Trialling and Advisory Ring (VuB) Nurseries e.V. Schleswig-Holstein

Chamber of Agriculture Schleswig-Holstein Horticultural Centre

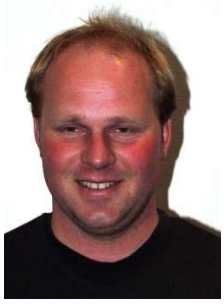
Annual report 2016

Bee protection and beneficial organism protection are very important in nurseries

Trialling and Advisory Ring (VuB)
Nurseries e.V.
Schleswig-Holstein
Thiensen 16, 25373 Ellerhoop
Tel.: 04120/7068-301-302-303
Fax: 04120/7068-319
info@vub.sh
www.vub.sh

Chamber of Agriculture
Schleswig-Holstein
Horticultural Centre
Thiensen 16, 25373 Ellerhoop
Tel.: 04120/7068-100
Fax: 04120/7068-101
info@lksh.de
www.lksh.de

Board of the Trialling and Advisory Ring:



Lars Harder
Deputy

Frank Ostermann
Chair

Bettina Stoldt
Treasurer

Christian Kordes
Committee member

Thomas Mohr
Committee member

Joachim Ellerbrock
Committee member

Ole Kleinwort
Committee member

Versuchs- und Beratungsring Baumschulen e.V. Schleswig-Holstein
Thiensen 16, 25373 Ellerhoop
Tel.: 04120 - 70 68 301-302-303
Fax: 04120 - 70 68 319
info@vub.sh
www.vub.sh

Chamber of Agriculture Schleswig-Holstein Horticultural Centre
Thiensen 16, 25737 Ellerhoop
Tel.: 04120 - 70 68 100
Fax: 04120 - 70 68 101
info@lksh.de
www.lksh.de

Employees in the Trialling and Advisory Ring:

Dr Heinrich Lösing
BTB Advisor
and
VuB Director

Britta Zielke
VuB Advisor

Sebastian Heise
VuB Advisor
from April 2016

Sabine Plüschau-Wöbcke
VuB Secretariat
Accounting

Hendrik Averdieck VuB
Advisor until
June 2016

Contents

UK Disclaimer

Important information:

The VuB publication is a translation of a document reporting research results from work conducted in Germany and consequently the information is only accurate in terms of active ingredients registered for use in Germany. Individuals are responsible for checking whether the use of these actives is legal within the UK and if so whether the doses and rates are the same.

Annual Report 2016

(Dr Heinrich Lösing, Director)

In 2016, the Testing and Advisory Ring continued its successful work. A total of 275 nurseries over 3,167 hectares and 41 supporting members were regularly informed of new findings from practical experience, science and industry, in particularly fertiliser and plant protection measures which protect the environment by means of 39 newsletters, via telephone/fax/email and information at events. Advice to individual businsses was continued as it had been previously.

The number of members has been decreasing since the dynamic structural change in the nursery industry in 1995. This trend also continued in 2016. The same also applies to the production area covered. It decreased by 106ha in the past year. Considerations are ongoing regarding expanding the advisory capacity to include Christmas tree production as a supplement to nursery advice, and other things.

Hendrik Averdieck stopped working for VuB in late May after many years. The Board and the members wish to thank him for his committed advisory and experimental work, particularly on issues of plant nutrition in woody crops.

Mr Sebastian Heise from Uetersen was recruited as his successor. Following a training period on a nursery and subsequent years spent working in gardens and graduating as a master gardener, he completed a Bachelor's degree in Horticulture at Weihenstephan University. Mr Heise started working for VuB in early April specialising in the provision of fertiliser advice.

CEO Dr Heinrich Lösing reached his 30th anniversary of working as a nursery advisor on 1 March 2016. This achievement was marked by a small party with the board and his colleagues.

The latest edition of the BdB handbook on damage symptoms in woody crops by Dr Lösing was published at almost exactly the same time. It includes 30 years of experience of pests of woody crops. All VuB members received a free copy for Christmas.

There has also been significant interest in machinery demonstrations this year.

