

THE FORECASTING POSSIBILITIES OF THE APPEARANCE
OF THE PEST CREATING GRADATIONS ON THE EXAMPLE OF BEET
LEAF BUG (*PIESMA QUADRATUM* FIEB. HETEROPTERA: PIESMATIDAE)

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Abstract. *Piesma quadratum* is the only vector of beet leaf curl – virosis affecting sugar beet. The sugar content of beets infected by beet leaf curl is reduced by an average of 9% and the root weight is decreased by an average of 58.4%. *P. quadratum* appeared in Poland in the beginning of this century after migration from the territory of Germany. This bug has one generation a year. Its occurrence is characterised by 2-3-years-long gradations in periods of every 9-11 years. Chemical control of beet leaf bug caused disturbance of this rhythm. Recent gradations of the pest occurred every 17 years.

Key words: *Piesma quadratum*, beet leaf curl, BLCV, gradations, harmfulness

I. INTRODUCTION

Piesma quadratum is the only vector of beet leaf curl – economically significant virosis affecting sugar beet and fodder beet.

The first reports concerning harmfulness of *P. quadratum* – beet leaf bug on the sugar beet in Poland were mentioned already in 1910 and cited later by Jeż (1936). According to Jeż the pest occurred in 1935 in as many as 465 locations in Wielkopolska region where it migrated from the territory of Germany.

P. quadratum as the vector of beet leaf curl caused serious economical damages in the 30th years of this century (Krasucka 1935; Kurryłło 1937; Ruszkowski 1933; 1937; Strawinski 1939).

In the 60th years the problem of beet leaf bug harmfulness occurred again. Number of monographs published in this period concerned overwintering, occurrence and harmfulness of *Piesma quadratum* at sugar beet crops and chemical control of this pest (Kotik-Królicka and Szulc 1961; Janas 1967; Narkiewicz-Jodko 1962; 1964; Opyrchałowa 1963).

Stachyra (1969) and later Korcz and Czerwińska (1982) showed that *Piesma quadratum* occurrence is characterised by gradations on the average every 10-12 years.

The aim of this paper is to show that intensive chemical control of this pest which had been carried out in Poland since 60th years caused disturbance of this rhythm.

II. MATERIALS AND METHODS

Observations on the occurrence and harmfulness of both *Piesma quadratum* and beet leaf curl were carried out at sugar beet plantations in Wielkopolska and other regions

of Poland in 1993-1998. The infestation level of sugar beet plantations by pest and virosis was estimated according to methods by Department of Methods of Forecast and Pest Registration of the Institute of Plant Protection.

Observations of developmental cycle of *P. quadratum* were carried out at the sugar beet plantations. At the same time rearing of the bug was performed at the insectary in the Institute of Plant Protection. In order to perform breeding experiments in spring, after migration of bugs to the fields, they were collected, brought to the insectary and transferred to bag isolators. In case of developmental cycle experiments couples of both male and female were joined and put to separate bag isolators with a sugar beet plant. For the studies of virosis transfer by the beet leaf bug single individuals (50 males and 50 females) were put separately to isolators with sugar beet. The presence of virus was detected using an electron microscop.

III. RESULTS AND DISCUSSION

1. Developmental cycle and harmfulness of *Piesma quadratum*

In 1993-1996 after many years break the increase of *Piesma quadratum* number and hence also beet leaf curl at sugar beet in Poland was observed. Therefore the studies on the time of migration of this pest to the plantations, its biology, ecology and harmfulness to sugar beet were undertaken.

Beet leaf bug overwinters in the form of imagines in the neighbourhood of sugar beet plantations in bedding at the edges of the forests, in ditches under separated trees, at balks and also besides the ricks and manure heaps. In spring when the air temperature reaches about 18°C degrees and is stable for few days (in Poland it is usually during the 1st decade of May) imagines of beet leaf bug migrate to sugar beet or fodder beet plantations.

Migration of the bug to the field is a single event (it was already reported by Jeż 1936) from the side of overwintering sites, usually not more that in the range of 20 m to the interior of the field. It is very important in relation to control of this pest.



Fig. 1. The damage of beet leaf caused by imagines of *Piesma quadratum* Fieb.

