Trial and Advisory Council
VuB
Schleswig-Holstein

Chamber of Agriculture
Schleswig-Holstein
Horticultural Centre

Annual report
2019

Carnation tortrix moth, a destructive pest of several hardy nursery stock species

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Introduction

Under an agreement with Dr Heinrich Lösing, AHDB obtain and translate the annual reports prepared by the Trial and Advisory Council (VuB) based in Ellerhoop, Germany. Each annual report consists of a summary of the trials and activity undertaken by VuB on nurseries in the local area around Ellerhoop during the year in question. Many of the issues and problems addressed are similar to those facing both container- and field-grown hardy nursery stock growers in the UK, as a result, the AHDB Hardy Nursery Stock Panel agreed to the purchase, translation and sharing of the results to avoid unnecessary duplication of work.

This year, the translated version of the report features only the technical trials undertaken, rather than other subject matter more specific to growers in Germany. The results of ten trials (and a brief summary of two others) are summarised in the following pages, along with a review of the machinery trade fair (Baumschultechnik) staged in 2019. All the trials focus on pest, disease or weed related issues, with the exception of the trial on plant growth regulators.

As the work was undertaken in Germany, rather than in the UK, your attention is drawn to the important disclaimers at the end of the report regarding the plant protection products used in the various trials.

Note – 'Authorisation' and 'note' columns in some of the treatment tables have been left in but relate to legislation in Germany and as such the information contained within them is often not relevant to the UK (as a consequence the codes in the note column have not been defined).

Assessing the efficacy of Jet 5 and Menno Ter forte to control algae on container floor surfaces

(B. Zielke, Dr H. Lösing)

1. Introduction

In horticultural businesses, algae will grow anywhere that is permanently damp and has sufficient light. Thick layers of algae develop on fabric matting covering container floor surfaces resulting in them becoming less permeable to water and remaining damp for longer. Standing water encourages further moss growth on the floor surfaces and can promote plant diseases. Container floor surfaces can also become very slippery as a result of algae growth, making algae a safety risk for employees. A trial was set up to test the efficacy of various products against algae on container floor surfaces.

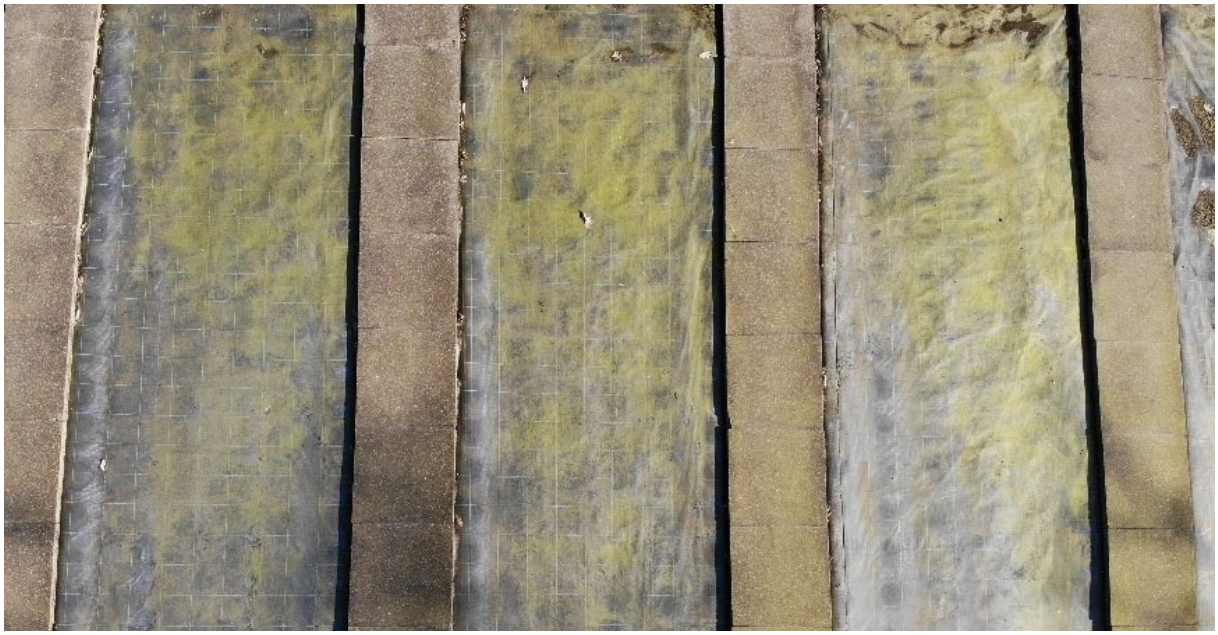


Fig. 1: Portion of the trial area from above (photo: Heissel)

2. Trial methodology

The trial was replicated three times in a tree nursery on a floor surface covered with Mypex fabric. The plot size was 1.5 m x 4 m. At the start of the trial, the surface was dry and free from weeds but covered with algae. The trial was carried out on 26/02/2019 in sunny weather at a temperature of 12°C and a wind speed of 0–2 m/sec.

Application of the products listed in Table 1 was carried out with a plot sprayer equipped with Lechler nozzles ID 120-04 at a pressure of 3.5 bar. In order to apply the required spray quantity, different walking speeds were maintained.

Table 1: Treatment list

No.	Treatment	Conc.	Active ingredient	Water volume	Product
1	Water		-	4000 l/ha	-
2	Jet 5	2%	Hydrogen peroxide 10–25% solution Acetic acid 10–25% Peracetic acid <5% Alcohols <3%	4000 l/ha	Biocide
3	Menno Ter forte	0.25%	Didecyldimethylammonium chloride 30–35% Isotridecanol ethoxylate 15–20% Isopropyl alcohol 5–10%	4000 l/ha	Biocide
4	Menno Ter forte	0.5%	See above	4000 l/ha	Biocide
5	Menno Ter forte	1%	See above	4000 l/ha	Biocide
6	Menno Ter forte	2%	See above	4000 l/ha	Biocide
7	Finalsan	16.6%	Pelargonic acid 186.7g/l	1000 l/ha	Herbicide

The planned assessment dates were one day, three days, one week and four weeks after treatment. It became clear, however, that assessment was only possible in dry weather. If the floor surface was wet due to precipitation, the algae was darker in colour and it was impossible to observe the algae growth. Because of the precipitation, assessments were therefore carried out one and two days after treatment. There followed a period of about two weeks of numerous rain showers during which the sites did not dry out. The last assessment of efficacy was carried out about four weeks after treatment.

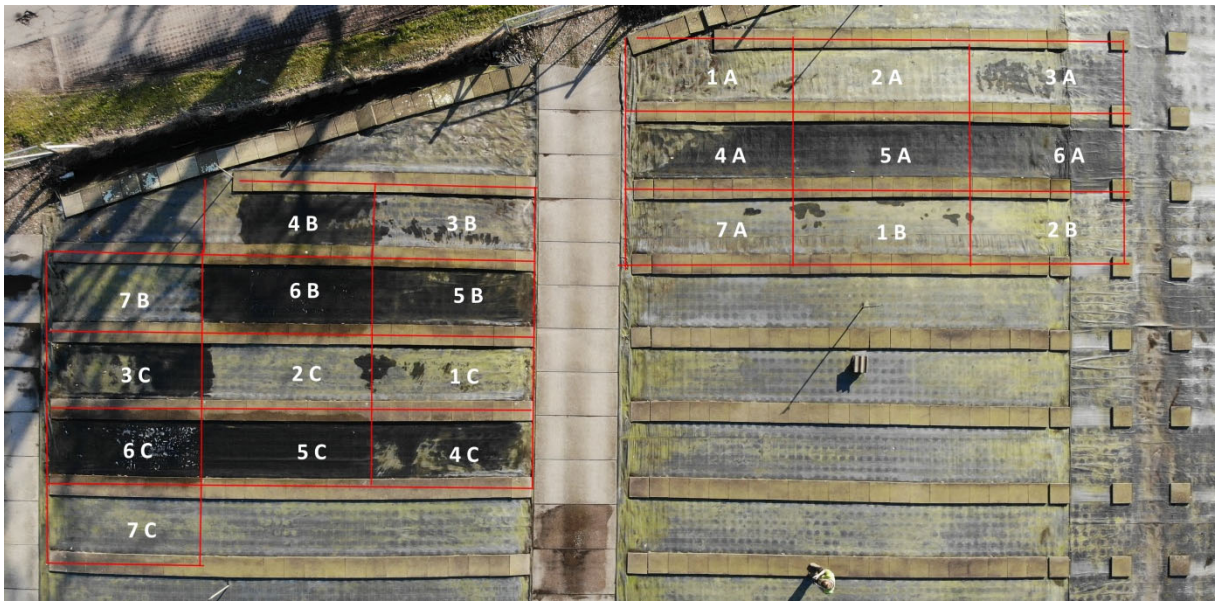


Fig. 2: Arrangement of the plots, trial area on the day of treatment, freshly treated plots are still damp (photo: Heissel)

3. Results

The spray liquid was prepared in canisters and carefully shaken before being poured into the plot sprayer tank. The higher the concentration of the Menno Ter forte spray liquid, the more it foamed up. Foam development was lower in the case of Jet 5. Finalsan also foamed up.

Despite the sunny weather and mild temperatures, it took more than half an hour for the spray liquid to dry on the plots treated with 4000 l/ha.

Fig. 3: Foam after application of Menno Ter forte 2% with 4000 l/ha of spray liquid

The effect of the products could be seen as early as one day after treatment. On the plots treated with Finalsan and Menno Ter forte (1% and 2% respectively), the algae had already died out completely. The Menno Ter forte treatment at a concentration of 0.5% showed a very good effect of more than 95% reduction on average as early as the first assessment date.

In the case of the Jet 5 (2%) and Menno Ter forte (0.25%) treatments, an effect of almost 80% reduction was observed on the first assessment date. In particular, Jet 5 seemed to have increased its effect still further on the second day after treatment, to over 95% reduction. Two days after treatment, only the Menno Ter forte 0.25% treatment had an effect of less than 80% reduction.

After the rainy period in March, no differences were detected between the treatments. The effect on algae was total for all treatments. In contrast, the untreated plots remained almost 80% covered in algae on average.

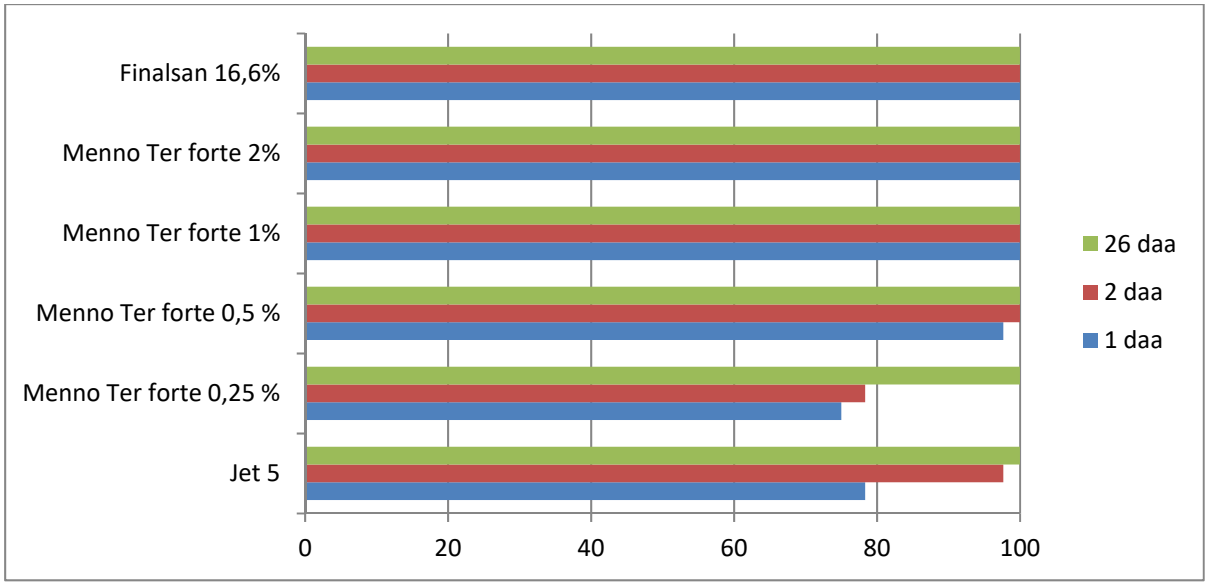


Fig. 4: Effect on algae as a percentage (mean values from three replicates) (daa = days after application)

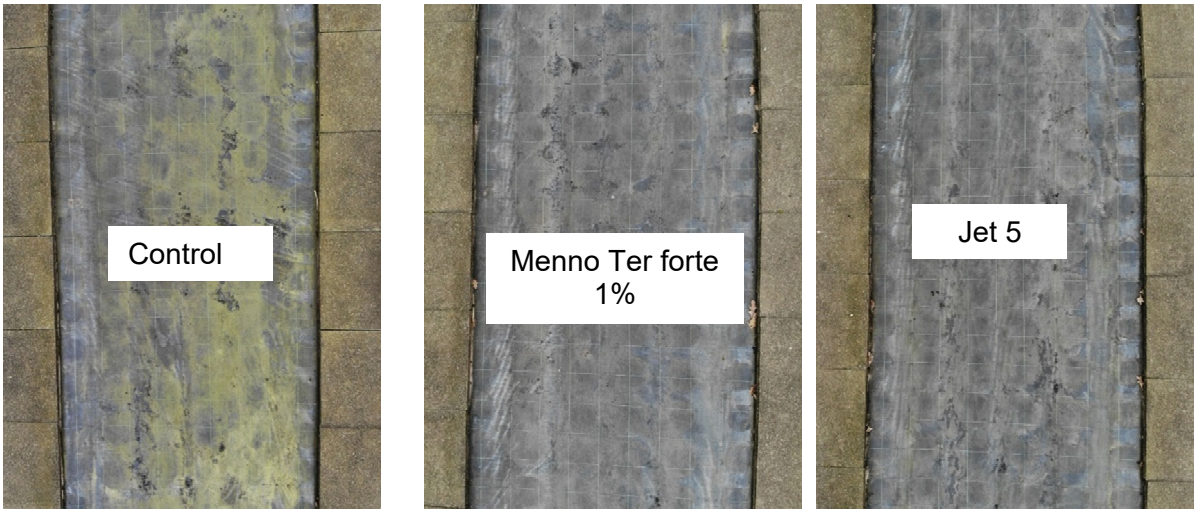


Fig. 5–7: Trial plots from above on 28/02/2019, two days after treatment

4. Summary

A trial was set up on a tree nursery to test the efficacy of various products against algae on container surfaces.

The biocides Jet 5 (2%) and Menno Ter forte (0.5%, 1% and 2%) with a spray quantity of 4000 l/ha and the herbicide Finalsan (16.6%) at 1000 l/ha had an almost total effect on the algae present two days after treatment. A concentration of 0.25% was too low for the product Menno Ter forte to have a rapid and comprehensive effect.

Control of liverwort in tree and shrub nurseries

(B. Zielke, Dr H. Lösing)

1. Introduction

Since the early 1990s, Mogeton (active ingredient quinoclamine) has been used to combat liverwort (*Marchantia polymorpha*) in tree nurseries. On 31 December 2018, the authorisation of all plant protection products with the active ingredient quinoclamine were withdrawn at the request of the authorisation holder, with a phase-out period ending on 30 June 2020. The use of Mogeton will also be prohibited in other European countries in the future.

Mogeton had the advantage of having a good effect on existing liverwort and a good long-term effect on the germination of liverwort spores. Mogeton and Mogeton Top were safe with nursery trees. The trial described below, tested the efficacy and safety of other products to combat liverwort. Two herbicides, an authorised ‘basic substance’, a disinfectant and two ‘natural’ products, which according to the manufacturer’s information are not biocides, were compared with the product Mogeton Top.

