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MIGRATION MONITORING OF BLACKCURRANT GALL MITE (*CECIDOPHYOPSIS RIBIS* WESTW.) FROM BUDS TO LEAVES ON SEVERAL BLACKCURRANT (*RIBES NIGRUM* L.) CULTIVARS

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ABSTRACT

The blackcurrant gall mite (*Cecidophyopsis ribis*) is the most important pest of blackcurrant crops. Over recent years withdrawal from plant protection programmes of chemical products (endosulfan and amitraz) used for the control of this pest in Poland, has led to an observed increase in population numbers. In 2013, fenpiroxymate (Ortus 05 SC) became registered for control of this pest. It is deemed best that chemical protection should be used during the migration period; when big gall mites emerge from buds in search of new buds. The studies were carried out in a plantation of blackcurrants during 2011-2013. The assessment of migration of the blackcurrant gall mite was carried out on the cultivars 'Ben Hope', 'Ben Alde'r, 'Ojeby'n and 'Ruben'. Every year, from selected cultivars buds were collected. They were then placed on blackcurrant leaves within Petri dishes. After one, three and five days of placing buds on the leaves, the estimated number of eriophyid mites on the leaves was calculated. The data has shown a very useful method for monitoring blackcurrant gall mite, which can be used in calculating the treatment dates for this pest. Also, the data has shown that differences in the periods of migration of the mite are dependent on the cultivar and time of flowering. Among the cultivars observed the least susceptible to colonization by the blackcurrant gall mite was a Polish cultivar 'Ruben', while the most susceptible cultivar was 'Ben Hope'.

Key words: monitoring, blackcurrant gall mite, 'Ben Alder', 'Ben Hope', 'Ruben', 'Ojebyn'

INTRODUCTION

Blackcurrant (*Ribes nigrum* L.) is an important fruit-growing crop (Brennan 1996, 2008). It is grown on a large scale mainly in the northern regions of the world (Mitchell et al. 2011). Poland is a world leader in the production of this fruit species (Pluta et al. 2012).

The blackcurrant gall mite (big gall mite), *Cecidophyopsis ribis* (Westwood) (Acarina: Eriophyidae), is the most important pest of blackcurrant crops world-wide (Cross & Ridout 2001; Alford 2007; Mitchell et al. 2011; Łabanowska & Gajek 2013). It occurs on amateur cultivations, commercial and mother plantations and nurseries (Łabanowska 2011). The mite colonizes developing blackcurrant buds in spring and its feeding initiates prolific growth of cells within the bud resulting in the characteristic "big bud" disorder (Cross & Ridout 2001). Such damage makes the buds completely dry up, leading to a reduction in yield and makes the plants more susceptible to frost (Łabanowska & Gajek 2013). This pest also is the vector of reversion virus disease, which causes sterility in blackcurrant bushes and is the principal factor limiting the life of blackcurrant plantations (Gordon et al. 1994; Jones et al. 1998; Pluta et al. 2000).

After the withdrawal from Polish plant protection programmes in 2004 of the active ingredient amitraz and then in 2007 of endosulfan, an increase

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in the number of blackcurrant plantations colonized by blackcurrant gall mite was observed (Gajek & Olszak 2004; Łabanowska 2011). In 2013, fenpyroximate (Ortus 05 SC) was registered in Poland for the control of blackcurrant gall mite. It is possible to apply this product twice during the growing season; from the beginning of flowering through to full flowering of the bushes (Plant Protection Program 2014). However, chemical protection is most effective during the migration period; that is when mites leave buds following overwintering and before they enter new buds to feed (Łabanowska & Gajek 1999; Mitchell et al. 2011; Apenite et al. 2012).