Beet leaf bug is a small (2.8-3.2 mm), grey-greenish to dark grey bug hence it is very difficult to notice in the field between the lumps of soil. Therefore necrotic spots at the first two leaves of beet – the traces of sucking by pest– are the first symptoms of pest migration for farmers (Fig. 1).

After migration to beet plantations the bugs copulate then females lay oblong, ribbed, about 0.64 mm – long, yellow eggs. The eggs are laid in singles by 2 to 3, in the beginning at the root crown of beet seedling and later at older plants at the etiole and along the main leaf vein. After on average 17,6 days green larvae with similar to imagines red eyes hatch from the eggs.

Larval period continues for 34 days (mean value) then the new generation of the bug appears, it overwinters and the whole cycle repeats. Complete development of the bug in subsequent years of studies reanged from 45.8 to 51.6 days (Korcz et al. 1998). In Poland only one generation of *Piesma quadratum* occurs (Fig. 2).

After migration to beet plantations *Piesma quadratum* sucks out beet leaves and goes through the complete developmental cycle there. Sucking out the leaves does not cause substantial damages. But the really important fact is that by sucking the leaf mesophyll *Piesma quadratum* transfers with its saliva the beet leaf curl (BLCV) to the beet (Fig. 3).

The beet leaf bug is the only vector of this viroid disease. Apparently not all individuals of the species are the vectors of beet leaf curl. Węgorzek and Ruszkiewicz (1972) found that among *Piesma quadratum* imagines collected from infected regions about 17-38% and in our studies only 14-25% of individuals were the vectors of beet leaf curl.