Fig. 1: Trial against liverwort

2. Trial methodology

The trial was replicated three times in a greenhouse on *Taxus baccata* potted in autumn 2018. Around 100 plants, pot thick in 9 cm pots, were treated per plot. At the start of the trial, on 25/03/2019, the plants had yet to come into growth. The plants and pot surfaces were dry, and

more than half of the pot surfaces were covered in liverwort. The liverwort was still in a young stage of development; its umbrella-like organs for sexual reproduction had not yet developed. The weather was overcast, with outside temperatures of about 5°C. As the side vents of the greenhouse were closed, the temperature measured inside the greenhouse was 11°C.

The various products were applied with different quantities of water according to the label instructions. A Birchmeier backpack sprayer was used with a Teejet 11005 nozzle at 1 bar of pressure. The products Green Cleaner Forte and Moss Kade were applied with a spray quantity of 2000 l/ha. The product Mogeton Top and the disinfectant Jet 5 (the instructions for use in fact prohibit direct application to humans, plants, animals, foodstuffs and animal feed) were applied over the plants at 1000 l/ha, and the two herbicides Vorox F and Proman were applied with a water volume of 500 l/ha each. None of the spray treatments were washed off.

Fig. 2: Application of a liquid treatment

Fig. 3: Application of sodium hydrogen carbonate

The powdered sodium hydrogen carbonate was procured through a food retailer. A quantity of 12.2 g/m² was weighed out and sprinkled over the plants directly from the bag. It was then carefully brushed off. Table 1 provides a summary of all the trial treatments.

On 10/04/2019, the treatments Green Cleaner Forte and Moss Kade were applied again. The *Taxus* had still not yet commenced growth. It was sunny and 15°C inside the greenhouse, significantly warmer than at the time of first treatment. The EC values and pH-values of the two spray solutions were established.

Assessments were carried out one and three days after treatment and on 04/04, 16/04, 03/05, 22/05 and 23/07. The efficacy and safety of the products were evaluated.

Table 1: Treatments applied on 25/03/2019. Applications of Green Cleaner Forte and Moss Kade were repeated on 10/04/2019

Treatment	Application rate/water volume	Active ingredient	Authorisation	Notes
Untreated	-	-	-	
GreenCleaner Forte	12.5% 2000 l/ha	Plant protein, starch and oil, lactic acid bacteria	'Not a biocide'	GHS 05
Jet 5	2% 1000 l/ha	Hydrogen peroxide 10–25% solution Acetic acid 10–25% Peracetic acid <5% Alcohols <3%	Biocide for disinfection and algae elimination	GHS03, GHS05, GHS07, GHS09
Mogeton Top	7.5 kg/ha 1000 l/ha	500 g/quinoclamine	Use by 06/20	N, Xn, B4
Moss Kade	12.5% 2000 l/ha	Proteins, starch, oils, lactic acid	'Not a biocide'	GHS 05
Dr. Oetker Baking Soda	122 kg/ha 12.2 g/m²	1000 g/kg sodium hydrogen carbonate	Basic substance	-
Proman	3 l/ha 500 l/ha	500 g/l metobromuron	Herbicide Section 22 (2) B	GHS08, GHS09
Vorox F	120 g/ha 500 l/ha	500 g/kg flumioxazin	Herbicide ZG	N, T, B4

3. Results

3.1 Crop safety

In the first few days after treatment, only the familiar orange coating on the needles of *Taxus* treated with Mogeton Top was observed. This coating faded or was washed away by irrigation and was barely visible by mid-April. Shoot emergence of the *Taxus* in late April was uniform in all the treatments, and no differences in the growth of the new shoots were observed between the treatments in early May. At the last assessment on 23/07/2019, symptoms of plant damage were still visible in the Proman plots. Treated plants had some yellowing on the (old) needles as well as slightly less vigour compared to plants in the other treatments.

Fig. 4: Left, four plants from the untreated plot; right, four plants from the Proman plot on 23/07/2019. *Taxus* plants from this treatment had the least average growth

The pH value and EC value measurements of the Green Cleaner Forte and Moss Kade spray liquids (12.5% each) showed extreme values. The EC values were 3.8 and 3.3 respectively. The pH values were 3.3 and 3.4 respectively. Nevertheless, neither treatment showed any identifiable plant damage to *Taxus* before shoot emergence.

3.2 Efficacy

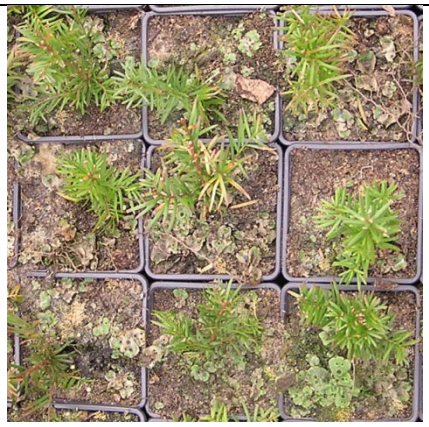
One day after treatment, some of the products had already started to have a visible effect on the common liverwort. On pot surfaces treated with Green Cleaner Forte, Moss Kade and Mogeton Top, the liverwort had started to turn brownish. Where sodium hydrogen carbonate had been scattered, the liverwort had already turned black in some places. Liverwort treated with the herbicides Proman and Vorox F or with the disinfectant Jet 5 was visually similar to the control. Three days after treatment, slight effects on the liverwort were also observed in the Jet 5 and Vorox F plots. The figures below show representative portions of the treated plots three days after treatment.

Proman

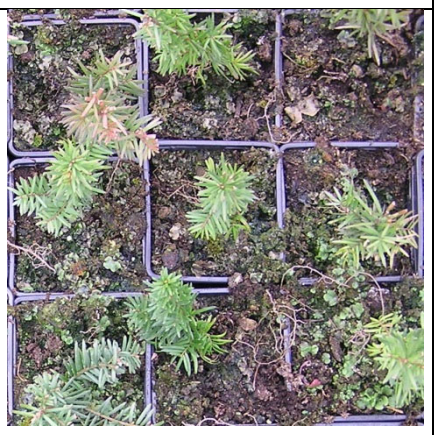
Green Cleaner Forte

Jet 5

Mogeton Top



Moss Kade



Baking soda

Figs. 5–10: Representative area of each treated plot on 28/03/2019, three days after treatment

In the control treatment, the degree of liverwort cover increased as the trial progressed. The average percentage cover on 28/03 was 63%, on 16/04 it was already over 90% and on 03/05 it was almost 100%. The sexual reproductive organs of the liverwort also began to develop in early May. In contrast to the untreated plots, the degree of liverwort cover on pot surfaces treated with the herbicide Proman decreased continuously. From over 40% in early April, it had fallen to just under 10% by mid-April. In late July, liverwort cover on these plots was still less than 10%. The herbicide Proman had a marked long-term effect on liverwort.

Despite the second treatment with the products Green Cleaner Forte and Moss Kade, liverwort cover on these plots quickly increased again from mid-April after an initial good effect. In early May it was already at a similar level to that of the untreated plots. From 22/05/2019, it was observed that the effect of the products Mogeton Top and Vorox F also began to diminish. The first small liverwort cushions on these plots grew rapidly and were soon occupying larger areas. In late July, all the plots except those treated with Proman were already over 90% covered with liverwort again.

Proman

Moss Kade

Jet 5

Mogeton Top

Vorox F

Baking soda

Figs. 11–16: Representative area of each treated plot on 22/05/2019, around eight weeks after treatment

4. Summary

Quinoclamine, the active substance in Mogeton, has lost its approval as an active ingredient in plant protection products throughout Europe. This means that the crop safe product Mogeton Top can only be used in horticulture until 30/06/2020. The situation is similar in neighbouring countries where the product has previously been approved.

The aim of the trial was to find a substitute for the product Mogeton Top to combat liverwort. Only the herbicides tested in the trial had a sustained effect on liverwort. With an application rate of 3 l/ha, the effect of the herbicide Proman was even better than that of the moss killer Mogeton Top in this trial. However, even when used over a conifer (*Taxus*) trial plant before shoot emergence, it was not crop safe. Crop safety will be presumably even worse in the case of deciduous trees, particularly after leaf emergence. The same applies to Vorox F, which, with an application rate of 120 g/ha, also had an effect on liverwort comparable to that of the product Mogeton Top. Further trials with herbicides to control liverwort (reduced application rates of Proman, Venzar 500 SC etc.) will be carried out in the spring of 2020.

Other products tested in the 2019 trial, such as Green Cleaner Forte and Moss Kade, initially had an effect on liverwort, but this was limited to a few weeks even after two treatments. Furthermore, the crop safety of these products in more sensitive species is uncertain and their use is not permitted in Germany.

Although the basic substance sodium hydrogen carbonate may be used, its effect is also very brief. Added to this are the difficulties of practical and even application over larger areas.

Liverwort grows in conditions of sufficient light, especially on the surface of permanently moist substrate. Optimising the water supply, good substrate drainage and the application of pot covers or mulch layers (made from sawdust or pine bark, for example) to the pot surfaces significantly reduce the growth of liverwort. Such measures will continue to grow in importance in the future.

Crop safety of herbicides for pre-emergence weed control in container-grown deciduous trees and shrubs

(B. Zielke, Dr H. Lösing)

1. Introduction

In recent years, the importance of mulch materials for application to the pot surface of container-grown plants has increased. This measure has the advantage that the pot surfaces dry out better and thus that there is less germination and reduced growth of mosses and weeds. This covering layer also gives a more decorative appearance to plants for sale in garden centres. However, application requires the use of special equipment and must be compatible with operational processes. Some tree and shrub nurseries therefore continue to rely on the preventive application of herbicides such as Butisan or Flexidor for weed control.

Two herbicides that are still quite new and have so far been little used in the tree and shrub nursery sector were tested for efficacy and safety in a practical trial.

Figs. 1–2: First part of the trial, treatment on 20/03/2019, two weeks after potting, in drizzly weather without irrigation

2. Trial methodology

The oilseed rape herbicide Crawler, unlike many recently approved herbicides, contains only one active ingredient: carbetamide 600 g/kg. In addition to the urea derivative dimefuron, this active ingredient was contained in the Pradone Kombi, which was used in tree nursery trials around 20 years ago (see the VuB annual reports for 1997–2002). Crawler is believed to have an effect on annual grasses as well as field pansies, some species of speedwell and chickweed. The herbicide was applied at the full application rate of 3 kg/ha.

The second treatment used was the herbicide Proman, which contains the active ingredient metobromuron and has increasingly been in use in tree nursery trials since 2013. The herbicide is now authorised for potato cultivation and is approved for VuB member companies in Schleswig-Holstein in accordance with Section 22 (2). It has a good residual effect on monocotyledonous and dicotyledonous weeds. The herbicide Proman was also applied at the full application rate of 3 l/ha.

The trial commenced on two separate days. The treatments were applied using a backpack sprayer with an 8002 flat spray nozzle at a pressure of 2 bar. A spray volume of 500 l/ha was used.

On 20/03/2019, nine genera and species of plants in 3 litre plus containers were treated. There was light drizzle and the temperature was 8°C. The plants had been potted bare-rooted about two weeks previously, the substrate had settled, but shoot emergence had not yet occurred.

The second part of the trial was carried out on 25/04/2019. Thirteen genera and species of plants were treated using the same sprayer and the same spray volume. The plants had also been potted bare-rooted two weeks previously, and because some species had already started to grow, a watering can was used to apply 3–5 l of water per square metre immediately after treatment. The plants were regularly assessed. Attention was paid to delayed shoot emergence and other differences compared to the untreated plants.

Figs. 3–4: Second part of the trial, treatment on 25/04/2019, two weeks after potting, in sunshine at 15°C, followed by immediate watering with a watering can at 3–5 l/m²

3. Results

3.1 Efficacy

The efficacy of the herbicides on a range of weeds associated with container-grown crop production was observed up to the beginning of June. The herbicide Proman had a very good effect on liverwort (*Marchantia polymorpha*), groundsel (*Senecio vulgaris*), bittercress (*Cardamine* sp.), willowherb (*Epilobium* sp.) and blown in poplar seeds (*Populus* sp.). The effect of the herbicide Crawler on these weeds was insufficient.

Fig. 5: Efficacy of the herbicide Proman, applied on 20/03/2019. On 05/06/2019 the pot surfaces of *Acer campestre* are still free from weeds

Figs. 6–7: Weed effect on 05/06/2019 on *Tilia cordata* of the herbicides Proman (left) and Crawler (right) applied on 20/03/2019

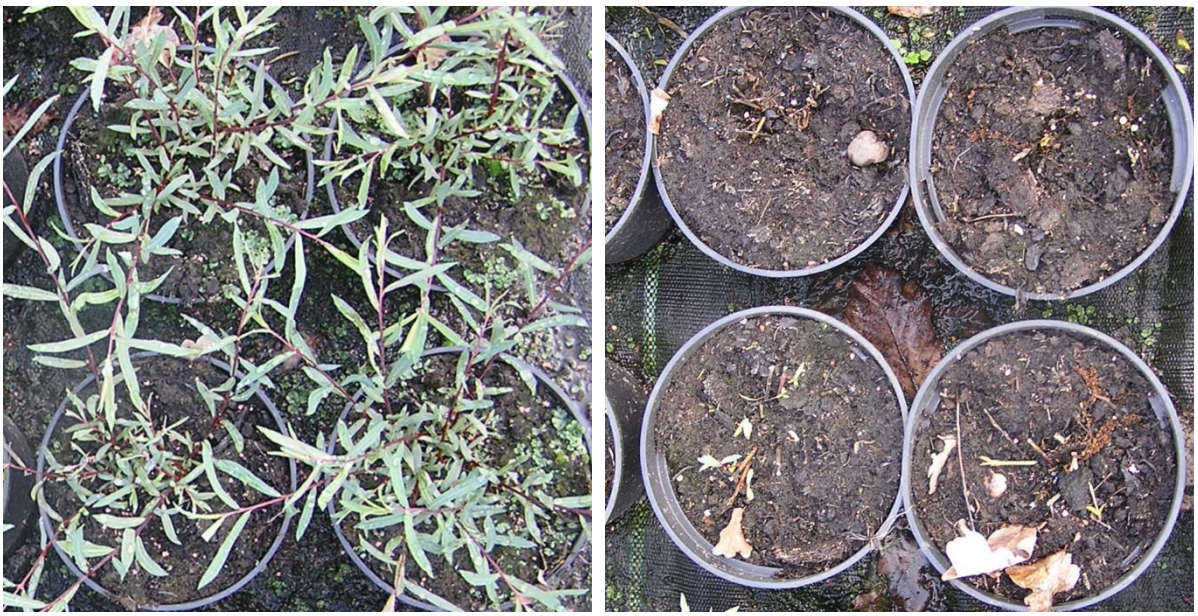
3.2 Crop safety

Crop safety was observed up to 05/06/2019. An overview of the growth stages of the species at the time of treatment and of the results is presented in Tables 1 and 2.

During the early hours of 5 May a frost event occurred, during which a temperature of -2°C was measured 2m above ground in Ellerhoop. In the tree nursery where the herbicide trial took place, no frost protection irrigation was applied. Frost damage to some trees made it difficult to assess plant phytotoxicity, as untreated plants also suffered damage.

The early herbicide treatment on 20/03/2019 applied without irrigation was generally well tolerated by the trees which had made little or no growth at the time. It is possible that the cool, humid conditions on the first application date played a part in the improved crop safety.

An exception was *Salix purpurea* ‘Nana’. These plants consisted of unrooted cuttings placed directly into containers. The cuttings treated with the herbicide Proman, hardly developed at all and mostly died off.



Figs. 8–9: *Salix purpurea* ‘Nana’ unrooted cuttings on 20/03/2019, treated with herbicides, photographed on 05/06/2019. Left a section of the Crawler plot with good safety but insufficient effect on liverwort, right a portion of the Proman plot with poor crop safety but a good preventive effect on liverwort

The second application date was sunny with higher temperatures. In addition, all the shrubs had developed further. The most developed were *Cotoneaster lucidus*, *Symphoricarpus albus var. laevigatus* and *Viburnum opulus*; the least developed were *Ribes alpinum* and *Viburnum*

lantana. Despite the immediate irrigation after treatment, the herbicide treatments caused damage in the form of chlorosis or necrosis on new shoots.