As far back as February an independently operating robot by the French company Naio (www.naio-technologies.com) was presented at the Heydorn Nursery in Bevern. Using lasers, the device can carry out mechanical soil processing autonomously in crops with in-row distances of 75cm or more.

The device is operated using a high-performance battery. It will certainly be a few more years until it is fully ready for practical implementation, but the current approaches are very promising.

A prototype for a new fully automatic covered steam device for field-grown crops was presented by the vegetable production company Bio-Behr in Kölzin as part of the EIP project “thermal soil treatment”. The device was built by the Germany company Zeyer (www.zeyer.biz) using proven steam technology by MSD (www.moeschle.de). Initial cost estimates for the device stand at approximately EUR 300,000.

Participants in the visit to Bio-Behr discussed the possibilities of the prototype for use on nurseries

Working with stationary steaming units is possible for small nursery businesses with a disinfestation area requirement of 1,000 to 3,000m^2 or less. In these stationary units, a steam generator compresses steam for 3-4 hours under a special film, heating the soil underneath to approximately 80°C. The film must then be moved onto the next area. Devices of this type have been built by Hombach (www.hombach.de) for decades. In floriculture they are generally used under glass and are sold by Mr W. Koch.

All activities are being financially supported over a period of almost three years from funds from the European Community and the federal state of Schleswig-Holstein as part of the EIP project on thermal soil treatment. The aim is to develop and optimise alternatives to chemical soil disinfection.

In September the Highlander V70 tractor by Rath from Austria (www.rath-maschinen.com) was presented at the Heydorn Nursery in Klein Nordende. The unit is a robust and versatile device used in nurseries for many years and has proven to be very valuable.
In the Heydorn Nursery the aim is to use the device to undercut plants of the genus *Carpinus* and others so the plants can be mechanically lifted in a second step with a rootball lifter by Lommers (www.lommerstuinbouwmachines.com) or Ezendam (www.ezendam.info) from the Netherlands.

The intensive trialling of plant protection products was continued in 2016. These included finishing waxes with additives such as the long-standing product, Rebwachs WF (formerly Stähler), the approval for which has expired. New formulations now have to be examined The trial will be continued in 2017 using the dipping method.

Well over 60 people took part in the nursery tour of the weed control trials in conifer seedbeds. In addition to the comparison of herbicides in Krohn Nursery in Halstenbek, there was also significant interest in the infra-red burning device at Flessau in Halstenbeck (images on the right and below).

Since many plant protection products do not have the necessary authorisation for nurseries, the group applications in accordance with Section 22 (2), formerly Section 18b, of the Plant Protection Act are still being processed. A total of 38 plant protection products are currently approved in Schleswig-Holstein for members of the VuB. The two herbicides Artist (flufenacet+ metribuzin) and Proman (metobromuron) have recently been added.

We have issued a printed ‘yellow list’ once a year for several years in order to provide our members with information on the current authorisation status of the plant protection products. A current version is also always available on our homepage. To date there has been no separation of products for integrated and ecological nursery production.

Pflanzenschutzmittel für die Integrierte Baumschulproduktion

Versuchs- und Beratungsring Baumschulen e.V. Schleswig-Holstein, Ellerhoop **VuB**

Die nachfolgende Übersicht zeigt die wichtigsten Kenndaten von Präparaten, die z. Zt. in Baumschulen Verwendung finden. Ein Anspruch auf Vollständigkeit wird nicht erhoben, die jährliche Aktualisierung wird fortgesetzt. **Mit Inkrafttreten des neuen Pflanzenschutzgesetzes am 14.02.12 gibt es eine Reihe neuer Regelungen und Begrifflichkeiten (siehe VuB JB 2011, S. 48). Regulär zugelassene Präparate**, die bisher 2 Jahre aufgebraucht werden durften, dürfen, wenn sie nach dem 14.02.12 zugelassen worden sind, bis 6 Monate nach Zulassungsende verkauft und bis 18 Monate nach Zulassungsende aufgebraucht werden. Dies gilt auch für Präparate, die nach **Art. 51** bundesweit zugelassen wurden (entspricht der bisherigen Genehmigung nach **§ 18a**).
Prinzipiell kann eine Zulassung auch widerrufen werden. Ob in dem Fall Aufbrauchfristen gewährt werden, kann den Rundschreiben des VuB entnommen werden. **Präparate**, für die **in Schleswig-Holstein § 22 (2) Genehmigungen im Sammelantrag-Verfahren** (bisher **§ 18b**) eingeholt wurden, sind durch **Fettdruck** hervorgehoben.