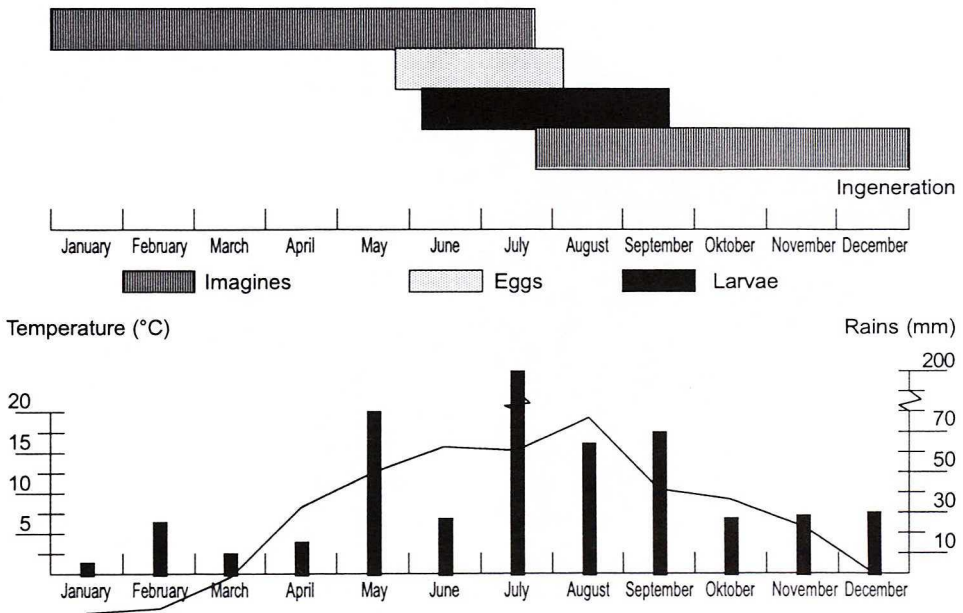


Fig. 2. The biological cycle of *Piesma quadratum* on field in 1996

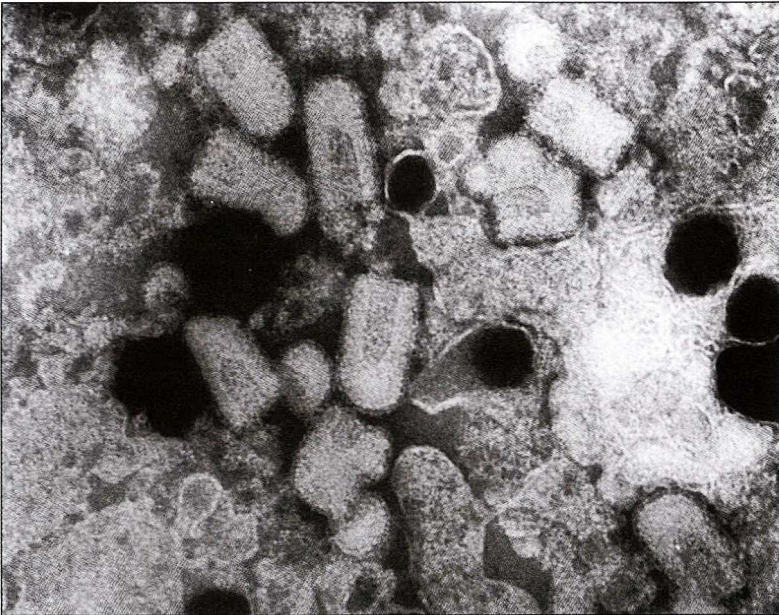


Fig. 3. Beet leaf curl virus in floem of sugar beet. Photo from electron microscope – magnification 171 000 \times (L. Zielińska)



Fig. 4. Sugar beet infected with beet leaf curl in the end of vegetation season – typical morphology of “lettuce head”

The first symptoms of virosis are visible 6 weeks after *P. quadratum* feeding on the beet: the leaves are slightly rolled, their midribs get bleached. In the end of vegetation season the beet looks like the head of lettuce (Fig. 4). Besides in the beets infected with the beet leaf curl the sugar content is reduced by an average of 58.4% and the root harvest is decreased up to 50% (Korcz et. al. 1994).

2. Occurrence of the *P. quadratum* gradations and the attempts for the forecasting them

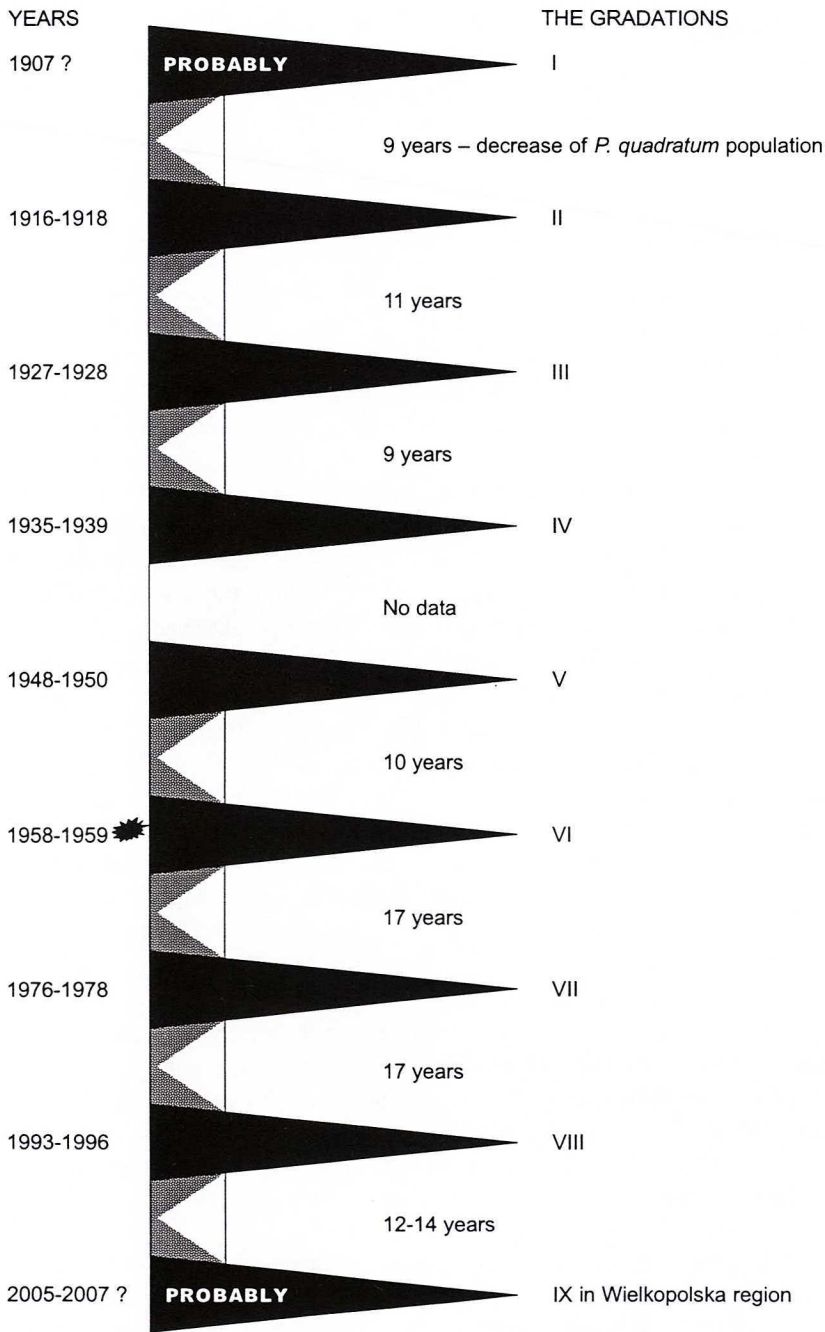
Observations on the occurrence of *P. quadratum* gradations were based on the occurrence of beet leaf curl at sugar beet plantations.