Figs. 10–12: Left: Herbicide damage on 15/05/2019 to *Viburnum opulus* (treated with irrigation after bud development on 25/04). Middle: *Symphoricarpos* photographed on 15/05/2019, treated on 25/04 with 3 l/ha of Proman. Right: An untreated comparison plot of *Symphoricarpos*

Table 1: Developmental stage (usually before shoot emergence) at the **beginning of the trial on 20/03/2019** and crop safety observations of the trial plants on 15/05/2019

Plant species and container size	Stage of development *	Crop safety	
		Crawler	Proman
	20/03/2019	15/05/2019	15/05/2019
Acer campestre, co 5 l	00		
Amelanchier spicata, co 3 l	07		
Aronia melanocarpa, co 3 l	09		
Carpinus betulus, co 3 l	01		
Cornus mas, co 7.5 l	03		
Ligustrum vulgare, 'Atropurpureum', co 12 l	01		
Ribes sanguienum 'King Edward VII', co 10 l	07		
Salix purpurea 'Nana' (unrooted cuttings), co 1.5 l	07		
Tilia cordata, co 5 l	00		

* 00 = dormancy; 01 = start of bud swelling; 03 = end of bud swelling;
07 = start of bud burst; 09 = leaf tips protrude over bud scales by 5 mm

= safe = damage possible = not safe

Table 2: Developmental stage (after shoot emergence) at the **beginning of the trial on 25/04/2019** and crop safety observations of the trial plants on 15/05/2019

Plant species and container size	Stage of development*	Crop safety	
		Crawler	Proman
	25/04/2019	15/05/2019	15/05/2019
Berberis thunbergii, co 3 l	11		
Cornus sericea 'Flaviramea', co 3 l	11		
Cotoneaster lucidus, co 3 l	15		
Crataegus monogyna, co 3 l	11		
Euonymus europaeus, co 3 l	11		
Philadelphus 'Virginal', co 3 l	11		
Rhamnus frangula, co 3 l	11		
Ribes alpinum, co 3 l	10		
Spiraea x *vanhouttei*, co 3 l	11		
Symphoricarpus albus var. laevigatus, co 3 l	15		
Viburnum lantana, co 3 l	10		
Viburnum opulus, co 3 l	15		

*10 = 'mouse-ear stage', first leaves spreading out; 11 = first leaves have unfolded; 15 = leaves have unfolded but not yet reached their final size

= safe = damage possible = not safe

As the trial progressed, anomalies and differences became largely obscured. In early June, it was difficult to detect any remaining herbicide damage to the trees and shrubs.

Figs. 13–14: On 05/06/2019 the stocks of *Ribes* and *Symphoricarpos* appeared uniform

4. Summary

To determine the crop safety of the products Crawler and Proman with freshly potted, bare-rooted deciduous trees and shrubs grown in containers, about 20 genera and species were treated with these herbicides two weeks after potting. During the early application date on 20/03, these treatments were quite safe even though they were carried out without irrigation, but in cool, drizzly weather.

Treatment of other shrub species about a month later in warm weather and with more advanced shoot emergence was less safe despite irrigation.

In terms of efficacy, the herbicide Proman proved to be more effective than the product Crawler. In addition to a good long-term effect on liverwort, Proman also had a long-lasting effect on the germination of typical container weeds such as bittercress, willowherb and blown in poplar seeds. With early potting dates, the herbicide Proman can be trialled at 1.5–2 l/ha, on deciduous trees and shrubs prior to shoot emergence, at the user's own risk.

Efficacy and safety of Kerb Flo tank mix partners

(B. Zielke, Dr H. Lösing)

1. Introduction

To reduce winter weed growth in tree nurseries, herbicides containing the active ingredient propyzamide (e.g. Kerb Flo, Groove), which are generally safe with tree species, have proved effective for many years. For example, the maximum authorised application rate of 6.25 l/ha of Kerb Flo covers chickweed, deadnettle and numerous grasses such as annual meadow grass and even couch grass. If there are no problem weeds, normal application rates are usually between 1.5 and 4 l/ha of Kerb Flo. In practice, a combination of Kerb Flo and another herbicide is often used to extend the spectrum of control (see the VuB annual report for 2002, pp. 42–46 and the VuB annual report for 2012, pp. 24–33).

In previous years, the liquid herbicide Mais Ter, which had both contact and residual action but is now no longer approved, was increasingly used to reduce winter weeds in transplanted red spruces and Nordmann firs. Some farms even use reduced application rates of glyphosate-containing herbicides applied overhead as an emergency measure in cases of severe weed infestation. Against the background of the EU-wide threat of the loss of this active ingredient, alternatives to reduce winter weed infestations must be developed for such farms. Trials have been carried out using the product Kerb in combination with contact-acting partners.

Fig. 1–2: *Abies* trial area with established weeds and close-up of the soil surface containing small weeds on the day of treatment

2. Trial methodology

The trial was replicated three times with two different tree genera (summer transplantings of *Abies nordmanniana* and *Picea abies*) as well as over a field (non-crop) area to assess efficacy. The treatments were carried out on 22/11/2018 and 27/11/2018 at temperatures of around 2°C during cloudy weather with good soil moisture.

The trial treatments listed in Table 1 were applied with a plot sprayer equipped with ID 120-03 blue Lechler nozzles. The pressure and operating speed were 3.5 bar and 3 km/h, resulting in a spray volume of 512 /ha.

Table 1: Overview of the trial treatments

Treatment	Application rate	Active ingredients	Authorisation	Notes
Control	-	-		-
Kerb Flo	3 l/ha	Propyzamide 400 g/l	ZG	N, Xn, B4
Kerb Flo + Artist	3 l/ha + 1 kg/ha	Propyzamide 400 g/l Metribuzin (175 g/kg) Flufenacet (240 g/kg)	ZG Section 22 (2) B	N, Xn, B4
Kerb Flo + Belkar	3 l/ha + 0.5 l/ha	Propyzamide 400 g/l Halauxifen-methyl 10 g/l Picloram 48 g/l	ZG Winter oilseed rape	N, Xn, B4 GHS07/09, B4
Kerb Flo + Broadway	3 l/ha + 130 g/ha	Propyzamide 400 g/l Florasulam 22.8 g/kg Pyroxsulam 68.3 g/kg	ZG Cereals	N, Xn, B4 GHS09, B4
Kerb Flo + Broadway	3 l/ha + 270 g/ha	Propyzamide 400 g/l Florasulam 22.8 g/kg Pyroxsulam 68.3 g/kg	ZG Cereals	N, Xn, B4 GHS09, B4
Kerb Flo + Proman	3 l/ha + 2 l/ha	Propyzamide 400 g/l Metobromuron 500 g/l	ZG Section 22 (2) B	N, Xn, B4 -
Kerb Flo + Zypar	3 l/ha + 1 l/ha	Propyzamide 400 g/l Cloquintocet 3.95 g/l Florasulam 5 g/l Haluxifen-methyl 6.25 g/l	ZG Cereals	N, Xn, B4

3. Results

Throughout the trial, no herbicide damage was observed on the spruce or fir trees up to 15/05/2019. At the end of the trial, new shoots had emerged and were about 3–7cm long.

Even though all the herbicides tested in this trial were safe with the two species, it is known that the use of urea-derived herbicides (in this trial, Proman with the active ingredient metobromuron) can cause damage to *Abies*.

The initial weed population was quite variable. Weed cover in the case of the Nordmann firs was over 90%, and the weeds consisted of a mixture of older, in some cases already flowering plants of chickweed, annual meadow grass, shepherd's purse and groundsel. In contrast, weed cover in the case of the spruces was only 20%. The weeds here consisted mainly of larger but not yet flowering field pansy plants. At the third location, the field area, there was a spectrum of weeds, but the weeds here were still at a young stage of development.

The level of weed cover was recorded on 27/02/2019 in the field area and on 28/03/2019 in the Nordmann fir location. In general, the herbicides had a better effect on the weeds in the field area, which were younger at the time of treatment, than on the weeds in the Nordmann fir location, which were older at the time of treatment.

In the spruce location, no assessment of the trial was carried out. None of the herbicides appeared to have had any effect on the field pansy plants, which were already quite large at the time of treatment. There were no obvious differences in the level of weed cover here.

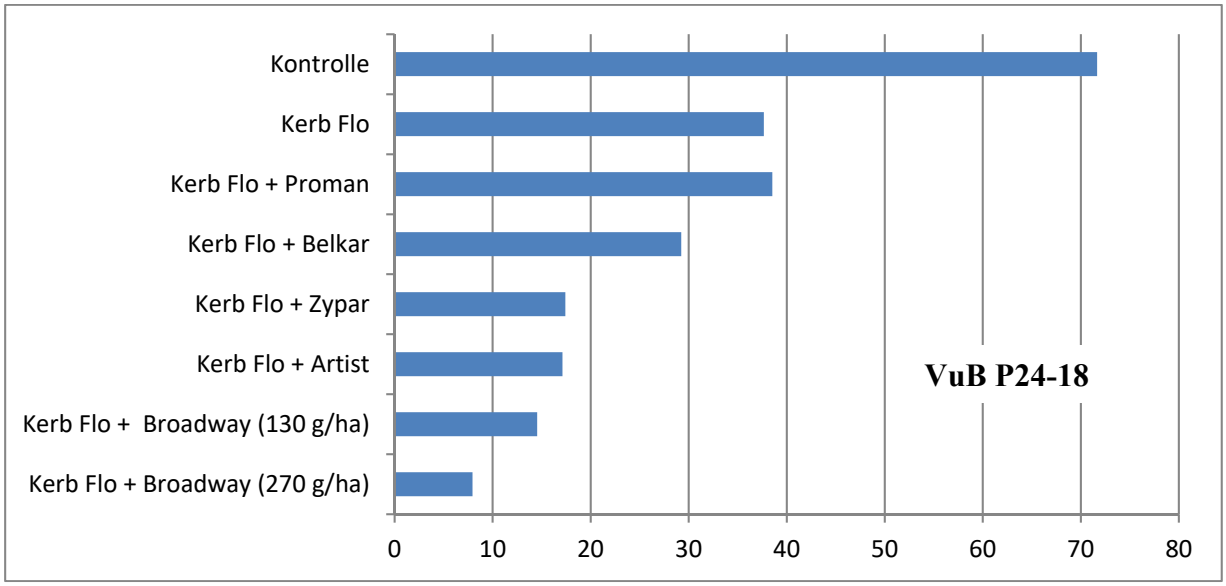


Fig. 3: Average percentage weed cover on 27/02/2019 and on 28/03/2019, mean values of two sites, one with three replicates and one with four

Untreated plots in the *Abies* and the field area were about 70% covered with weeds on average at the time of assessment. Treatment with Kerb Flo alone reduced the level of weed cover to about half. The addition of the herbicide Proman did not improve the effect of Kerb Flo in this trial. The addition of the herbicides Belkar or Zypar improved the effect of Kerb Flo, bringing weed cover levels down to just under 30% and just under 20% respectively. In this trial, the effect of Zypar exceeded that of Belkar with shepherd's purse, groundsel and red deadnettle.

With almost 10% weed cover, the best results were achieved through treatment with the full application rate of the herbicide Broadway. Weed cover was also reduced by the treatments containing the reduced application rate of Broadway or the herbicide Artist. The table on the following page shows the strengths and weaknesses of the herbicide combinations on the main weeds occurring in the trial, namely chickweed, annual meadow grass, groundsel, shepherd's purse, field pansy and red deadnettle.

Control

Kerb Flo + Artist
3 l + 1 kg/ha

Kerb Flo + Broadway
3 l + 0.13 kg/ha

Kerb Flo + Proman
3 l + 2 l/ha

Figs. 4–7: On 28/03/2019, 18 weeks after the start of the trial, the different effects of the herbicides can be clearly seen in the Nordmann fir location

Species of speedwell were found only sporadically on the trial plots. None of the herbicides or herbicide combinations appeared to have an effect on the speedwell species. Yellow field cress rosettes also occurred only sporadically in this trial. The yellow field cress was only damaged by the herbicide combinations containing florasulam. Sporadically occurring species of geranium were only damaged in this trial by the herbicides Belkar and Zypar.

Table 2: Average effect of the herbicides and herbicide combinations against the weeds occurring in the trial. With the exception of chickweed, the weed species were only found in significant numbers in one of the trial locations

	Chickweed	Annual meadow grass	Deadnettle	Groundsel	Field pansy	Shepherd's purse
Kerb Flo 3 l/ha	+-	+	-	-	-	-
Kerb Flo + Artist 3 l/ha + 1 kg/ha	+	+	-	-	-	+-
Kerb Flo + Belkar 3 l/ha + 0.5 l/ha	+	+	++	-	+-	-
Kerb Flo + Broadway 3 l/ha + 130 g/ha	++	+	-	++	+-	++
Kerb Flo + Broadway 3 l/ha + 270 g/ha	++	+	-	++	+-	++
Kerb Flo + Proman 3 l/ha + 2 l/ha	+-	+	-	-	-	-
Kerb Flo + Zypar 3 l/ha + 1 l/ha	++	+	++	+	+-	++

++ = good effect, >80% + = satisfactory effect, 60–80%

+- = sufficient effect, 40–60% - = insufficient effect, <40%

4. Summary

The trial compared the efficacy and safety of herbicides for weed control in winter. The herbicide Kerb Flo was tank mixed with various other herbicides. After the end of the main growing period, during winter, trees are least sensitive to herbicides. In this trial, there was no herbicide damage to Nordmann firs and red spruces up to mid-May of the following year.

While some annual weeds are killed during winter (e.g. gallant soldier) or survive in underground organs (e.g. common couch, yellow field cress), other weeds continue to grow in mild periods (e.g. annual meadow grass, chickweed, shepherd's purse, field pansy and others). Treating weed-infested areas at the start of winter with Kerb Flo in combination with a residual/contact acting herbicide prevents the germination and further growth of weeds. The smaller the weed is on the day of treatment, the better the effect of the herbicide.

In this trial, the herbicide combinations Kerb Flo + Broadway, Kerb Flo + Artist or Kerb Flo + Zypar had the best effect. VuB members with land in Schleswig-Holstein are authorised under Section 22 (2) to use the product Artist. In late autumn of 2019, a further trial examining Kerb Flo tank mixes was set up.

Examining the efficacy of fungicides to control downy mildew on *Rosa*

(Dr H. Lösing, B. Zielke)

1. Introduction

In the production of wild rose rootstocks, downy mildew can be problematic during cultivation. During longer periods of leaf wetness in late summer in particular, downy mildew leads to massive leaf loss as well as wine-red leaf spots and green bark.

Numerous fungicides have been approved to combat downy mildew in viticulture and related late blight in potatoes. Trials to combat downy mildew on ornamental trees were last carried out by the VuB in 2010 and 2011 (see the VuB annual report for 2011, p. 9). In 2019, another trial to combat downy mildew was conducted to test the efficacy and safety of newly approved fungicides.

Fig. 1: Plots of *Rosa* 'Laxa' (1/0) at the start of the trial on 18/07/2020

2. Trial methodology

The trial was replicated three times on *Rosa corymbifera* 'Laxa', which showed a slight pre-infestation of powdery mildew. No downy mildew was yet discernible, but the variety is considered susceptible to it. The trial products listed in Table 1 were applied on five dates starting on 18/07/2019, using a plot sprayer with IDN 120-03 blue Lechler injector nozzles, a pressure of 3.5 bar and a water volume of 512 l/ha. The treatment interval was approximately 14–17 days. The subsequent downy mildew treatments took place on 01/08, 14/08, 02/09 and 19/09/2019. Additional measures were also taken against powdery mildew.