Alle Betriebe sind verpflichtet, ein **Gefahrstoffverzeichnis** über die im Betrieb lagernden Pflanzenschutzmittel und deren Menge zu führen. Mit Angabe der ungefähren jährlich benötigten Menge in der äußersten Spalte „Lagermenge“ kann die Pflanzenschutzmittelliste auch als **Gefahrstoffverzeichnis** genutzt werden.

Zulassung von Pflanzenschutzmitteln in Baumschulen (Stand 23.01.17)

Produkt	Zul. Bis	Zulassung/ Genehmigung	Hauptwirkung	Resistenz-gruppe	Aufwandmenge	Anwen-Häufig.	Kenn-zeichnung	Abstände / Auflagen NW	NG	NT	Lager-klasse	Lager-menge
1. Herbizide												
Arelon Top	12/14	**Keine Aufbrauchfrist.**										
Aramo	aufbrauchen bis 11/16		Gräserherbizid	A	2 l/ha	1 x	N, Xn, B4	642		101	10	
Artist	10/18	**§ 22 (2) B, St**	Boden-/Blattherbizid	K3, C1	2 kg/ha	1 x	N, Xn, B4	605/9, 706		103	11	

Section from a sample “yellow list” with preparations for integrated nursery production.

By popular demand, we prepared a ‘green list’ of products authorised for ecological nursery production in accordance with Regulation (EC) No. 834/2007 for the first time last year. On the one hand, growers nowadays are attempting to break new ground in terms of plant protection, but on the other there is increasing interest among consumers for plants free of any residue from conventional plant protection products.

Pflanzenschutzmittel für die Ökologische Baumschulproduktion

Versuchs- und Beratungsring Baumschulen e.V. Schleswig-Holstein, Ellerhoop **VuB**

Alle Betriebe sind verpflichtet, ein **Gefahrstoffverzeichnis** über die im Betrieb lagernden Pflanzenschutzmittel und deren Menge zu führen. Mit Angabe der ungefähren jährlich benötigten Menge in der äußersten Spalte „Lagermenge“ kann die Pflanzenschutzmittelliste auch als **Gefahrstoffverzeichnis** genutzt werden.

Zulassung von Pflanzenschutzmitteln in der **ökologischen Baumschulproduktion.** (Stand 15.01.2017)
Grundlage für die Auswahl ist die Verordnung (EG) Nr. 834/2007.

Produkt	Zul. Bis	Zulassung/ Genehmi-gung	Hauptwirkung	Wirkstoff	Aufwandmenge	Anwen-Häufig.	Kennzeich-nung	Abstände / Auflagen NW	NG	NT	Lager-klasse	Lager-menge
1. Herbizide												
Keine zugelassenen Herbizide in der ökologischen Produktion.												
2. Fungizide												
Bioten	12/24	ZP uGlas	Bodenpilze	Trichoderma	25 g/m³ einmischen 0,25 kg/ha	1 x 1-4 x	B4					
Contans	12/18	ZP	Sclerotinia	Coniothyrium	2 kg/ha nach Ernte 4-8 kg/ha einarbeiten	1-2 x 1-2 x	B3					

Section from a sample ‘green list’ with products for ecological nursery production.

There was high demand for the specialist training organised under the auspices of the Chamber of Agriculture Plant Protection Department together with VuB. More than 100 participants were able to be trained over two training sessions. Each person who is trained in the application of plant protection products must undergo training lasting at least four hours at intervals of three years. Options in terms of online training have also been available for some time. The costs of this are approximately the same.