There is much information available on the life cycle of the mite (Massee 1928; Behrens 1964; Taksdal 1967; Gajek 1997; Apenite et al. 2012), the annual cycle of egg (Collingwood & Brock 1959; Csapo 1992) and mite content of galls (Smith 1960a, b, 1961; Mitchell et al. 2011), and the migration of mites from galls in spring in order to colonize new buds (Łabanowska & Gajek 1999; Cross & Ridout 2001). Although, it has been long recognized that the timing of the migration of the gall mite is not closely associated with a particular growth stage of the plant, commercial acaricide applications are still timed according to plant growth stage (Apenite et al. 2012). It is probable that such timings are often less than optimal and may contribute to poor control (Cross & Ridout 2001). Direct observation of the migration of mites from the galls is possible but is difficult (they are one of the smallest pests of blackcurrant: average body length of the female leaving buds is approx. ¼ mm) and time-consuming and is unlikely to be practiced by growers who, in any event, try to control the pest in the dormant period (De Lillo & Duso 1996; Łabanowska 2011; Łabanowska & Gajek 2013).

The aim of this study was to evaluate the migration of *C. ribis* from damaged buds in spring on four cultivars of blackcurrant using a new method for estimating the migration period. The results will allow for a more precise definition of mite migration time so allowing optimal application of control options.

MATERIALS AND METHODS

Experiments were carried out during 2011-2013 on a blackcurrant cultivar trial located in the Research Institute of Horticulture, Experimental Orchard in Dąbrowice near Skierniewice, Central Poland. In 2002, the plantation was established in a random block, with 4 replications of 3 plants per plot. Planting density was 3.5 × 0.75 m. The first damaged buds appeared in the second year after planting. The plants received no chemical protection against the big bud mite or any other pests and fungal diseases. Fertilizing of plants was applied according to recommendations for commercial plantations. Weeds were controlled with soil and contact-acting herbicides, according to the Polish Programme of Fruit Plant Protection. Additionally, if required, weeds were destroyed mechanically or manually (Łabanowska 2010).

Evaluation of mite emergence in the lab

The migration of blackcurrant gall mite experiments were conducted on cultivars differing in time of flowering and fruit ripening: a Swedish cultivar Ojebyn (regarded as moderately susceptible to big gall mite and reversion virus) with early ripening of fruits; a Polish cultivar, 'Ruben' (moderately susceptible to big gall mite and reversion virus) with medium-early ripening of fruits; 'Ben Hope' and 'Ben Alder' both late ripening fruit cultivars from Scotland, susceptible to big gall mite and reversion virus. Their share in the planting cultivar structure in Poland is 1, 8, 4 and 2% respectively (Associate Professor Stanisław Pluta, Research Institute of Horticulture, RIH, Poland, personal communication).

Every year, from the beginning of the growing season to the end of June, two times a week, from selected cultivars 6 buds with symptoms of colonization by big bud mite were collected. Buds were transferred to the laboratory and placed on blackcurrant leaves in Petri dishes (Fig. 1). These leaves were placed on filter paper soaked with water, which was additionally wetted if necessary. The Petri dishes with the buds were stored in a temperature controlled cabinet at 20 °C with a L16 : D8 photoperiod. After one, three and five days of placing buds on the leaves, the number of eriophyid mites

on the leaves, which came out of the buds, was estimated using a stereoscopic microscope (Fig. 2). Fresh leaves were introduced after counting the mites. The results aimed at determining the period of migration of the mites from the colonized buds.

Fig. 1. The buds placed on leaves in Petri dishes (photo: W. Piotrowski)

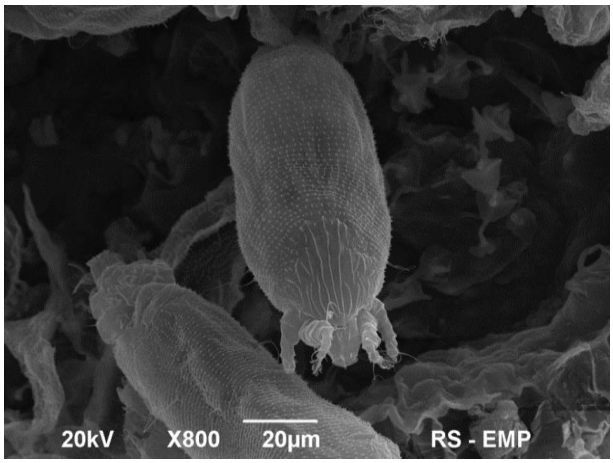

Fig. 2. Adult form (magnification 800x) of *Cecidophyopsis ribis* on the leaf (photo: A. Murgrabia)

RESULTS

Big bud mite migration from the blackcurrant buds taken from the different cultivars along with the periods of flowering are shown in Figures 3-5.