Table1: Summary of treatments examined in the trial

Preparation	Application rate	Active ingredient	Authorisation	Notes
Control				
Carial Flex	0.6 l/ha	Cymoxanil 180 g/kg, mandipropamid 250 g/kg	Potatoes	N, Xn, B4
Infinito	1.6 l/ha	Propamocarb 524 g/l, fluopicolide 63 g/l	Potatoes, tomatoes	N, Xi, B4
Luna Care	1 kg/ha	Fosetyl-Al 66% Fluopyram 5%	Apples	GHS07, B4
Luna Max*	1 l/ha	Spiroxamine 200 g/l Fluopyram 75 g/l	Section 22 (2)	GHS07, 08, 09 B4
Previcur Energy	2.5 l/ha	Fosetyl-Al 310 g/l, propamocarb 530 g/l	ZP	Xi, B4
Presidium	1 l/ha	Dimethomorph 180 g/l, zoxamide 180 g/l	Potatoes	GHS07, 09 B4
Revus	0.6 l/ha	Mandipropamid 250 g/l	ZP	GHS09, B4
Ridomil Gold MZ	1 kg/ha	Metalaxyl-M 38.8 g/kg + mancozeb 640 g/kg	Section 22 (2)	N, Xn, B4
Zorvec Zelavin + Flovine	0.15 l/ha + 0.8 kg/ha	Oxathiapiprolin 100 g/l Folpet 800 g/kg	Section 22 (2)	GHS07, 09, B4 N, Xn, B4
Serenade ASO	8 l/ha**	Bacillus amiloliquefaciens 156 g/l	ZP	B4

*Product is effective against powdery mildew and has been tested for safety.
**Maximum application rate on roses and ornamental plants is 5 l/ha. 8 l/ha is the maximum application rate on lettuces.

Table 2: Treatment dates and weather conditions

Date	Temperature	Wind	Weather conditions
11/07/2019	21°C	0–1 m/sec	Changeable
01/08/2019	21°C	1–3 m/sec	Overcast
14/08/2019	17°C	2–4 m/sec	Sunny
02/09/2019	18°C	2–3 m/sec	Sunny
19/09/2019	15°C	1–3 m/sec	Changeable

Assessments were performed on each treatment date. The final assessment was made on 07/10/2019. The level of downy mildew infestation was assessed per plot according to the following scale:

5 = very severe infection, 4 = severe infection, 3 = medium infection, 2 = slight infection, 1 = no infection with downy mildew. The mean of the results of the last two assessments was taken.

3. Results

None of the treatments resulted in damage to or abnormalities on the roses. All the trial products were safe at the application rates examined.

At the start of the trial, the product Luna Max appeared to have a positive effect on powdery mildew. The intention was only to test this product for its safety with roses. Nevertheless, observations were made with regard to efficacy. However, as expected, Luna Max had no effect on downy mildew, which was the actual purpose of the trial. Due to the initially dry weather conditions, infection with downy mildew increased only at the end of the trial.

The untreated plots were heavily infected with downy mildew at the end of the trial. Leaf loss had already begun. Plots that had been treated with the product Serenade ASO were almost equally severely infected. The lowest incidence of downy mildew at that time was on plots treated with Luna Care or Previcur Energy.

Fig. 3: Untreated plot on 10/08/2019


Fig. 4: Previcur Energy plot on 10/08/2019

The new product Zorvec Zelavin also worked well to prevent downy mildew. In the case of this product, it would probably have been reasonable not to use the lowest application rate of 160 ml/ha, but instead to use one that would have corresponded to a more advanced stage of plant development. The effect of Ridomil Gold MZ fell short of expectations. However, the product was erroneously applied at only 1 kg/ha, and not 2 kg/ha as stated in the Section 22 (2) authorisation. The following graph shows the downy mildew infection level by treatment.

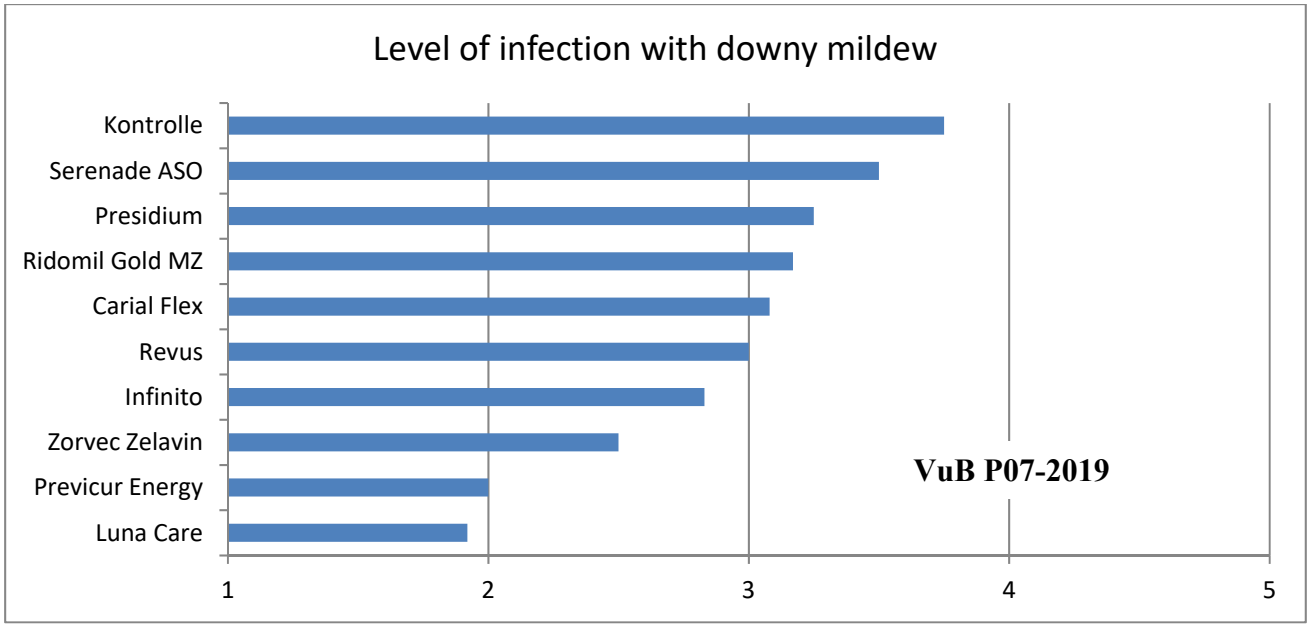


Fig. 2: Downy mildew infection level (mean values from the assessment dates 02/09 and 07/10/2019, with three replicates each). 1 = no infection, 5 = very severe infection

4. Summary

In a trial to examine the efficacy and safety of products to combat downy mildew on *Rosa* 'Laxa' in seed beds, all trial products reduced infection levels following a treatment interval of about two weeks. No damage to the crop plants was observed in any of the cases.

As in 2010 and 2011, products containing the active ingredient fosetyl produced the best effect. In 2019 these were the products Luna Care and Previcur Energy.

Depending on weather conditions, treatments for downy mildew are necessary throughout the growing season. In order not to exceed the prescribed application frequencies, it is necessary to use several products. In addition to the authorised products examined in the trial, other approved or authorised products such as Acrobat Plus, Forum, Profiler, Polyram WG, Ranman and Revus Top are available.

Combating bacterial shot hole disease in cherry laurel

(Britta Zielke, Dr Heinrich Lösing)

1. Introduction

'Shot hole' in cherry laurel (*Prunus laurocerasus*) makes this popular evergreen plant unsightly, and in the worst cases unsaleable. As described in detail in the VuB annual report for 2005 (pp. 26 ff.), shot hole can be caused by a number of possible factors. The holes are often the symptom of bacterial infection (*Pseudomonas sp.*), particularly if they are surrounded by a yellow border. These can only be combated with products containing copper (see the VuB annual report for 2006, pp. 11 ff. and the VuB annual report for 2007, pp. 17 ff.). In 2009, trials were conducted with products containing the active ingredient copper hydroxide. In these trials, the standard products at that time, Cuprozin Liquid and Cuprozin WP, were compared with newly formulated products (Cuprozin Progress and Funguran Progress) with a reduced copper content with regard to their efficacy on bacterial shot hole disease. Over subsequent years, the newly formulated products Cuprozin Progress and Funguran Progress, which were launched in 2011, became the new standard.

Surprisingly, in April 2019, two new copper products, Airone SC liquid and Coprantol Duo powder, were approved for use on ornamental plants. In addition to the active ingredient copper hydroxide, which was introduced in 1994, both products contain copper oxychloride, which has been a known active ingredient since 1926. At the full application rates, higher pure copper contents per hectare are therefore being applied in a single application once again. In one trial, the products Airone SC and Coprantol Duo were compared with the well-known products Funguran Progress and Cuprozin Progress with regard to their efficacy and safety.

Fig. 1: Trial area on 12/08/2019

2. Trial methodology

The trial was carried out in a young plant nursery on the cherry laurel variety 'Genolia'. The design of the trial was a randomised block design with three replicates. Each trial block consisted of 180 plants in 9cm pots, which were placed in trays. Starting on 30/07/2019, the products listed in Table 1 were applied four times at intervals of 2–3 weeks. The treatment

dates and weather conditions are shown in Table 2. The plants were trimmed by the nursery during the trial shortly before the second treatment. The treatments were carried out using a backpack sprayer with an 8004 flat spray nozzle at a pressure of 2 bar with 600 l/ha of water.

Table 1: Summary of the treatments examined

Treatment/ application rate	Active ingredient	Pure copper /application	Auth.	Price/ha*	Note
Control	-		-	-	-
Airone SC 2.8 l/ha	Copper hydroxide 208.3 g/l Copper oxychloride 229.8 g/l	784 g/ha	ZP	40.85	GHS09, B4
Coprantol Duo 2.7 kg/ha	Copper hydroxide 215 g/kg Copper oxychloride 235 g/kg	756 g/ha	ZP	31.35	GHS07, GHS09, B4
Cuprozin Progress 2 l/ha	Copper hydroxide 383 g/l	500 g/ha	ZP	58.36	N, T, B4 GHS05, GHS07, GHS09,
Funguran Progress 2 kg/ha	Copper hydroxide 537 g/kg	700 g/ha	ZG	32.32	N, Xn, B4 GHS07, GHS09

*Product costs per ha for one treatment, net prices for spring 2020, based on a 5 kg or 5 l container (Funguran Progress 10 kg container).

Table 2: Dates of application and weather conditions

Date	Weather conditions
30/07/2019	Sunny, 25°C, wind 1–2 m/sec
12/08/2019	Variable, 22°C, wind 2–3 m/sec
04/09/2019	Overcast, 18°C, wind 2–3 m/sec
20/09/2019	Variable, 15°C, wind 1–3 m/sec

The safety of the products was assessed on each treatment date. On 10/10/2019, about three weeks after the last treatment, the leaf area infected with bacterial shot hole disease was determined as a percentage on 50 leaves per plot. The mean values were calculated.

3. Results

The trial plants tolerated all the treatments without suffering damage. Copper damage in the form of cork-like spots on the leaves or, in the worst case, necrotic spots, which occurs from time to time in commercial practice, especially when using motor powered sprayers, was not detected throughout the trial. After the treatments, there were deposits of varying intensity in the form of leaf stains, which were visible not only immediately after the treatment, but for up to three weeks afterwards despite irrigation and natural rainfall.

The new copper fungicides Airone SC and Coprantol Duo left more visible deposits. The deposits caused by the liquid product Airone SC were more pronounced than those caused by the powder product Coprantol Duo. Deposits left by the previous standard fungicides Funguran Progress and Cuprozin Progress were less distinct and faded more quickly. Again, there was a tendency here for the deposits caused by the powder product to be less. In young plant production, visible deposits caused by pesticides are not an issue. In contrast, visible deposits on garden centre product are undesirable.

Untreated plants on 10/10/2019

Airone SC plot on 10/10/2019

Coprantol Duo plot on 10/10/2019

Cuprozin Progress plot on 10/10/2019

The products were applied in accordance with standard practice where there was a risk of disease infection. In the untreated plots, only a mild bacterial shot hole disease infection occurred during the trial period. The percentage of leaf area affected was very low, less than 5%.

The infection level in the treated plots was even lower. In all treated plots, the number of infected leaves in particular was lower. In this trial, all the products used were successful in protecting the plants against bacterial shot hole disease. In terms of efficacy, there were no differences between the products.

4. Summary

In this trial to examine the efficacy and safety of copper fungicides to combat bacterial shot hole disease (*Pseudomonas sp.*), the two new products Airone SC and Coprantol Duo reduced infection levels similarly well compared to the standard products Cuprozin Progress and Funguran Progress relative to the untreated control. The infection pressure was not high in this practical trial.

The two new copper products Airone SC and Coprantol Duo have already been approved for use in ornamental plant production, and contain the old active ingredient copper oxychloride in addition to copper hydroxide. All the copper products used in the trial are subject to the NT 620 condition: ‘The maximum application rate of 3000g of pure copper/ha/year (hop cultivation: 4000g of pure copper per hectare per year) on the same area must not be exceeded, including in combination with other copper-containing plant protection products.’

More copper is applied with Airone SC or Coprantol Duo at the full application rate than with the standard products Cuprozin Progress or Funguran Progress at the full application rate (see Table 1). The products Airone SC and Coprantol Duo also cause more visible spray deposits.

Efficacy of insecticides for the control of the carnation tortrix moth

(B. Zielke, Dr H. Lösing)

1. Introduction

The carnation tortrix moth *(Cacoecimorpha pronubana*) originally comes from Africa and is now found in many European countries. It is currently still assumed that the incidence of carnation tortrix moth in large parts of central Europe is dependent on a constant 'replenishment from greenhouse crops'. In England and the Netherlands, however, there are already indications that the moth has established itself outdoors. (Source: www.lepiforum.de, E. Rennwald).

In Northern Germany, the carnation tortrix moth can be observed mainly in glasshouses and polythene tunnels. As the name of the pest suggests, carnations are among its preferred host plants. However, the moths are very polyphagous and also infest a wide range of shrubs.

The conspicuous feeding damage and silken shelters on shoot tips and leaves are caused by the caterpillars. Due to overlapping generations, caterpillars can occur in greenhouses almost all-year round. The pest hibernates as a caterpillar protected by its leaf shelter.

After a pupation, the first generation of carnation tortrix moths hatch at the end of April. After mating, the eggs are laid in large clusters on the underside of leaves on host plants. Two to three weeks after the first appearance of the moths, young caterpillars emerge. Several generations occur during the year, and moths are active until October.

Fig. 1: Caterpillar of the carnation tortrix moth on cherry laurel (left)
Fig. 2: Deformation of *Ligustrum* – leaf shelters created by the caterpillars in shoot tips (right)

An infestation of this initially inconspicuous pest is often only detected at a later stage. However, treatment with insecticide has only a limited effect on older caterpillars living inside their leaf shelters.

In 2019 there was the opportunity to conduct a practical trial on a nursery to compare the effectiveness of different products against the pest. In addition, the population development of the carnation tortrix moth was monitored by means of pheromone traps.

Fig. 3: Female carnation tortrix moths are somewhat larger with a wingspan of 18–22 mm; they are also lighter in colour and appear more monochrome (left)
Fig. 4: Male carnation tortrix moths have a wingspan of 12–17 mm and are often more darkly patterned (right). When disturbed, the moths fly up, but settle down again quickly

2. Trial methodology

The trial was carried out on a tree and shrub nursery. Due to the rather mild winter with only brief minimum temperatures of -9°C in January, the carnation tortrix moth was able to survive the winter well in the greenhouse. As temperatures rose, caterpillars resumed their feeding activity. The damage was not immediately detected, especially on deciduous plants, because the caterpillars, hidden inside their shelters in the old foliage, immediately consumed the fresh shoots. The damage was more conspicuous on evergreen plants; last year's foliage was severely damaged by caterpillar feeding.

A trial involving seven different insecticides was set up. Since the trial was carried out in the middle of the dispatch season, and it was not clear how long any of the crops would remain on the nursery, the insecticides were each applied to half the plants in a greenhouse. The plants used in the trial included *Caryopteris*, *Ceanothus*, *Buddleja*, *Ligustrum*, various

evergreen species and varieties of *Prunus*, *Hederea*, *Hypericum*, large-leaved *Ilex*, *Weigela* and others.

The products shown in Table 1 were applied on 03/04/2019 using a battery-powered backpack sprayer with a conical nozzle at a pressure of 2 bar.