P. quadratum is a small grey bug, which easy fades its colour with a colour of soil. Therefore it is difficult to notice it in the field during springtime. However the beets infected with beet leaf curl are easy to distinguish from the healthy plants already after 2 months from sowing.

It turned out that in the north part of Poznań region where no *P. quadratum* was noticed the beet leaf curl occurred and even in some cases quite intensively. Therefore based on the data collected by Stachyra (1967) and also our own observations we worked out the *P. quadratum* gradation periods occurring from 1907 up to the beginning of new century (Fig. 5). The data presented in Fig. 5 show that gradations continued for 2-3 years and occurred every 9-11 years. Only two latest periods of the *P. quadratum* population decrease had prolonged up to 17 years. This can be easily explained. Chemical control of *P. quadratum* is conducted in Poland from the 60th and continuously with better insecticides. The technology of sugar beet cultivation had also changed. Nowadays pelleted seed containing very good insecticides in the coat of the seed are used for sowing. Therefore less and less number of beet leaf bug in plantations has been observed and the period of the *P. quadratum* population decrease extends. The next gradation of *P. quadratum* may occur probably around 2005-6 in Wielkopolska region because of the existence of stable enclaves of *P. quadratum* in this region. The gradation of *P. quadratum* in other regions may occur later.

Since the last gradation of *P. quadratum* which occurred in Poland in 1993-1996 there had been slow but continuous decrease of the population number of this pest. It may be concluded based on the map of Poland where the occurrence of beet leaf curl in 1993-1994 was marked (Fig. 6). The most intense infection by beet leaf curl occurred in 1993: in 5 provinces the level of infection was locally from 20% to 100%. We point out that it was locally because as usually not in all counties and not in all plantations *P. quadratum* and hence beet leaf curl had occurred. In 1994 the highest infection of sugar beet plantations (up to 10%) occurred in only 3 provinces (Fig. 6).

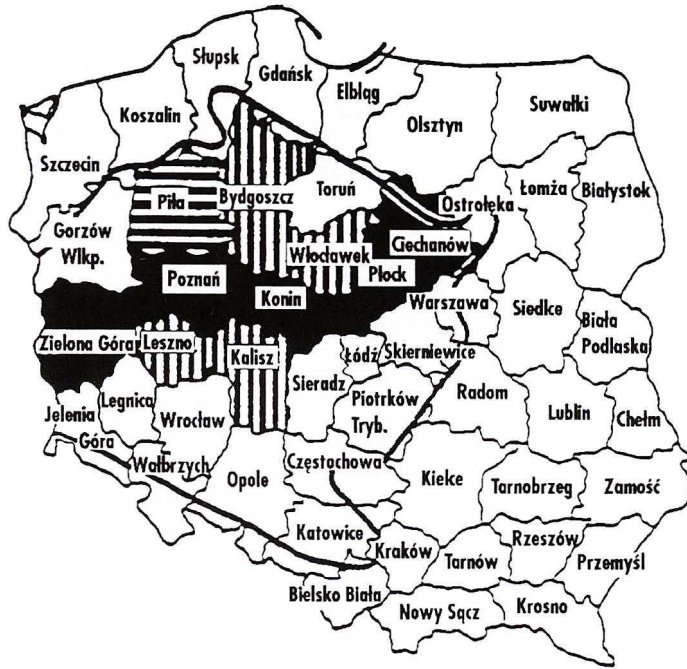
However in 1995 and 1996 the increase of infection of sugar beet by beet leaf curl was reported again. In 1995 virosis occurred locally in the intensity of 5 to 10% in 2 provinces and in the intensity of 20 to 100% in one province (Fig. 7). In 1996 virosis occurred in the intensity of 5 to 10% in 2 provinces and in the intensity of 20 to 100% in 3 provinces. 1996 was at the same time the last year when beet leaf curl strongly infected the sugar beet plantations (Fig. 7).