In 2011, first single mites on the cultivar 'Ben Alder' started migrating from buds at the beginning of April, about 4 weeks before the beginning of flowering. Increased intensity of migration began about a week before the start of flowering, and maximum migration took place at the end of flowering (Fig. 3A). Big bud mites recorded on the cultivar 'Ben Hope' had a similar period of migration, except that the maximum migration coincided with full flowering of the bushes on this cultivar (Fig. 3B). On the cultivar Ojebyn, migration of mites was different. It began in early April, with maximum migration occurring about 7-10 days before the beginning of flowering. However, intensive migrating of big bud mite was recorded also throughout the flowering period (from the first week of May) until the end of May (Fig. 3C).

In 2012, observation of big gall mite migration was carried out on three cultivars of black currant: 'Ben Hope', 'Ojebyn' and 'Ruben'. The migration of big bud mites on 'Ben Hope' started in the second week of April and lasted about five weeks, until early June (Fig. 4A). The most mites came out of the buds following 3 days after placing them on leaves in the Petri dishes. The maximum migration took place in mid-May (16th). During this period approximately 500 mites were noted on the leaves. Mites from 'Ojebyn' buds migrated on leaves during the second half of April, a few days before the beginning of the flowering of this cultivar (Fig. 4B). Around the 11th of May the number of emerging pests decreased. Migration was completed by the first week of June. The migration of big bud mite on 'Ruben' proceeded in similar fashion to that on 'Ben Hope', but the numbers of mites which migrated from the buds was much lower (up to five times less) (Fig. 4C). During the mass migration at the flowering time, up to 110 eriophyoid mites were recorded emerging from one bud. The majority of mites came out of the currant buds after 5 days following placing them on the leaves in the Petri dishes.

In 2013, following an unusually long winter, spring was late. As a result, the migration of the big bud mite started at the end of April, only few days before beginning of the period of flowering of the blackcurrant bushes. The intensive migration lasted 3-4 weeks on 'Ben Alder' and 'Ben Hope' respectively (Fig. 5A, B).