Table 1: Treatments, rates and water volumes used

Treatment	**Rate applied**	**Spray volume**	**Active ingredient**	**Mode of action**	**Authorisation No.**
Coragen	125 ml/ha	600 l/ha	200 g/l chlorantraniliprole	Mainly ingested (ns)	O, section 22 B GHS09, B4
Danadim Progress	600 ml/ha	600 l/ha	400 g/l dimethoate	Contact, ingested (s)	Use by 06/20 N, Xn, B1
Karate Zeon	75 ml/ha	600 l/ha	100 g/l lambda-cyhalothrin	Mainly contact (ns)	Article 51 ZP N, Xn, B4
Mainspring	50 g/ha	600 l/ha	400 g/kg cyantraniliprole	Mainly ingested (ns)	ZP uG GHS09, B1
NeemAzal T/S	3 l/ha	1000 l/ha	10.6 g/l azadirachtin	Ingested (s)	ZP GHS09, B4
Steward	85 g/ha	600 l/ha	300 g/kg indoxacarb	Contact, ingested (ns)	ZP uG N, Xn, B4
Turex	1 kg/ha	1000 l/ha	500 g/kg *Bacillus thuringiensis aizawai*	Ingested (ns)	ZP, Xi, B4

s= systemic, ns= non-systemic.

Assessments were carried out on 05/04/2019 and 10/04/2019. For this purpose, ten randomly selected caterpillar leaf shelters from different plant species were opened for each treatment, the caterpillars inside were examined and their health assessed. A distinction was made between ‘normal’, ‘impaired’, ‘dead’ and ‘pupated’.

During each assessment, the plants were also inspected for possible damage caused by the products used.

The flight of the carnation tortrix moth was monitored with pheromone traps. After the appearance of the first moths, a new trial was set up on 26/04/2019. The insecticides listed in Table 1 were applied to plots of two larger, uniform plant species *(Ligustrum* and *Prunus laurocerasus*). On 07/05/2019 and 28/05/2019 the growth of the plants was examined for fresh damage and new shelters of the carnation tortrix moth.

Fig. 5: In the first trial against overwintering caterpillars on 03/04, half of the greenhouse was treated

Fig. 6: In the second trial against the first generation of 2019, it was possible to treat uniform plant species

3. Results

The following table shows the results of the first trial against the overwintering caterpillars of the carnation tortrix moth.

Table 2: Results of the assessments on 05/04/2019 and 10/04/2019

Treatment	**Live larvae**		**Impaired larvae**		**Dead larvae**		**Pupae**	
	05/04	10/04	05/04	10/04	05/04	10/04	05/04	10/04
Coragen	4	3	0	0	**4**	**5**	2	2
Danadim Progress	9	8	0	0	**0**	**0**	1	2
Karate Zeon	10	10	0	0	**0**	**0**	0	0
Mainspring	2	5	5	3	**3**	**2**	0	0
NeemAzal T/S	8	8	0	0	**0**	**0**	2	2
Steward	9	10	0	0	**0**	**0**	1	0
Turex	9	7	0	0	**0**	**3**	1	0

It was found that none of the insecticides in this trial were able to achieve a satisfactory level of control. In particular, the insecticides Danadim Progress, Karate Zeon, NeemAzal T/S and Steward had no effect on the live caterpillars, which were already relatively large and within their leaf shelters at the start of the trial. The ‘age’ of the caterpillars was also shown by the fact that some of the leaf shelters opened for the assessment already contained pupae.

Impaired or dead caterpillars were found were products from the Diamide group had been applied (Coragen and Mainspring). During the second assessment, one week after treatment,

single dead caterpillars were also found in the Turex treatment. Turex is a biological insecticide. The active ingredient is a bacterium that produces crystalline proteins (Bt toxins). These proteins, which are toxic to caterpillars, are absorbed by the insects eating the treated leaves and lead to the destruction of their intestinal cells.

Fig. 7: Dead tortrix caterpillar after treatment with Coragen

Fig. 8: Pupa of the tortrix moth inside the leaf shelter; at this stage it does not eat and is well protected against contact products

On 10/04/2019 the first individual carnation tortrix moths were sighted. The systematic monitoring of adult moth activity was carried out with pheromone traps. Male moths are attracted by scents that resemble the smell of female tortrix moths. The males become stuck to the traps and can be counted.

Fig. 9: Male moths circled within a triangle-shaped pheromone trap

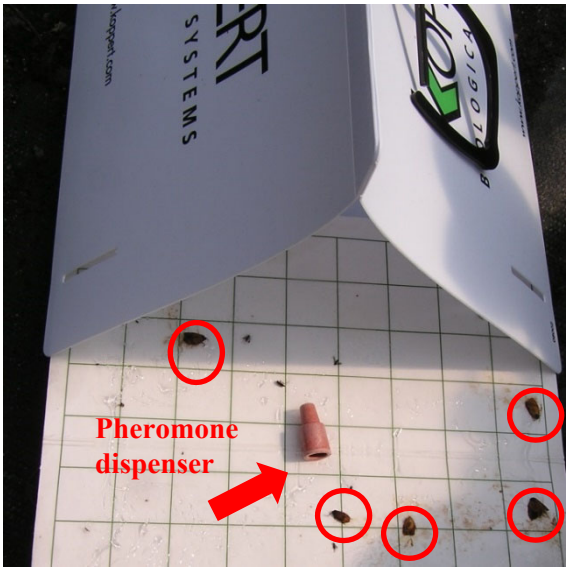


Fig. 10: The moths once trapped cannot escape from the adhesive strip

The traps are very specific in that they attract only carnation tortrix moths. However, they simply serve to monitor adult moth activity. It is not possible to catch all the males present and thus prevent mating and egg laying. Monitoring showed high numbers of moths for several weeks from late April to mid-June. During the rest of the year, moths could be observed until mid-October.

On 07/05/2019 the growth of cherry laurel was examined for new caterpillar leaf shelters in the second trial. Fresh shelters were found in the upper part of the plants only in the untreated plots and in the Danadim Progress plots. However, these were overwintered caterpillars that had climbed from the lower part of the plants onto the young plant tissue. On 28/05, the first young caterpillars, only a few millimetres in size, were observed on shrubs in the greenhouse where the second trial took place. On the plants in the trial, individual young caterpillars could only be detected on the untreated plants. The caterpillars were probably sensitive to all the insecticides used at this early stage.

4. Summary

In April and May 2019, the efficacy and safety of seven products against caterpillars of the carnation tortrix moth were examined in two field trials. Only the products Mainspring and Coragen were effective against the overwintering, relatively older caterpillars in the first trial. Since the end of April 2019, members of the Trial and Advisory Council (VuB) have had a permit for the product Coragen for outdoor use in accordance with section 22 (2) of the Plant Protection Act. Mainspring is approved against clouded drab moth caterpillars in ornamental plants under glass, but only under condition NZ 113 (only in completely sealed structures). The insecticides Karate Zeon (only to be used outside), Neem Azal T/S, Steward and Turex also appear to be effective against the young tortrix moth caterpillars, which are only a few millimetres in size.

The trials were accompanied by monitoring the activity of adult moths using pheromone traps. It was shown that moths can appear from the end of April until well into October. Watch out for adult tortrix moths in greenhouses; depending on the temperature young caterpillars can be expected about 2–3 weeks after their appearance. Young caterpillars are much easier to control with insecticides. Tortrix moth caterpillars can also appear in autumn, and they then overwinter on the plants. Also check bought in plants for leaf shelters containing caterpillars. The damage potential of the carnation tortrix moth is great because of its concealed lifestyle and its rapid rate of reproduction.

Insecticides for the control of silver fir adelgids

(B. Zielke, Dr H. Lösing)

1. Introduction

Infestation with silver fir adlegids *(Dreyfusia nordmannianae*) can cause considerable damage to Christmas tree plantations. The Nordmann fir *(Abies nordmanniana*) is primarily affected, but silver fir *(A. alba*) can also be infested. Damage is caused by the feeding activity of the young adelgids (nymphs) on the needles of the new shoots. Still soft, growing needles curl downwards, remain shorter and turn yellow. The new growth acquires a 'bottle-brush-like' appearance. Heavily infested trees are delayed into growth.

In its original area of distribution, the silver fir adelgid undergoes a two-year development cycle with five successive life stages and a host change to the Norway spruce *(Picea abies*). In our latitudes the silver fir adelgid reproduces asexually on the secondary host Nordmann fir. It usually reproduces on the tree where it hatched. Spread from tree to tree is mainly passive by means of wind, animals or humans. This is why neighbouring trees can have very different adelgid populations. Individual, heavily infested trees should be sawn out.

Fig. 1: Trial area, heavily infested trees were marked out and treated

The best time to control the silver fir adelgid is in March/April during egg laying. In practice, the insecticides Karate Zeon or Karate Forest Liquid (active ingredient: lambda-cyhalothrin) have been used for this purpose for many years through individual company approvals in accordance with section 22 (2) of the Plant Protection Act.

In 2019, a trial was set up to test the efficacy of new, not yet approved insecticides against silver fir adelgids. The focus was also on products compatible with beneficial organisms that could be used in organic production.

2. Trial methodology

It was possible to set the trial up in an area with high pest pressure. In mid-March, six Nordmann firs per treatment were marked out. Five shoots per tree were marked with MAX binding pliers for the assessments.

An application of the products listed in Table 1 was carried out on 04/04/2019 in cloudy weather at 10°C. The products were applied using a battery-powered backpack sprayer equipped with a hollow cone nozzle. The pressure was 2 bar. The trees were treated until they were almost dripping with the spray liquid. The subsequently extrapolated spray volume corresponded to 2000 l per ha.

On 30/04, only the products highlighted in colour in the table were applied a second time. In the case of these treatments, the effect of the first treatment against the adult insects and egg clusters had not been sufficient, so that numerous adelgid nymphs had hatched. The second treatment was to determine the effect of the products against the nymphs. On the day of the second treatment it was sunny, and the temperature was 16°C.

Table 1: Summary of treatments

	Treatment	**Conc.**	**Active ingredient**	**Authorisation Notes**
1	Untreated		-	-
2	Test product A	0.02%		-
3	Karate Zeon	0.0125%	Lambda-cyhalothrin 100 g/l	Section 22 (2) N, Xn, B4
4	NeemAzal-T/S	0.3%	Azadirachtin 10.6 g/l	ZP GHS09, B4
5	Para Sommer oil	2%	Paraffin oil 654 g/l	ZP GHS09, B4
6	Prev AM	0.2%	Orange oil 60 g/l	ZP only uGlas, GHS07, GHS09, B4
7	Test product B	0.075%		-
8	Teppeki + Break-Thru S 301	0.16% + 0.02%	Flonicamid 500 g/kg Wetting agent	Art. 51 ZP GHS07, B2
9	Break-Thru S 301	0.15%	Wetting agent	-

The following table gives a summary of all treatment and assessment dates as well as the development stages of the trial trees and the pest during the trial. Due to the ongoing development of the adelgids, different forms were present at the time of the assessment, and these were counted in each case.

Table 2: Summary of assessment and treatment dates as well as the developmental stages of host and pest

Date	**Stage of development**		**Assessment/Treatment**
	Abies	***Dreyfusia***	
02/04/2019	Dormancy	Adults with egg clusters	Adult adelgid count per 10cm old shoot
04/04/2019	Dormancy	Adults with egg clusters	First treatment with all products from Table 1
24/04/2019	Dormancy	Nymphs	Nymph count per old needle
30/04/2019	Bud swelling	Nymphs	Second treatment, only highlighted products from Table 1
06/05/2019	Just before bud opening	Nymphs	Nymph count per old needle

3. Results

On 02/04 as a pre-assessment, adult females were counted per 10cm shoot length. At this stage, eggs had already been laid in large numbers but had not yet hatched. The average number of egg laying females per 10cm shoot was more than 20. Three weeks after the treatment, on 25/04, the majority of the nymphs had hatched on the untreated trees. As the firs had not yet started to grow, the nymphs were still on the old needles. With regard to product efficacy, large differences between the treatments were observed. While there were about 30 nymphs per needle on the marked shoots of the untreated trees, there were no nymphs on the needles of trees treated with Karate Zeon. Other treatments showing a good effect were Para Sommer oil and Test Agent B. In the case of the other treatments, numerous nymphs per needle were counted. The following illustrations show the effect of the first treatment.

Fig. 2: Untreated control, larvae on old needles, 21 days after the start of the trial

Fig. 3: Karate Zeon treatment, 21 days after the start of the trial

Fig. 4: Para Sommer treatment, 21 days after the start of the trial

Fig. 5: Prev AM treatment, 21 days after the start of the trial

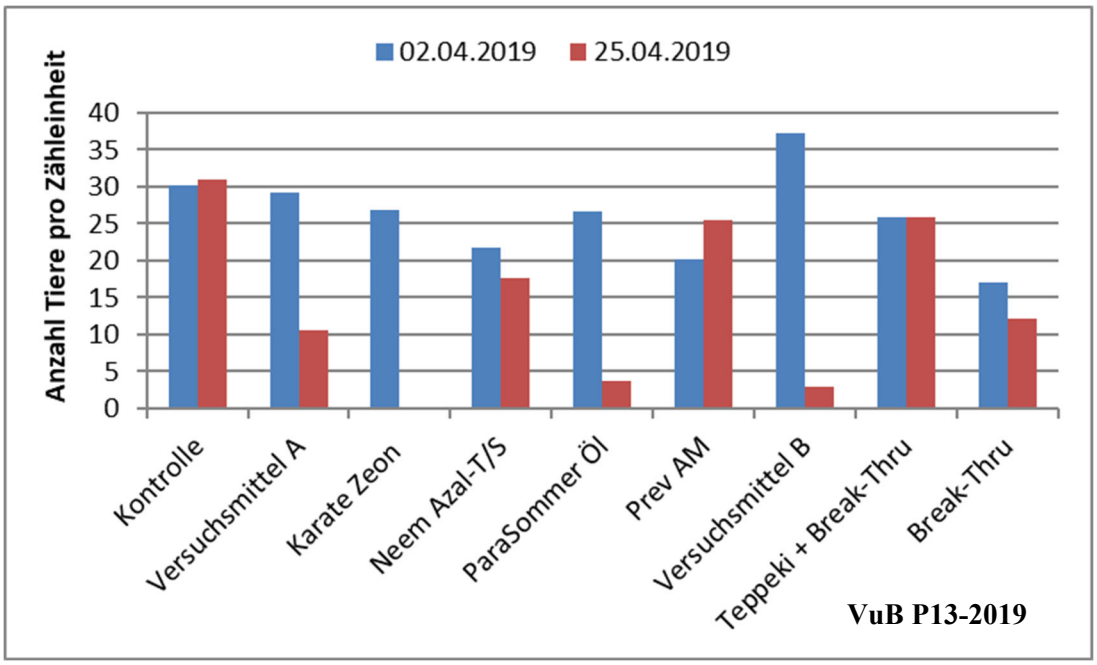


Fig. 6: For the pre-assessment on 02/04, the number of adult female silver fir adelgids per 10cm shoot section was determined (blue bars). During the count on 25/04/2019, 3 weeks after the treatment, the number of hatched nymphs per needle was determined (red bars). These are average values of 6 trees with 5 counting points each. (Versuchsmittel A and B – Test products A and B)

The results of the second treatment on 30/04, which was only carried out with those products where the first treatment had an insufficient effect, are shown in Figure 7.