Landwirtschafts-
kammer
Schleswig-Holstein

Nachweis

über die Teilnahme an einer
anerkannten Fort- oder Weiterbildungsmaßnahme
zur Sachkunde im Pflanzenschutz

Hiermit wird bestätigt, dass

Frau Britta Zielke

geboren am 29.03.1976

am 13. Februar 2014

an der Fort- oder Weiterbildungsmaßnahme
des Pflanzenschutzdienstes
der Landwirtschaftskammer Schleswig-Holstein

zur Sachkunde nach § 9 Abs. 4 des PflSchG teilgenommen hat.

Landwirtschaftskammer S-H, Standort Ellerhoop
(Verantwortliche/r der Fortbildungsmaßnahme)

Rendsburg, 24.04.2014

Claudia Peters
Claudia Peters

Fertiliser advice for nurseries continues to be a focus of our advisory work. Fertiliser recommendations are provided for around 464 substrate samples from container-grown crops and 875 soil samples. This high number of samples shows the high level of awareness of nursery companies of the requirement for a needs-based and environmentally sound fertiliser application programme. The guideline values in accordance with the Fertiliser Regulations Section 3 for nitrogen in the soil, which are required once a year, were determined. In order to do this, the nitrogen contents of representative locations are determined for the main crop groups, and these are provided to all businesses (see also under fertiliser use: nitrogen contents in nursery soils – guideline values). The costs for the sampling and analysis of the 40 N_{min} samples are thankfully once again covered by the Horticultural Department of the Chamber of Agriculture. The individual nursery companies will therefore comply with the necessary annual compulsory testing in accordance with the Fertiliser Regulations. Furthermore, over the course of the growing season for 332 N_{min} samples of tree nurseries, thus achieving a very targeted nitrogen supply to the crops, taking into account the nitrogen supply in the soil.

Shoot dieback in privet (photo: S. Heise)

The issue of shoot dieback in privet was hugely important in 2016. The symptoms were particularly pronounced in the field during dry phases in late summer, as this makes the uptake of boron from the soil more difficult for the plants. The topic of shoot dieback was further investigated in trials in 2016. The focus of the investigations was a comparison of soil and foliar feed fertiliser treatments.

The issue of reducing nitrogen leaching in areas used by nurseries has been very important for a number of years. An extensive investigation into avenue trees is being carried out over a period of several years in collaboration with the engineering firm Gerries.
Trialling of long-term fertilisers in different crops grown in field nursery beds was undertaken, predominantly with partially coated fertiliser products. The aim of this is to also reduce nitrate leaching while maintaining plant quality.

View of the *Fagus* trial fields in Appen and *Ligustrum* trial fields in Klein Nordende

Several prototype fertilisers were also trialled in a number of container-grown crops in comparison with standard products. As part of these tests *Pyracantha coccinea* ‘Red Column‘ and *Prunus lusitanica* ‘Angustifolia‘ were used as trial plants.

Many of the trials were supported by fertiliser and plant protection product manufacturers, substrate suppliers and nursery suppliers. For 2016, particular thanks go to BASF, Bayer CropScience, Belchim, Biofa, Compo Expert, DowAgroSciences, DuPont, Flügel, ICL Specialty Fertilizers, FCS, Haifa North West Europe NV, Hauert Günther Düngerwerke, Heinrich Harden, Jost Mikronährstoff- u. Spezialdünger, H. Meyer, Mivena BV, Neudorff, Plantacote NV, Syngenta, Spiess-Urania Chemicals, Stender AG, Vereinigte Kreidewerke Dammann and Yara.