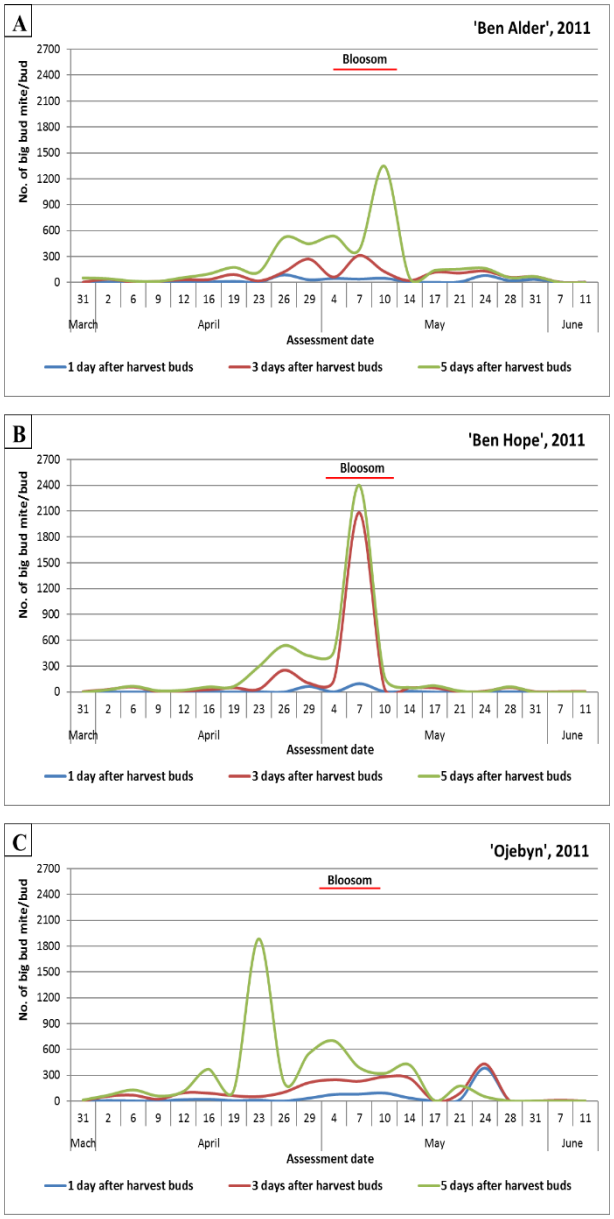

Fig. 3 A, B, C. Migration of the blackcurrant gall mite (*Cecidophyopsis ribis*) on three blackcurrant cultivars in 2011

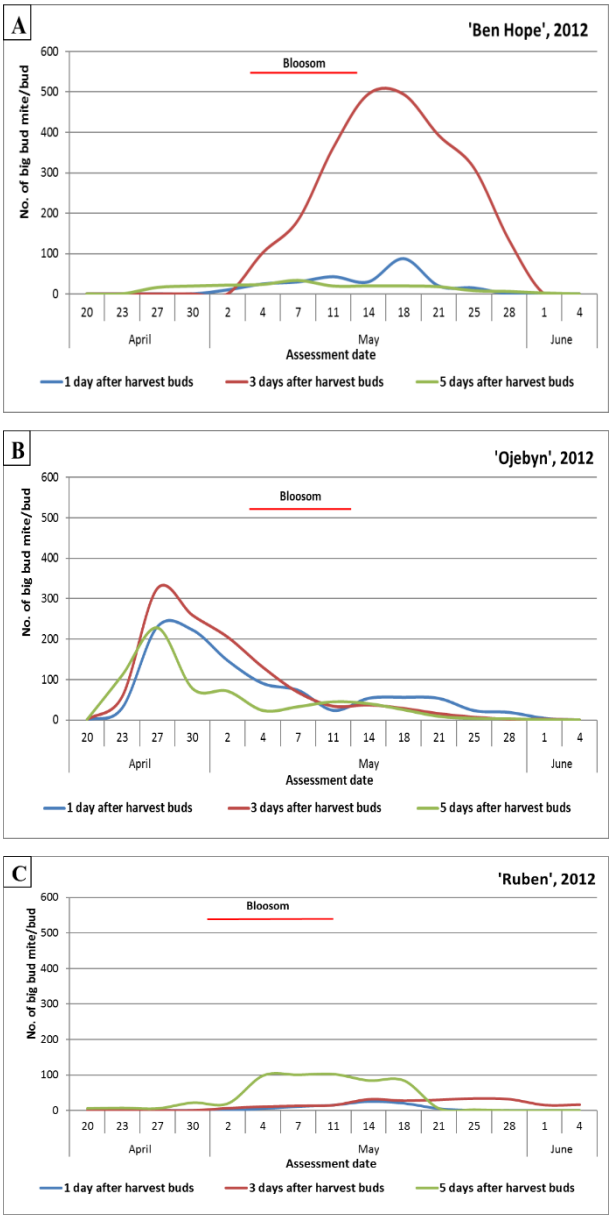

Fig. 4 A, B, C. Migration of the blackcurrant gall mite (*Cecidophyopsis ribis*) on three blackcurrant cultivars in 2012

It started just before flowering, and lasted approximately 10-14 days after blossom. The highest number of migrated big bud mites from the buds of 'Ben Hope' and 'Ben Alder' was noted 3 days after placing the buds on the leaves. During the period of maximum migration up to 660 mites per one bud of 'Ben Hope' and 630 mites of 'Ben Alder' was recorded respectively. The number of migrated mites from buds on 'Ruben' was several times lower than the other two cultivars (maximum of approximately 150 mites per bud). Mite migration started at the beginning of flowering, around the 30th April, and only a single blackcurrant gall mite was recorded during the first week of June; about a month after flowering. The largest migration of big bud mite from the buds was counted during the period 23rd - 31st May; approximately 10-20 days after flowering, and five days after positioning the buds in Petri dishes. There was approximately 150-170 adults recorded from individual buds (Fig. 5C).