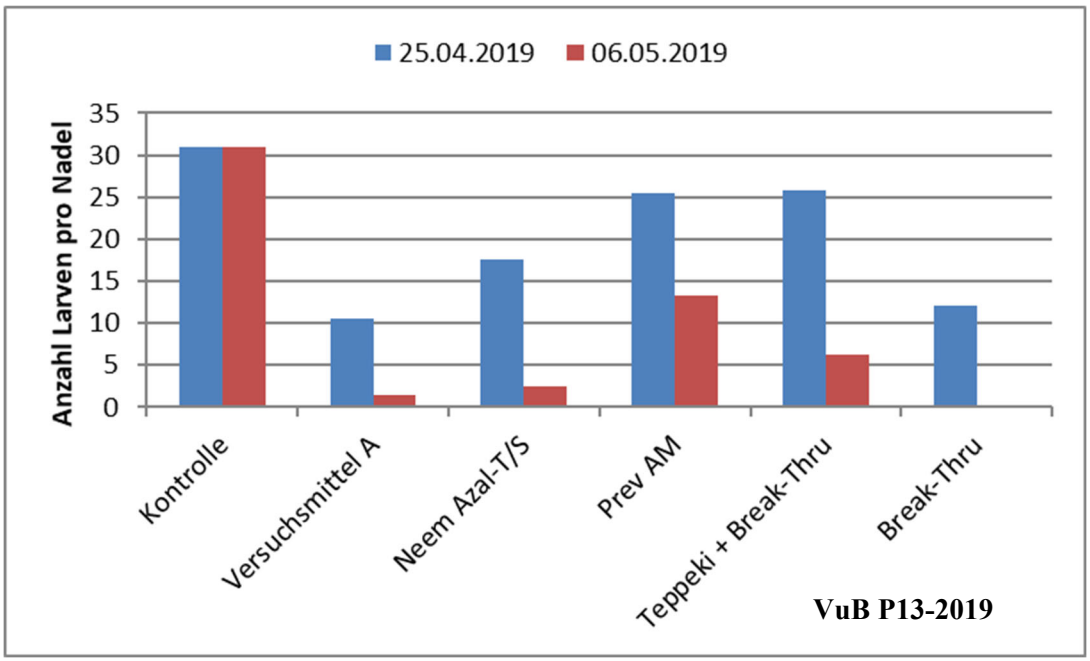


Fig. 7: Effect of the second treatment against the nymphs of the silver fir adelgids. The number of nymphs per needle was determined for the assessment (mean values of 6 trees with 5 counting points each)

Most treatments were very effective against the nymphs. A calculation of the level of efficacy according to the Henderson and Tilton correction formula showed that only the products Prev AM and Teppeki in combination with Break Thru had efficacy levels below 80%.

4. Summary

Depending on weather conditions and region, planted areas should be monitored for silver fir adelgid activity from March onwards. The trial confirmed the efficacy of the product Karate Zeon against this pest at the time of egg laying.

In this trial, the product Teppeki, which is known to be compatible with beneficial organisms and has proven efficacy against aphids in agriculture and horticulture, did not work against silver fir adelgids. Other classic insecticides such as Mospilan SG (B4), Movento SC and Movento OD (B1, Section 22–2) had shown a good result against this pest in a trial in 2015. The mineral oil preparation Para Sommer which is listed by the Research Institute of Organic Agriculture (FiBL), can be used in organic Christmas tree cultivation in the event of infestation. The use of this product assumes that the silver fir adelgids have left their place of hibernation at the base of the trunk and moved to the outer shoots, otherwise the thorough wetting that is required is not possible. The product NeemAzal T/S, which is suitable for organic production, was also effective in this trial, but not against adult insects during egg laying, only against nymphs that had already hatched. In practice, the time for successful treatment must be planned very precisely on the basis of individual observations.

Soil disinfection with mustard seed meal and Basamid granules (interim report)

(Dr Heinrich Lösing)

1. Introduction

In 2004, the approval for the use of Basamid granules expired in Germany. Until 2013, under Article 53 of the Plant Protection Act, the product could be used with various emergency authorisations, each for 120 days under strict conditions, but at irregular intervals and without a security plan. At the same time, attempts were made to transfer steam sterilisation processes for soil disinfection, which have been used in protected horticulture for decades, to the field.

From 2014 onwards, applications for emergency authorisations to use Basamid granules were rejected despite intensive efforts on the part of professional associations. While chemical soil disinfectants and even Basamid granules were still permitted in some neighbouring EU countries and could be used to prepare seedbeds, Germany and in particular the district of Pinneberg, developed into a stronghold for outdoor soil steaming processes. Some tree nurseries invested six-figure sums in purchasing machinery for soil sterilisation. Within the scope of an EIP project, the various challenges of this technology such as high energy demand, slow driving speed, etc. were examined and the use of the machinery was optimised.

Biofumigation is another idea for the disinfection of soil outdoors. Initially, Sarepta mustard was sown and all the biomass grown was freshly reincorporated into the soil. Even using the theoretical content of glucosinulates in the plants, which are converted into isothiocyanates in the soil, the level was too low to be effective. A further development was seen in trials carried out by the Schleswig-Holstein Chamber of Agriculture using Sarepta mustard seed meal from Petersen Saatzucht. Due to the higher glucosinulate content of the mustard seed meal, these trials were more successful. Problems were caused by the limited availability and high application rates (5 t/ha) of the seed meal. A new supplier (Progress Agrar, Tostedt) of very finely ground and somewhat cheaper seed meal appeared in spring 2018. Three trials were carried out to compare the efficacy and safety of these two seed meals at different application rates. Basamid granules at 400 kg/ha were also used as the conventional standard product in this trial. In addition, another product for soil disinfection (Kardox Agrar) was sometimes used.

A total of three trials in 2018 showed that mustard seed meal was not sufficiently effective against weed seedlings, especially at the application rate of 250 g/m^2. The efficacy of Basamid granules at 40 g/m^2 was confirmed. This application rate was chosen as a compromise in

2018, as it was not yet clear whether Basamid granules would be re-approved. Re-approval was given in spring 2019 until 31/05/2024.

Further trials were carried out in 2019 at three locations using different application dates. The mustard seed meal treatments, applied at the high dose rate of 500 g/m^2, were compared with Basamid granules applied at 30 and 50g/m^2 with regard to their efficacy against weed seedlings, and at one site with regard to their efficacy against nematodes. The covering was carried out using the prescribed totally impermeable film (TIF).

2. Trial methodology

In 2019, a total of three trials were set up on this topic. Table 1 provides a summary of the treatments, Table 2 provides a summary of the locations, dates and conditions of use. The trials were a randomised block design with four replicates each. The length of the plots varied depending on the location (but at least 5m), the bed width was 1.1m. The soil types were humus to loamy sand.

Table 1: Summary of treatments

No.	Treatment	Application rate	Supplier, distributor
1	Untreated	-	-
2	Terrafit Biofum	500 g/m²	Petersen Seeds, Lundsgaard
3	Mustard seed meal, ProGrow PRX	550 g/m²	Progress Agrar, Tostedt
4	Basamid granules	30 g/m²	From 2019: Certis
5	Basamid granules	50 g/m²	From 2019: Certis

The products were incorporated into the soil using a rotavator (test sites Ellerhoop, Ellerbek) or with a special machine for the application of Basamid granules from Forigo (test site: Lutzhorn). Black TIF from RKW was used for covering.

The soil moisture was determined using a moisture meter from Sartorius at 110°C. The values indicate the percentage total moisture by weight.

Table 2: Test sites, application conditions

No.	Location	Application date	Film removal	Soil moisture, total	Soil temperature at the time of application
1	Ellerhoop	06/05/2019	24/06/2019	12.95%	5 cm: 17°C, 10 cm: 14°C, 20 cm: 10°C
2	Lutzhorn	12/06/2019	01/08/2019	15.04%	5 cm: 25°C, 10 cm: 24°C, 20 cm: 20°C
3	Ellerbek	05/09/2019	05/12/2019*	12.12%	5 cm: 18°C, 10 cm: 18°C, 20 cm: 15°C

*Film remains on the beds until spring 2020 to prevent an influx of weed seeds.

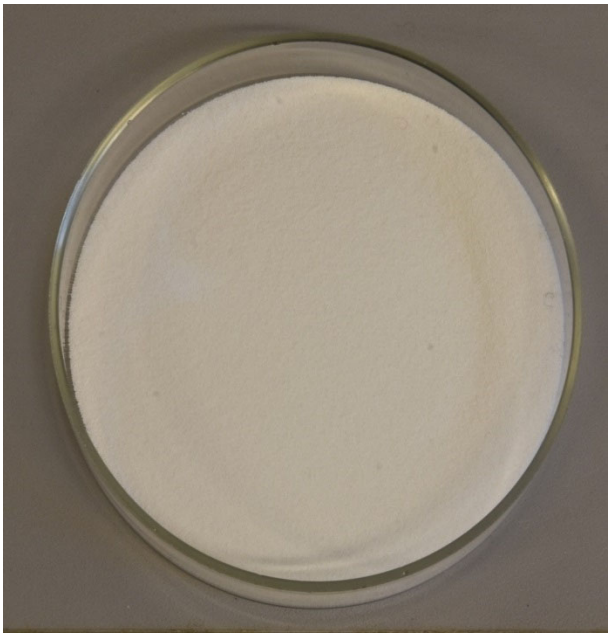


Fig. 1 (top left): Coarse Sarepta mustard seed meal (Terrafit Biofum) from Petersen Saatzucht, Lundsgaard

Fig. 2 (top right): Fine mustard seed meal (ProGrow PRX), supplied by Progress Agrar, Tostedt

Fig. 3 (left): Basamid granules, distributed by Certis

Fig. 4: Special machine for the application of Basamid granules, manufacturer: Forigo

Fig. 5: Rotavator for incorporating Basamid granules into the soil; film covering is applied afterwards

3. Results

3.1 Herbicidal efficacy

Trials with mustard seed meal carried out in 2018 had already shown that an application quantity of 500 g/m^2 is required to achieve an herbicidal effect. Therefore, no more trials with lower application rates were carried out in 2019.

In the 2019 trial year, Basamid granules were tested at 30 and 50g/m^2. With both application rates an excellent effect against weed seedlings was achieved.

Fig. 6: Counting frame, a special counting frame for weed assessment in herbicide trials, area 0.1m^2

Table 3: Number of seedling weeds per 0.1m^2, assessed with a counting frame on 16/07/2019, approximately three weeks after removing the film at the Ellerhoop site

Treatment	Replicate				Average number
	a	b	c	d	
Untreated control plot	120	90	98	26	83.5
Terrafit Biofum, 500 g/m^2	156	92	86	39	93.25
Mustard seed meal, ProGrow PRX, 550 g/m^2	41	24	15	8	22
Basamid granules, 30 g/m^2	1	5	0	0	1.5
Basamid granules, 50 g/m^2	1	0	2	1	1

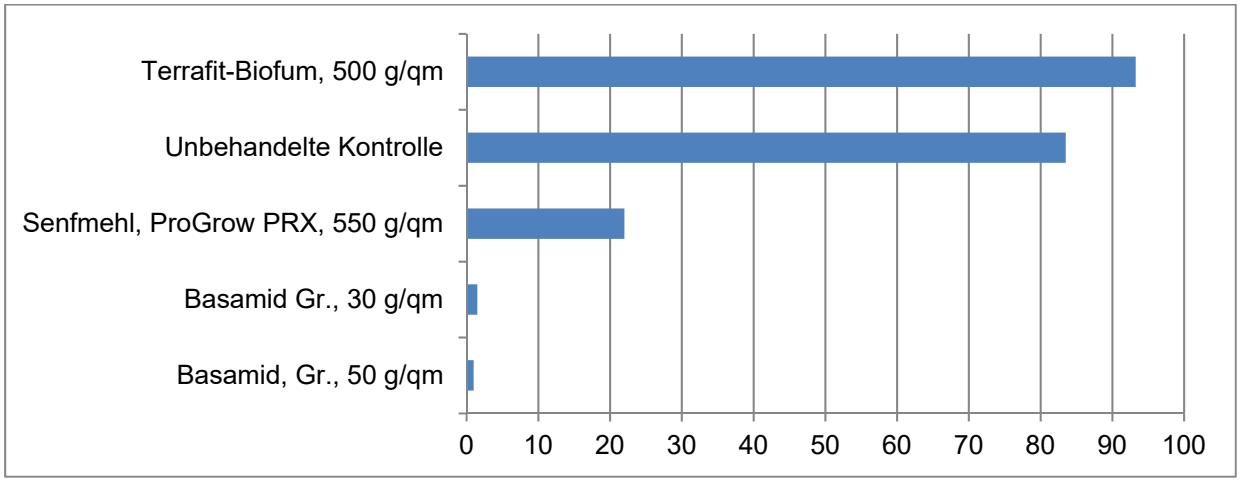


Fig. 7: Number of weed seedlings per 0.1m^2, assessed with a counting frame on 16/07/2019, approximately three weeks after removing the film at the Ellerhoop site

Fig. 8: Untreated control plot

Fig. 9: Terrafit Biofum, 500 g/m^2

Fig. 10: Mustard seed meal, ProGrow PRX, 550g/m^2

Fig. 11: Basamid granules, 30 g/m^2

Fig. 12: Basamid granules, 50 g/m^2

Figs. 8–12: The effectiveness of treatments against weed seedlings approximately six weeks after removal of the film at the Ellerhoop site

3.2 Nematicidal efficacy

Free-living nematodes, especially of the genus *Pratylenchus*, can cause growth suppression in many trees and shrubs. Therefore, a tree nursery site with a naturally occurring infestation was used to examine product efficacy. With the corresponding sampling (20 soil cores per plot, sampling depth up to 30cm), the number of *Pratylenchus* nematodes in Table 1 (pre-infestation) and Table 2 (14 weeks after treatment application) were determined in the laboratory.

Table 4: Number of nematodes per 100ml of soil before treatment on 06/06/2019 at the Lutzhorn site

Treatment	Replicate				Average number
	a	b	c	d	
Untreated control plot	168	240	228	132	192
Terrafit Biofum, 500 g/m^2	188	252	336	224	250
Mustard seed meal, ProGrow PRX, 550 g/m^2	168	360	184	207	229.75
Basamid granules, 30 g/m^2	198	285	275	236	248.5
Basamid granules, 50 g/m^2	236	352	200	231	254.75

Table 5: Number of nematodes per 100ml of soil 14 weeks after treatment application and six weeks after removal of the film at the Lutzhorn site

Treatment	Replicate				Average number
	a	b	c	d	
Untreated control plot	88	124	32	45	72.25
Terrafit Biofum, 500 g/m^2	23	27	14	8	18
Mustard seed meal, ProGrow PRX, 550 g/m^2	11	15	0	8	8.5
Basamid granules, 30 g/m^2	0	0	0	0	0
Basamid granules, 50 g/m^2	0	0	0	0	0

The numbers show a strong decrease with all treatments. This may at first seem surprising. However, we generally see a strong decrease of *Pratylenchus* nematodes in the absence of host plants. The effect of leaving land fallow for several months can be given as an example. It achieves approximately 70–80% the reduction in nematode population that can be achieved by the cultivation of marigold plants on the land.

In this trial, both mustard seed meal products led to a significant decrease in the number of *Pratylenchus* nematodes. However, these are not comparable with the excellent effect of Basamid granules in the two application rates tested here.

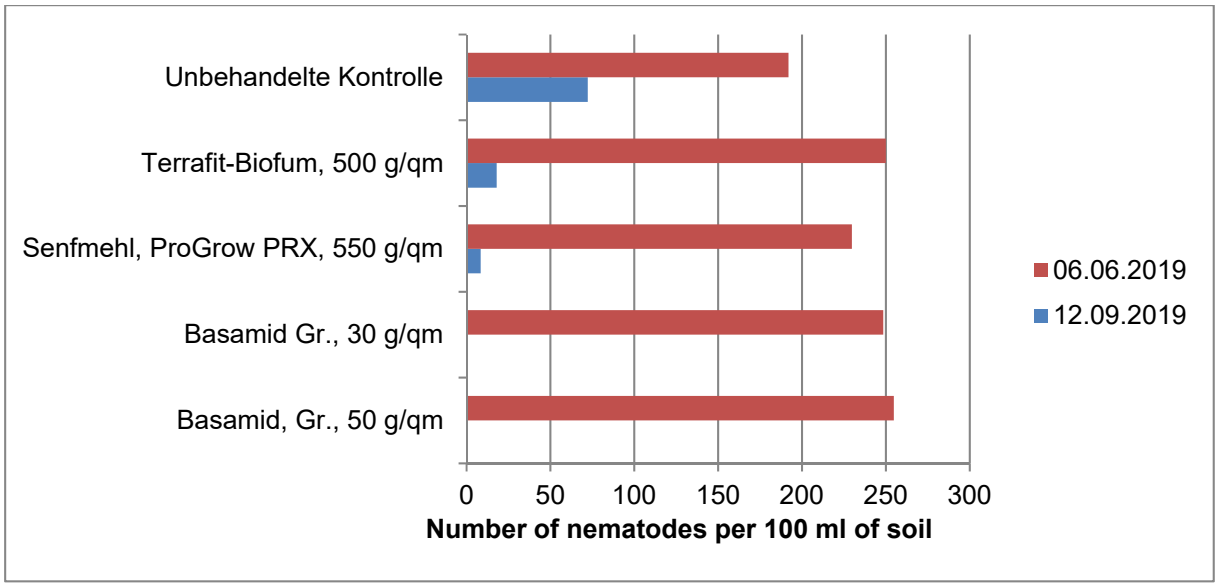


Fig. 13: Effect of the treatments on the number of *Pratylenchus* nematodes at the Lutzhorn site before (red bars) and 14 weeks after treatment (blue bars)

4. Summary

In 2019, several comparative trials on the efficacy of mustard seed meal products (Terrafit-Biofum, ProGrow PRX) and Basamid granules applied at 30 and 50 g/m^2 with regard to efficacy against weeds and free-living nematodes were carried out involving the recently prescribed use of TIF (manufactured by RKW).

