W badaniach określono liczebność i zdrowotność czterotygodniowych siewek salsefii oraz korzeni z objawami nekrozy. Laboratoryjna analiza mikologiczna pozwoliła na określenie składu ilościowego i jakościowego grzybów porażających organy podziemne *Tragopogon porrifolius* var. *sativus.* Wschody oraz udział porażonych siewek salsefii były różne i zależały od gatunku rośliny mulczującej. Najmniej porażonych siewek uzyskano po mulczowaniu gleby owsem. Nieco więcej po zastosowaniu wyki siewnej lub facelii, jako roślin okrywowych, a najwięcej w kontroli. Bez względu na gatunek rośliny mulczującej, z chorych siewek oraz korzeni salsefii często izolowano *Alternaria alternata, Fusarium culmorum, Fusarium oxysporum, Penicillium* spp., *Rhizoctonia solani* i *Sclerotinia sclerotiorum.* Najbardziej szkodliwymi dla badanych korzeni salsefii okazały się *R. solani* i *S. sclerotiorum*. System uprawy, tj. wykonanie orki wiosennej lub przedzimowej, nie miał istotnego wpływu na liczebność grzybów izolowanych z roślin salsefii.

Słowa kluczowe: owies, facelia, wyka siewna, mulcz, fitopatogeny salsefii

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