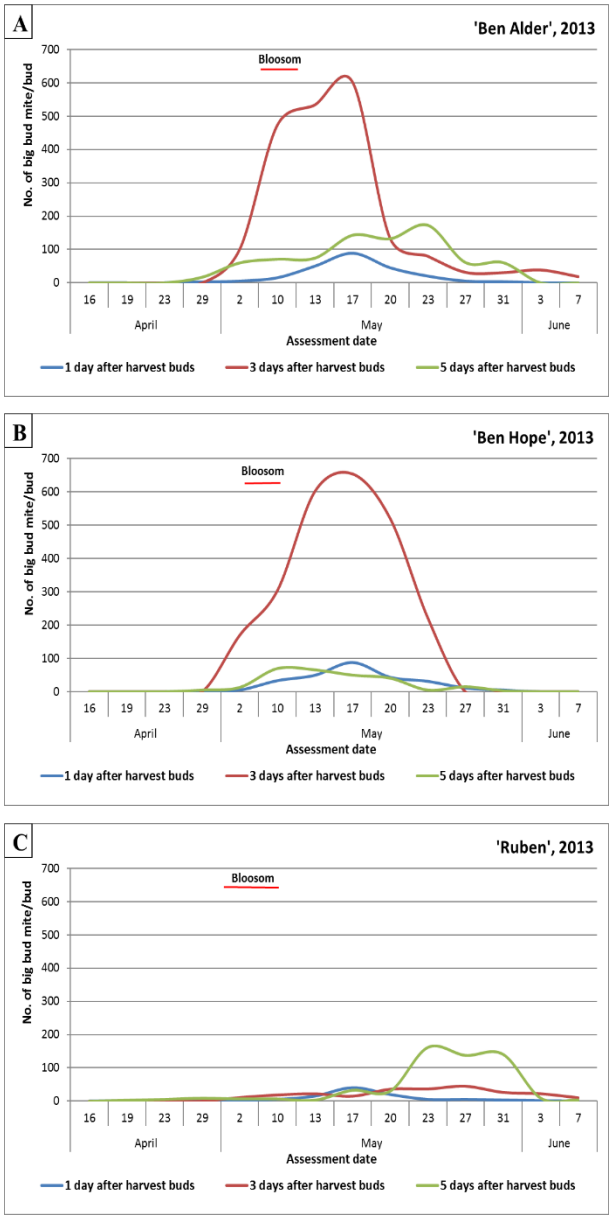

Fig. 5 A, B, C. Migration of the blackcurrant gall mite (*Cecidophyopsis ribis*) on three blackcurrant cultivars in 2013

DISCUSSION

The big bud mite feeds inside blackcurrant buds for almost the entire season (Mitchell et al. 2011). Therefore, such a situation makes the pest very difficult to control (Apenite et al. 2012). However, it is possible to target them during their migration periods (Cross & Ridout 2001). As the occurrence and infestation level of blackcurrant buds by the pest depends on cultivar (Łabanowska & Pluta 2010; Gwozdecki 2000; Kahu et al. 2009), it is envisaged that the migration period may also be dependent on the currant cultivar (Gajek et al. 1996; Gajek 1997; Rubauskis et al. 2006). Therefore, the time to control big bud mite should take into account the migration period deadlines on a specific cultivar (Cross & Ridout 2001; Apenite et al. 2012; Mitchell et al. 2011). The results obtained in these previous studies are confirmed by the data in our studies: both numbers and migration time of big bud mite (*C. ribis*) on 'Ben Alder', 'Ben Hope', 'Ojebyn' and 'Ruben' used in the experiments was very diverse and depended on the cultivar. The numbers of migrated eriophyid mites from buds of 'Ben Alder', 'Ben Hope' and 'Ojebyn' were classed as high or very high. Only low migration numbers was noted on 'Ruben'. According to Łabanowska and Pluta (2010) the cultivar 'Ruben' is classified as having average sensitivity to the mite, whereas, 'Ben Hope' was classified as one of the most susceptible cultivars to big bud mite colonization.