A reduction in both weed seedlings and nematodes was achieved with the mustard seed meals that were tested, especially with the product ProGrow PRX. However, Basamid granules were much more effective at both application rates tested.

Growth regulators to manage shoot growth in *Hydrangea paniculata* varieties

(B. Zielke, Dr H. Lösing)

1. Introduction

The use of plant growth regulators (PGRs) is widespread in ornamental horticulture.

PGRs are used to provide compact and well branched plants of uniform quality.

The interest of tree and shrub nurseries in this topic is on the increase. The combination of Dazide Enhance and Tilt, which is often used on *Hydrangea macrophylla* and *H. paniculata* varieties, can no longer be used in the future because Tilt has lost its approval. In one trial, fast-growing *H. paniculata* varieties were treated with various growth regulators to gain insights into their efficacy and safety.

Fig. 1: Trial plants on the day of the first treatment (23/05/2019). The hydrangea varieties in each row are of different sizes at the beginning of the trial

2. Trial methodology

The trial plants were *Hydrangea paniculata* ‘Limelight’, ‘Pinky Winky’, ‘Silver Dollar’, ‘Vanilla Fraise’ and ‘Wim’s Red’. Root balled plants were potted into 5-litre containers using a fertilised white peat substrate in spring 2019. From 23/05/2019, the PGRs listed in Table 1 were applied on four dates at intervals of about one week. Four plants per variety and treatment were treated. The dates of application and the weather conditions on the day of treatment are shown in Table 2.

The first two treatments were carried out with a plot sprayer equipped with ID 120-03 Lechler blue nozzles, at a pressure of 3.5 bar and a driving speed of 1.5 km/h. From the third treatment date onwards, the plants were too high to be driven over with the plot sprayer, and the treatments were applied with a backpack sprayer equipped with a Teejet 8004 flat spray nozzle. The water volume used was 1000 l/ha on all application dates.

The plants were repeatedly assessed for phytotoxicity and flowering date. In addition, the height of all the plants was determined on 29/05, 07/06, 14/06, 24/06 and 19/07/2019.

Table 1: Summary of treatments

Treatment	Application rate	Active ingredients	Authorisation	Notes
Control	-	-	-	-
Carax	0.45 l/ha	160.2 g/l mepiquat 30 g/l metconazole	Raps, ZP	N, Xn, B4
Dazide Enhance + Carax	3 kg/ha + 0.45 l/ha	851.4 g/kg daminozide 160.2 g/l mepiquat 30 g/l metconazole	ZP uG Raps, ZP	B3 N, Xn, B4
Primo Maxx II	2.4 l/ha	103.5 g/l trinexepac-ethyl	ZP	GHS07, B4
Primo Maxx II + Peters Professional Foliar Feed (foliar fertiliser)	2.4 l/ha + 1 g/l	103.5 g/l trinexepac-ethyl 27-12-15-TE	ZP -	GHS07, B4 -
Regalis Plus	A + B + C: 1.5 kg/ha D: 2.5 kg/ha	84.8 g/kg prohexadione	Art. 51 ZP	Xi, B4

Table 2: Application dates and weather

	Date	Application device	Weather conditions
A	23/05/2019	Plot sprayer	Sunny, 15°C, 2–3 m/sec wind
B	29/05/2019	Plot sprayer	Overcast, 12°C, 2 m/sec wind
C	07/06/2019	Backpack sprayer	Sunny, 18°C, 1–2 m/sec wind
D	14/06/2019	Backpack sprayer	Sunny, 23°C, 2–3 m/sec wind

3. Results

Crop safety

One week after the first treatment, chlorosis on the older leaves was observed with all the varieties, especially in the case of ‘Wim’s Red’ and ‘Vanilla Fraise’. The chlorosis was most noticeable in response to the Primo Maxx II treatments (with and without Peter’s Professional Foliar Feed) and with the Regalis Plus treatment. Slight chlorosis was detected even in the untreated control group. As the trial progressed, the chlorosis disappeared. No further leaf yellowing occurred, and no other damage or plant abnormalities were noted in the trial.

Figs. 2–3: At the beginning of the trial, chlorosis of varying degrees could be observed in some plants

Efficacy

At the beginning of the trial, the young plants appeared to be uniform within each variety. Measurements of plant size at the beginning of the trial was not carried out. Plant height measurements were not started until 29/05/2019, one week after the first treatment. Initially, the differences between the plant varieties were greater than the differences between the product treatments. Thus, the untreated plants of the ‘Limelight’ variety had an average size of 19cm on 29/05/2019, whereas the untreated plants of the ‘Wim’s Red’ variety had an average height of 36cm (see Fig. 1).

The plants showed strong, almost linear growth during the course of the trial. They grew 5–10cm per week on average, depending on the variety and product treatment. Initially, the growth regulators did not seem to have any effect on the growth of the plants. All treatments were similar within each plant variety. From mid-June onwards, plants treated with Regalis Plus or Dazide Enhance + Carax were slowed in terms of growth.

By the end of the trial on 19/07/2019, the untreated plants had reached average sizes of 65–80cm, depending on the variety. In the untreated controls, ‘Silver Dollar’ remained the smallest, and ‘Vanilla Fraise’ the tallest.

At the end of the trial, the plants treated with ‘Carax only’ were similar in height to the untreated plants. In contrast, the combination of Carax and Dazide Enhance led to a reduction in the

height of the plants. Hydrangeas treated with this tank mix were about 5cm smaller on average than the plants in the untreated control.

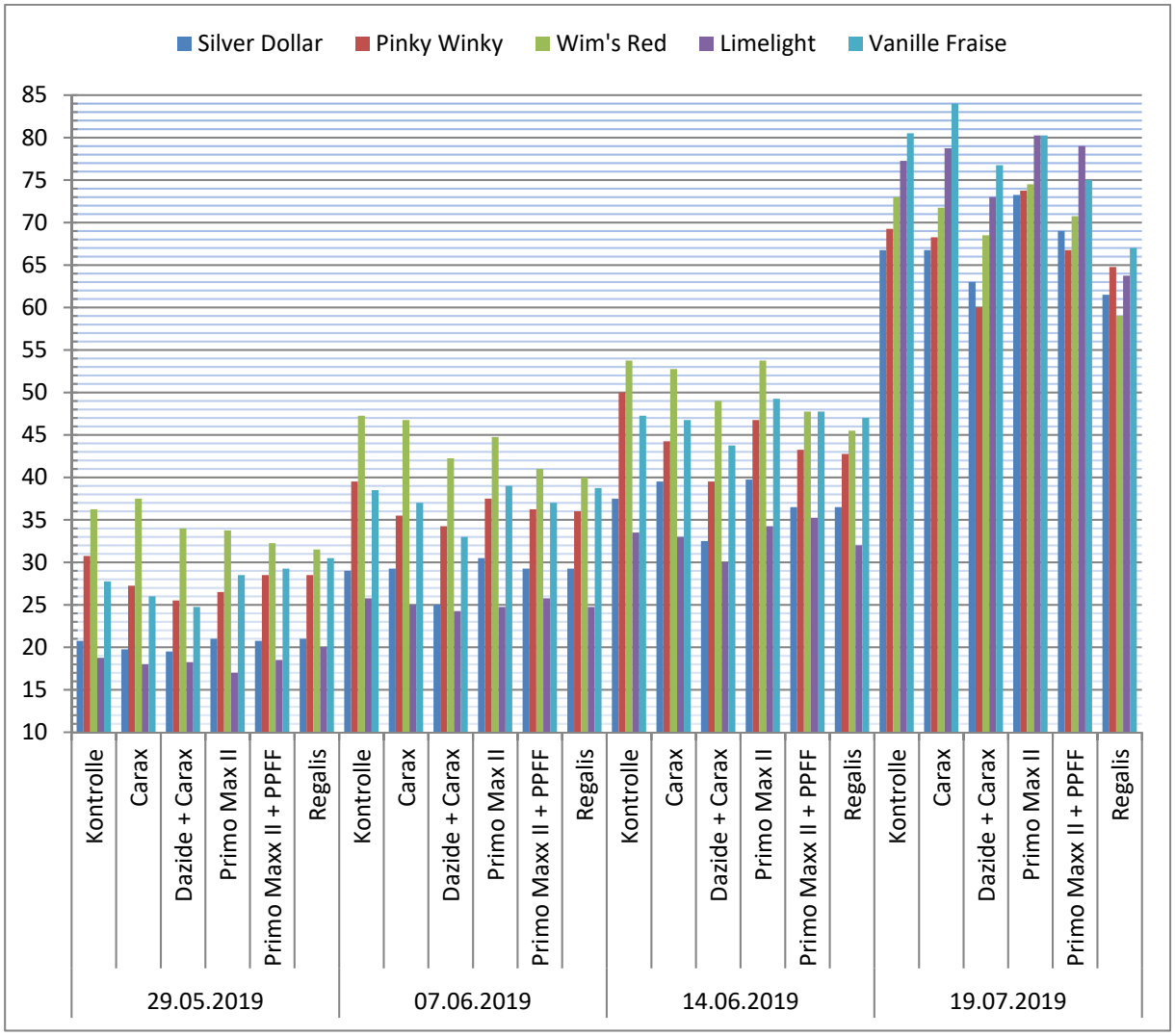


Fig. 4: Height of the hydrangea plants (cm) in terms of varietal average for each PGR treatment at all four assessment dates

Plants treated with the Regalis Plus were about 10cm smaller on average on 19/07/2019. In particular, the faster growing varieties ‘Limelight’ and ‘Vanilla Fraise’ were strongly inhibited by the four applications of Regalis Plus.

Four applications with Primo Maxx II in combination with Peter’s Professional Foliar Feed resulted in a slight reduction of about 2cm on average in the shoot growth of some of the hydrangeas by the last assessment date. ‘Pinky Winky’, ‘Vanilla Fraise’ and ‘Wim’s Red’ remained slightly smaller on average, while ‘Limelight’ and ‘Silver Dollar’ were on average larger than the control plants.

In contrast, applications of Primo Maxx II without the foliar fertiliser showed no inhibitory effect. At the last assessment date, the plants treated in this way were on average about 3cm taller than the untreated plants. In particular, the slow-growing varieties ‘Silver Dollar’, ‘Pinky Winky’ and ‘Wim’s Red grew faster on average than control plants.

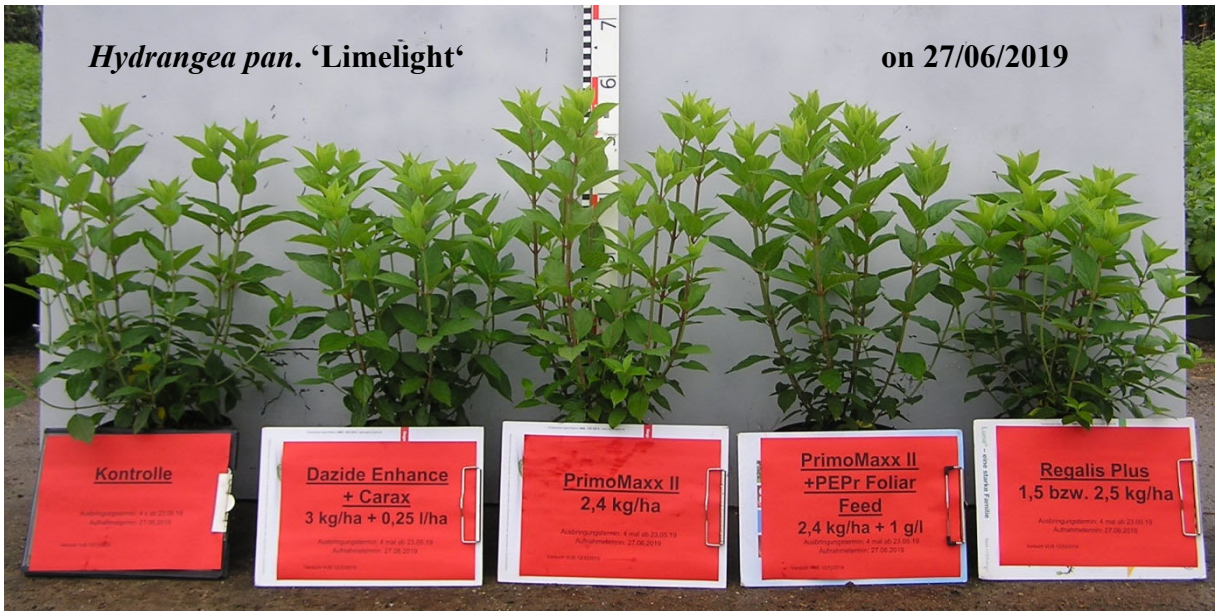


Fig. 5: Average plants of the variety ‘Limelight’ from different trial treatments on 27/06/2019

Fig. 6: Average plants of the variety ‘Wim’s Red’ from different trial treatments on 27/06/2019. Paler leaves were typical in response to Primo Maxx II. Equally typical was the slight delay in flowering due to Dazide Enhance + Carax.

The start of flowering was more dependent on the hydrangea variety than on the PGR treatment. In this trial, the variety ‘Wim’s Red’ was already starting to flower on 07/06/2019. On 24/06 all of the varieties except ‘Limelight’ were starting to flower. In all varieties, treatment

with Dazide Enhance + Carax seemed to slightly delay flowering. This can be seen in Figure 6 and 7.

Fig. 7: Average plants of the variety 'Pinky Winky' from different trial treatments on 19/07/2019.

Fig. 8: Average plants of the variety 'Silver Dollar' from different trial treatments on 19/07/2019.

In addition, the positive effect of the addition of the foliar fertiliser to Primo Maxx II on leaf colour could be observed in the trial from mid-June onwards. Without the addition of the fertiliser, the trial plants treated with Primo Maxx II sometimes looked as if they had a slight lack of nitrogen.

4. Discussion

In light of the end of the approval of Tilt, which was previously used in combination with the Dazide Enhance to reduce growth in hydrangeas, a trial with PGRs over panicle hydrangeas was set up. The efficacy and safety of various products and tank mixes were examined.

It turned out that it is difficult to inhibit growth in panicle hydrangeas overall. On the advice of the tree and shrub nursery where the trial was carried out, four treatments with the trial products took place instead of the two initially planned. Otherwise, the effects of the inhibitors would probably have been even less.

Of the five treatments examined, only two products or tank mixes were able to achieve a significant reduction in shoot length when applied four times during the trial period. These were Regalis (used three times at 1.5 kg/ha and once at 2.5 kg/ha) and the tank mix Dazide Enhance + Carax (3 kg/ha + 0.45 l/ha).

Treatments with Carax, Primo Maxx II and Primo Maxx II tank mixed with Peters Professional Foliar Feed even resulted in taller plants in some cases. The growth regulators Carax and Primo Maxx II may only be used twice a year per crop in ornamental plants according to the approval.