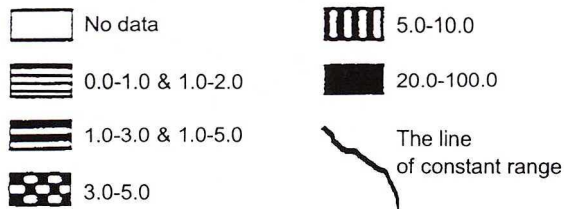
* 1907-1959 data presented according to Stachyra

Fig. 5. Periodicity of *Piesma quadratum* gradation based on the occurrence of beet leaf curl in Poland

1993



Scale % (locally)



1994



Fig. 6. The occurrence of the beet leaf curl at the beet plantations in Poland in the years 1993 and 1994



Scale % (locally)

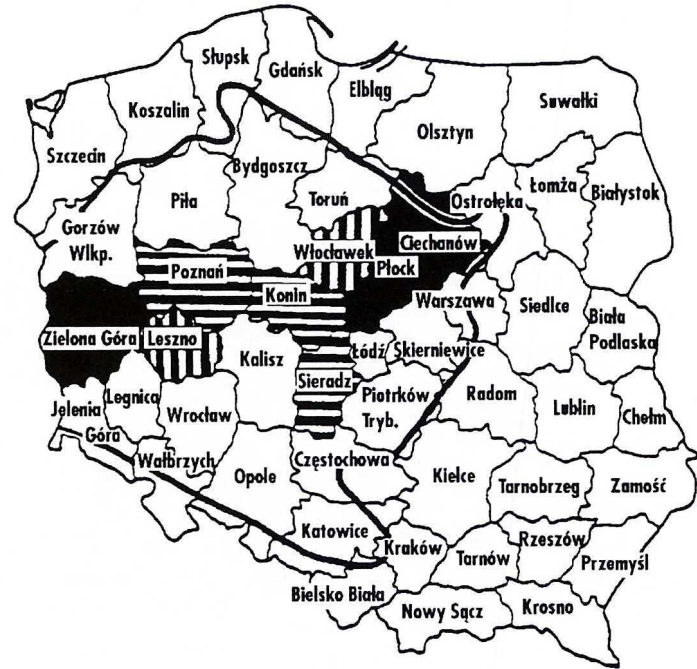
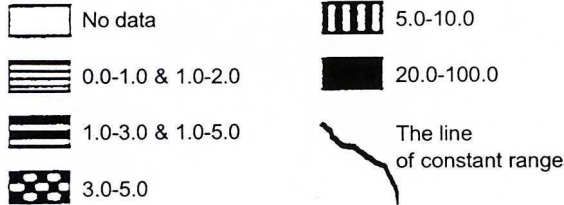
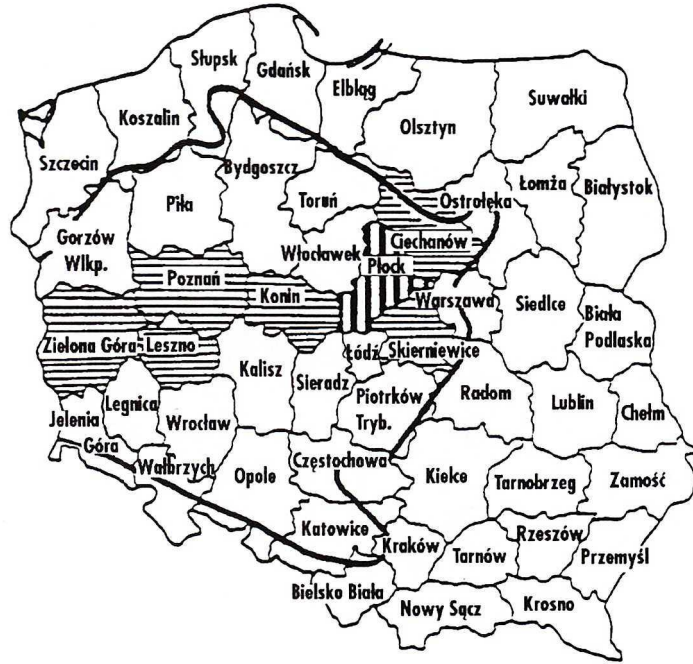
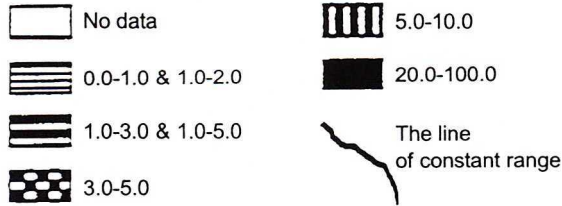