The migration of big bud mite has been studied intensively (Massee 1928; Collingwood & Brock 1959; Smith 1960a; Łęska 1970; Smolarz & Suski 1987; Csapo 1992; Gajek 1997). These studies were based on viewing infected buds under a stereoscopic microscope from which the best timing for chemical spray application was concluded. Alternatively, Cross and Ridout (2001) in determining the migration period of big bud mite used miniature sticky traps. The authors of these previous studies pointed out that each method used had both advantages and disadvantages. The monitoring method used in our study, namely taking colonized buds from plantations and placing them on leaves in Petri dishes is simple and effective; however, it should be taken into consideration that not all mites migrated from the buds onto the leaf. Some of mites remained on the surface of the bud, while other adults stayed inside the buds and died alongside the drying bud.

According to Łęska (1970), the first emergence of mites from buds, defines the beginning of migration. This time is correlated with the time of flowering of the blackcurrant. However, the research conducted by Csapo (1992), Gajek (1997) and Cross and Ridout (2001), determined that the period of eriophyoid mites leaving buds is not always dependent on the timing of flowering. They found that the first emergence of the mites from buds

occurred almost at the same time of year, regardless of plant growth stage or season of the cultivar fruit ripening. These results are confirmed by our data, for example, on the cultivar Ojebyn in 2010 and 2011 migration of mites began much earlier before the beginning of full blooming.

Łęska (1970) reported that mass migration and populating of new buds usually occurs during the flowering period. However, Gajek (1997) observed that the period of migration is also dependent on plant habit. Namely, bushes of more loose habit begin to grow faster, due to better lighting. Therefore, the migration of mites (*C. ribis*) from buds located on the outer shoots of the bush started migration earlier and proceeded faster than from buds in the middle of the crown of the bush. Cross and Ridout (2001) in their observations found that vegetative buds at the base of the plant burst earlier; much before flowering, and that they are an initial source of spread of the mite. These authors then suggested that the first application of acaricide should be done just before the first mites migrate from the buds. Collingwood and Brock (1959) as well as Smith (1960a, b; 1961) suggested, that the first migrating mites are less important because only a few young buds are present on the plants before flowering. However, according to Cross and Ridout (2001) acaricide application just before flowering is too late to control a significant proportion of mites migrating from the buds. The treatments should be done earlier, and repeated, depending on the durability of the acaricide used, to offer protection over the entire migration period. The results of our study show, that the migration period can take up to 70 days. Pesticides usually remain active for a period of 7-10 days, so the standard security programme based on two treatments per season will not guarantee adequate protection. This may be the answer as to why the pest is still present on the plantations. The described monitoring method has now been used to develop various programmes of control for the big bud mite in experiments carried out on the blackcurrant production plantations at the Research Institution of Horticulture, Poland. The outcome of these 3-year studies will prove both interesting and valuable in regards to offering information to further control big bud mite.

CONCLUSIONS

1. The period of migration of big bud mite colonizing blackcurrant buds differs, depending on the cultivar and timing of its flowering period.
2. The number of mites migrating from buds depends on the cultivar, especially in regards to its susceptibility to colonization by the big bud mite.
3. Among the observed cultivars, ‘Ben Alder’, ‘Ben Hope’, ‘Ojebyn’ and ‘Ruben’, ‘Ruben’ was the least susceptible to colonization by big bud mite.
4. The highest number of the mites migrated from buds of the cultivar ‘Ben Hope’.

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