In the future, growth could be inhibited in panicle hydrangeas with the product Regalis Plus. However, according to the approval, only a maximum of 3 kg/ha per crop per year is permitted. In the trial, plants treated with Regalis Plus reached an average size of about 85% that of untreated plants. However, this product is not suitable for coloured varieties of hydrangea as it can lead to bleaching of the flower colour. This bleaching also occurs following treatment with Primo Maxx II, which in this trial only had a slightly inhibiting effect on some varieties when tank mixed with the foliar leaf fertiliser.

Treatment with Dazide Enhance + Carax may, according to the trial results, also be considered to manage growth in panicle hydrangeas, but it is only permitted for use under glass and only for two applications due to the approval. Plants treated four times with this tank mix reached about 92% of the size of the untreated plants on average. It is necessary to calculate whether the effort and cost required to achieve this result is worthwhile.

Other trials

Mould prevention during seed stratification

(L Heissel)

1. Treatment list

Treatment	Application rate per kg of seed	Active ingredient	Approval
Control	300ml of water	-	-
MiCo	0.25%	*Trichoderma harzianum* and *Bacillus subtilis*	Plant strengthener
Basfoliar Kelp SL	2%	*Ecklonia maxima* extract	Plant strengthener
Mustard flour	124g	Isothiocyanate (ITC)	EU basic substance
Signum WG	0.1%	267g/kg boscalid 67g/kg pyraclostrobin	Ornamental plants, fruit

2. Summary

As part of a practical trial undertaken in 2019 during the stratification of beech and fir seeds, the efficacy and safety of four products were compared. At the start of the stratification, the various products were mixed in with the seeds. In the untreated control, fungus growth on the seeds increased steadily during the stratification process. The mustard flour had a very negative impact on the seeds. All other products seemed to have a positive influence on the germination capacity. Further trials are planned for 2020.

Comparison of peat-free and peat-reduced substrates in the cultivation of container-grown roses

(L. Heissel, L. Fröhlich)

1. Summary

In a trial undertaken in 2019, three peat-free or peat-reduced substrates were trialled in comparison to a peat based substrate in the cultivation of container-grown roses. Due to the fact that it was carried out on a nursery, irrigation tailored to the respective substrate was not possible. Special measures, e.g. additional watering, were not necessary during the trial period. The results show a good and equal development of the roses for all the substrates used. In trials with other plant genera in previous years, comparable results could be achieved depending on the plant genus and substrate examined (see annual report VuB 2017).

The 2019 trade fair for nursery machinery – a technical review

(Dr H Lösing)

On 29 and 30 August, the 2019 trade fair for tree nursery machinery took place on the premises of the horticultural centre of the Schleswig-Holstein Chamber of Agriculture in Ellerhoop. Among the organisers were the Schleswig-Holstein Chamber of Agriculture, the BdB – Landesverband Schleswig-Holstein (Schleswig-Holstein association of tree nurseries) and the Trial and Advisory Council for Nurseries. BTB Baumschultechnik und Beratung GmbH (nursery machinery and consulting) was entrusted with the practical organisation of the trade fair.

The following associations also provided professional consulting and support for the event: The Bund deutscher Baumschulen (BdB), the Verband deutscher Forstbaumschulen (VDF) (the German association of forest nurseries), the IG-Holstein – Ländergruppe Nord im (VDF), the European Nursery Association (ENA), the Bundesverband der Weihnachtsbaum- und Schnittgrünerzeuger (the German association of Christmas tree and decorative greenery producers). The VR Bank in Pinneberg also supported the event with considerable financial sponsorship.

Fig. 1: HV-100 nursery robot at work

Under the banner '**Innovation meets tradition**', over 300 exhibitors, 33 nurseries from the region and over 6,000 experts from all over Europe, Asia and North America gathered to find out about the latest developments in the field of nursery machinery and supplies. This is the 11th time since 1958 that the trade fair has taken place in Schleswig-Holstein, and the third time since 2006 that it has been organised at the Horticultural Centre of the Schleswig-Holstein Chamber of Agriculture.

For the first time, Christmas tree producers and distributors of special equipment for Christmas tree producers were also present.

Fig. 2 : Marvin, Claus and Christian Meyer on the day of the summer party; image: www.dawawas.de

Another highlight was the 200th anniversary of the company Hermann Meyer from Rellingen. Since the first trade fair for nursery machinery in 1958, the event has received generous support from this company. The merging of the two events was therefore a stroke of luck for everyone involved.

This showed the solidarity of the tree nurseries from all over Europe for the company Hermann Meyer and the nursery machinery trade fair.

Fig. 3: View of the trade fair site from the north side; image courtesy of EHS

Some examples of the wide range of innovations for the industry are listed below.

XPOWER Electrical weed control, from the firm Zasso, Aachen, www.zasso.eu

A method for controlling existing weeds, including weeds which spread by rhizome, with the aid of 8000 V direct current. The electrical power is conducted into the weeds by means of so-called applicators. A PTO-driven generator is located in the rear part of the support unit to

supply power. Appropriate equipment is available for mounting on a tractor to provide a working width of approximately 3m. Further implements for row-based treatment of fruit, vine and trees are being developed. The equipment can travel at speeds of 3–5km/h.

Fig. 4: Front-mounted Xpower implement for surface treatment with power generator at the rear

Fig. 5: So-called applicators glide over the weeds, following the electric sensors

Hand-operated equipment for paths and squares has also been developed, these devices are then supplied with the necessary energy from a cable.

Fig. 6: Implement for treating rows of trees (prototype)

Fig. 7: Hand-operated device for treating paths and squares (prototype)

Grass killer for tree rows, from the firm Dröppelmann, www.droeppelmann.de

The device destroys weeds by spraying cold water at a pressure of approximately 1,000 bar. The water jet penetrates the ground to a depth of about 3–6cm. By means of an electro-hydrostatic control system, the head of the device also swivels into the tree row in avenues of trees. Approximately. 0.3 l of water are required per metre of work. It can be carried in a water tank up to 2,000 l in volume.

Fig. 8: 'Grass killer' for alternative weed control using cold water to treat rows of trees

Fig. 9: Rotating nozzles destroy the weeds with water at a pressure of 1,000 bar

RowCropPilot, from the firm Robot Makers, Kaiserslautern, www.robotmakers.de

The firm Robot Makers has broken new ground with the development of the RowCropPilot. They do not develop new machinery but use proven technology from other manufacturers such as Aebi (www.aebi.at) or Damcon (www.damcon.nl) and supplement it with their control technology to allow machinery to work autonomously. A complex laser scanner is used for this purpose. A GPS signal, which often causes problems under trees, is not necessary. The machine is therefore able to carry out mulching or belt spraying applications independently.

Fig. 10: Mulcher working autonomously in an avenue of trees (from the firm Aebi)

Fig. 11: Band sprayer working autonomously in an avenue of trees (from the firm Damcon)

Flunick – autonomous tool carrier for special crops, www.semesis.ch

The tool carrier, designed as a crawler vehicle, was built by the Andreas Reichenbach tree nursery in Switzerland (www.baumschulen-reichenbach.ch). The track width can be adjusted to between 1.5 and 2.5m. A minimum space of 50cm between rows is required. The tool carrier can drive over plants up to a height of 2.3m. Two independent 30 HP diesel engines are available to power the vehicle. The device does not have a driver's seat and is only controlled

by a steering console or autonomously via GPS. All work, such as mechanical weed control, fertiliser application etc. can be carried out with this machine.

Fig. 12: The Flunick tool carrier with designer Andreas Reichenbach from Switzerland

Fig. 13: The Flunick tool carrier with variable track width can be used for a wide range of tasks

Automatic control of front-mounted, triple-bed implements, from the firms Elco www.elco-machinebouw.nl and Schrauwen, www.s-m-z.com

For the simultaneous cultivation of several seedbeds/nursery beds, individual control is required for each bed, as there are variations even when using GPS-controlled tractors during sowing or planting. A signal is transmitted by means of a mechanical button to a hydraulic cylinder which controls the implement. For the first time, hoeing or under-leaf spraying of three beds simultaneously is now possible. The devices from both manufacturers work on the same principle and are therefore presented together here.

Fig. 14: Triple-bed hoeing machine, Schrauwen, Netherlands

Fig. 15: Triple-bed under-leaf spraying machine, Elco, Netherlands

Weeding harrow with drive, from the firms Elco www.elco-machinebouw.nl and Jacobs (www.jacobsconstructie.nl

For many years now, weeding harrows from various manufacturers such as Einböck (www.einboeck.at) or Hatzenbichler (www.hatzenbichler.com) have been used for mechanical weed control in tree nurseries. These have tines that are approximately 30 to 50cm long and of varying thicknesses. Taller woody crops cannot be treated with them. For this reason, weeding harrows with 70–80cm tine lengths have been developed in the Netherlands, among others by Jacobs (www.jacobsconstructie.nl). In order to achieve effective weeding, relatively high driving speeds of 6–8km/h are necessary with these implements, otherwise the tines will not 'swing'. The new Elco and Jacobs machines compensate for this drawback by means of a hydraulic drive for the tines. The implements are equipped with long tines and are guided at right angles to the planting row. This ensures optimum weed control between the plants.

Fig. 16: Hydraulically driven diagonal weeding harrow for 3 beds from the firm Jacobs, Netherlands

Fig. 17: Single bed, diagonal weeding harrow from the firm Elco, Netherlands; a triple-bed version is also available

Automatic sorting of trees, new development from the firm SMO, www.smo.be

The sorting of woody plants is still one of the most labour-intensive activities in production. At present, only the firm Gejo Grading (www.gejograding.nl) has ready-to-use equipment for deciduous trees. The processing of conifers is not yet possible. The firm SMO from Belgium has broken new ground together with the Sylva tree nursery (www.sylva.be), the pioneer of tree sorting in Europe. The first working prototype was presented at the trade fair. The device has a space requirement of 12x15m and, according to the manufacturer's instructions, can sort 4–6,000 seedlings per hour by length and thickness using electronic image processing.

Fig. 18: Sorting copper beeches using image processing

Fig. 19: The manual sorting of seedlings accounts for approximately 30% of production costs

Optimised steamer from Mobildampf.de, www.mobildampf.de

The tractor-drawn device for disinfecting seedbeds from the firm Mobildampf.de has been working successfully in tree nurseries in Germany, Switzerland and Austria for several years. The original tractor-mounted implement was criticised for its large turning circle, lack of 'tracking stability' and the tendency of the reciprocating harrow to mix up the heated soil. The device was therefore redesigned by the firms Mobildampf.de and Zorn Sondermaschinenbau (www.zorn-sondermaschinenbau.de) and all its weak points were eliminated. The proven steam boiler from the firm MSD (www.moeschle.de) will continue to be used.

Fig. 20: Single-axle steamer with improved reciprocating harrow

Fig. 21: Newly designed steaming unit with tandem axle from the firm Zorn, in Tangstedt

Forigo – special device for incorporating Basamid granules into the soil

A special device for the introduction and incorporation of Basamid granules, with optional rotavator, reverse rotavator or bed rotavator, including film covering with gas-tight, totally impermeable membrane in one operation. The machines are available in different working

widths starting at 110cm. After removal of the film, the beds are available for sowing or nursery plants without further processing (www.forigo.it).

Fig. 22: Special equipment from the firm Forigo for the application of Basamid granules and film covering in one operation

Naio Dino – autonomous machine for cultivating vegetable beds, (www.naio-technologies.com

The support unit is primarily designed for mechanical weed control on vegetable farms with bed widths of around 1.8m. It can be converted to the track width of 1.5m, which is common in tree nurseries. Depending on the type of the built-in rechargeable battery and the tools mounted on it, the machine can work for 4 to 8 hours. The device can move autonomously on the ground surface using GPS or camera technology.

Fig. 23: Dino from the firm Naio – autonomous machine for soil cultivation in vegetable beds

Naio Oz – autonomous machine for row crops, www.naio-technologies.com

Fig. 24: Oz by Naio – autonomous machine for row crops

This small machine has already been on the market for some years; its dimensions are: width: 45cm, length: 100cm, height: 60cm and it weighs about 150kg. It is driven by electric motors (four-wheel drive) and depending on the battery and tools used, it can work for a period of 3 to 10 hours. The machine can autonomously carry out soil cultivation of entire fields starting from a row spacing of 60cm. The device is controlled by laser and camera systems.

Tool carrier, designed as a crawler vehicle, from the firm Ezendam, www.ezendam.nl

Minimisation of soil pressure and therefore the possibility of working on boggy sites were among the objectives in developing the tool carrier. Nevertheless, the tractor has a standard attachment device for all auxiliary equipment on the nursery. Earth drills etc. can be optimally controlled by means of GPS, for example. The tool carrier is equipped with an electronic-hydraulic drive; the maximum driving speed on the road is 15 km/h. All machines are manufactured individually according to customer requirements.

Fig. 25: Tool carrier designed as a crawler vehicle, from the firm Ezendam, Netherlands

Hand-held, air assisted sprayer for AS 1200 battery powered backpack

The firm Birchmeier from Switzerland offers a new model of air-supported backpack sprayer. Here, the spray liquid is fed into an air stream by means of anti-drift hollow cone nozzles and, depending on the setting of the device, is carried up to a distance of 13m at a maximum air speed of 65km/h. The battery power is calculated at maximum 3.5 hours.

The accessories can only be operated in combination with a REC 15 ABZ or REX 15 AZ1 series backpack sprayer (www.birchmeier.com)

Fig. 26: Hand-operated spray blower AS 1200 (image courtesy of Birchmeier)

Robotti – autonomous implement carrier, www.agrointelli.com

The autonomous implement carrier from Denmark is equipped with a 3-cylinder Kubota diesel engine. All common implements with the option of a three-point hitch can be used with the implement carrier. The device can either be steered manually or driven autonomously (www.agrointelli.com).

Fig. 27: Robotti implement carrier with hoeing machine in a sugar beet field

Fig. 28: Robotti implement carrier with hoeing machine from the firm Egedal during a demonstration

DJI Agras MG-1 agricultural drone, distribution in Germany, www.solectric.de

The use of drones has already become established in many areas of agriculture. So far, the devices have been used mainly for monitoring purposes. However, the first devices are already showing good prospects for practical use on the nursery.

Fig. 29 : DJI Agras MG-1 agricultural drone (image courtesy of manufacturer)

For example, the Agras MG-1 agricultural drone from the Chinese manufacturer DJI can carry a payload of 10kg and be equipped with nozzles to apply crop protection products. The drone's maximum flight time is currently 22 minutes. When using this drone, not only are high demands made on the user, but also on the crop protection products used. For example, an authorisation is required for application by aircraft.

BoniRob – Robotic work platform for weed control

Mechanical weed control is particularly cost-intensive. The prototype of the BoniRob work platform and the sensor technology mounted on it are used to distinguish cultivated plants from weeds and to control the weeds. The first successes have been achieved in the cultivation of organic carrots. The prototype still needs to be further developed/optimised to make it ready for practical use. www.fh-westküste.de/forschung/projekte-technik/hochgenaue-unkrauterkennung

Fig. 30: BoniRob being used in weed control for organic carrots (image courtesy of Ellerhoop horticultural centre)

Fig. 31: Demonstration in the horticultural centre of the Schleswig-Holstein Chamber of Agriculture, (image courtesy of Ellerhoop horticultural centre)

Important note: VuB disclaimer

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They are based on trial results, practical experience and industry recommendations and correspond to the current level of our knowledge. They can only be used as tools to facilitate decision making. This applies in particular to all trial reports and trial results, which cannot be transferred to practice without taking into account specific operational conditions. In the case of any doubt, we recommend that companies carry out their own small-scale trials to obtain local experience. In this context, we also refer to careful compliance with all regulations, instructions for use and precautionary measures.

Many conditions have an impact on the effect of plant protection products and fertilisers such as the condition of the plants, the nature of the soil, the physical location, the crop management, the interaction with other products and factors and the weather. Since these conditions and the proper use are outside the control and potential influence of the Trial and Advisory Council for Nurseries, liability for the efficacy and the consequences of use is excluded.

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