Fig. 7. The occurrence of the beet leaf curl at the beet plantations in Poland in the years 1995 and 1996

1997



Scale % (locally)



1998



Fig. 8. The occurrence of the beet leaf curl at the beet plantations in Poland in the years 1997 and 1998

During next years 1997-98 there is a clear decrease of threat to sugar beet plantations by *P. quadratum* hence by beet leaf curl. Occurrence of virosis was reported locally in the intensity of only 2 to 5% in separate provinces (Fig. 8). Based on the presented maps it is clear that this little mobile bug moves slowly but continuously to the east and at the same time it occurs sometimes in the south of Poland. Next century it may cross our east frontiers as once it arrived in Poland from Germany.

IV. SUMMARISING

For the last 40 years the wide spectrum of pesticides and more modern methods of their application had been used in Poland for control of *P. quadratum*. Chemical control caused the disturbance of the periodicity of *P. quadratum* gradations. Although it makes the forecasting of next gradations very difficult but based on the observations of the gradations periodicity of *P. quadratum* during last 90 years we may expect the next gradation of this pest in Wielkopolska region around 2005-6. However we cannot forecast whether it will concern also the rest of Poland.

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Alicja Korcz

MOŻLIWOŚCI PROGNOZOWANIA POJAWU SZKODNIKÓW TWORZĄCYCH GRADACJE NA PRZYKŁADZIE PŁASZCZYŃCA BURAKOWEGO – *PIESMA QUADRATUM* FIEB. (*HETEROPTERA: PIESMATIDAE*)

STRESZCZENIE

Płaszczyńiec burakowy (*Piesma quadratum* Fieb.) naleciał do Polski z ówczesnego obszaru Niemiec na początku tego stulecia. W 1910 roku zaobserwowano po raz pierwszy na polach buraka cukrowego szkody wywołane przez tego pluskwiaka.

U płaszczyńca burakowego występuje tylko jedno pokolenie w roku. Zimują dorosłe osobniki w ściółce pod drzewami, na brzegach lasów, miedzach, stogach i przyrmach obornika. Wiosną, kiedy temperatura 18°C utrzymuje się przez kilka dni, pluskwiaki nalatują na pola buraka cukrowego. Tam kopulują, składają jaja, jednocześnie wysysając liście tej rośliny. Widoczne wczesną wiosną uszkodzenia liści w postaci nekrotycznych plamek, nie są bezpośrednio szkodliwe dla buraka.

Wysysając jednak miękisz liścia pluskwiak przenosi wraz ze śliną wirusa.

Piesma quadratum jest jedynym wektorem wirusa kędzierzawki płaszczyńcowej (beet leaf curl). (Przy czym stwierdzono, że nie wszystkie osobniki są nosicielami wirusa). Wiroza ta porażając buraki cukrowe wpływa na zmniejszenie zawartości cukru średnio o 9%, masy korzenia o 58,4% oraz plonu o 50%.

Wieloletnie obserwacje wykazały, że u płaszczyńca burakowego co 9-11 lat występują gradacje, które trwają 2-3 lat, po czym następuje stopniowa regresja populacji szkodnika.

Prowadzone od lat 60. intensywne zwalczanie tego pluskwiaka coraz nowszymi insektycydami, spowodowało zakłócenie tego rytmu. Ostatnie 2 gradacje wystąpiły po 17 latach. W związku z tym trudno jest prognozować wystąpienie następnego wzrostu populacji płaszczyńca burakowego, a więc i kędzierzawki płaszczyńcowej.