The intensive trials work is not possible without practical support. We wish to thank the companies listed below for their support in 2016:

Bielenberg, Horst
Bradfisch, Borstel-Hohen.
Bruhn, Barmstedt
Diercks, Pinneberg
Eberts, Tangstedt
Ellerbrock, Schenefeld
Flessau ,Halstenbek
Glismann, Bullenkuhlen
Harder, P., Ellerhoop
Heinrich, K., Ellerhoop
Heydorn Söhne, Klein-Nordende
Heydorn, Bevern
Hofmann, Rellingen
Hoyer, H.-H., Bevern
Kleinwort, H. & J., Holm
Krohn, H., Halstenbek
Langeloh, Tornesch
Michelsen, Pinneberg
Münster, G., Appen-Etz
Münster, G., Borstel-Hohenraden
Oetting, J.-T., Rellingen
Ostermann, M., Ellerbek
Pein, E., Ellerhoop
Pein, H., Appen
Röttger, H., Heist
Schmidt, J., Lutzhorn
Schrader, Kölln-Reisiek
Schuldt, Helge, Ellerhoop
Seidler, Elmshorn
Spilkers, Barmstedt
Spitzmann, Halstenbek
Stahl, Gr. Nordende
Stahl, Tornesch
Steffen-Jansen, Rellingen
Thies, H., Seeth-Ekholt
Vogt, H., Rellingen
Wrage, Ellerhoop

The VuB 2016 study trip was to the Czech Republic. A total of 10 nurseries were visited. The trip was very popular, with 29 growers participating.

Participants on the study trip to the Czech Republic with the Chair of the Nursery Association, Jiri Veleba, and the interpreter, Zbynek Slezacek

Joint training events were carried out with the Schleswig-Holstein Chamber of Agriculture and the DEULA in Rendsburg within the scope of employee training. There is still a significant demand for the forklift driver seminar.

Added to the programme seven years ago and carried out by the German Red Cross, was the first aid training for first aiders at work. Retraining is a requirement every two years. The costs of this are covered by the Professional Horticultural Association.

Co-operation with the Agricultural Chamber, Crop Production Department and Plant Protection Industry Advisers, has continued, with particular emphasis on environmental protection, with a focus on gathering and disseminating information. The collaboration has intensified as a result of the merger at the Ellerhoop location.

In the entire BdB, contributions were made to the committees on ‘production and environment’, ‘IT’, ‘deciduous trees’ and in the ‘working group on horticultural research’.

Written questions and questions by telephone from within Germany and abroad continued to be answered as they had previously.

Trialling various grafting waxes
(B. Zielke, Dr H. Lösing)

1. Trial objective

The product Rebwachs WF has proven itself for winter grafting of woody crops in nurseries for many years. On 31 December 2014 the product lost its authorisation as a plant protection product. It was no longer sold during the winter 2015 grafting season. Residual quantities of Rebwachs WF were permitted to be used up by 30 June 2016.

In a trial examining various waxes for their suitability for nursery grafting, the product Rebwachs Pro (previously sold under the name Rebwachs WF) was compared with other waxes. The substances used for comparison were the grafting wax Trigol, which some operations have been using for many years, the plant paraffin PP 140 listed, as a plant strengthener, the trial product Rebwachs N and the products Proagriwax RH-Ester and Proagriwax 60/66 W, both of which come from Norway.

Some of the products contained hormones and would accordingly require authorisation as plant protection products. Products that do not contain hormones can be used if they are listed as plant strengtheners.

Fig. 1: Grafting of *Prunus serrulata* ‘Amanogawa‘ coated with PP140

2. Trial design

In the period from 25 February 2016 to 3 March 2016, 875 *Corylus avellana* ‘Contorta‘, 875 *Malus* ‘Evereste‘ and 875 *Prunus serrulata* ‘Amanogawa‘ were grafted. The grafting sites were wrapped with Fleicobands and coated with the various waxes. In each case, only the connecting point and the interface of the graft were covered with wax, the buds on the graft were left free. A total of 125 grafts of each species were treated with the same product. Table

1 provides an overview of the waxes and the date of use. During the procedure, the ideal melting temperature and the consumption in grams were determined for 375 grafts.
After grafting, the woody crops were placed in boxes containing peat and stored in a cool place until they were planted on 9 April 2016 or in the case of the *Corylus* until they were potted on 22 April 2016. The potted *Corylus* were then placed in the glasshouse.

Fig. 2: Proagriwax RH-Ester and in the background Proagriwax 60/66 W, block at delivery

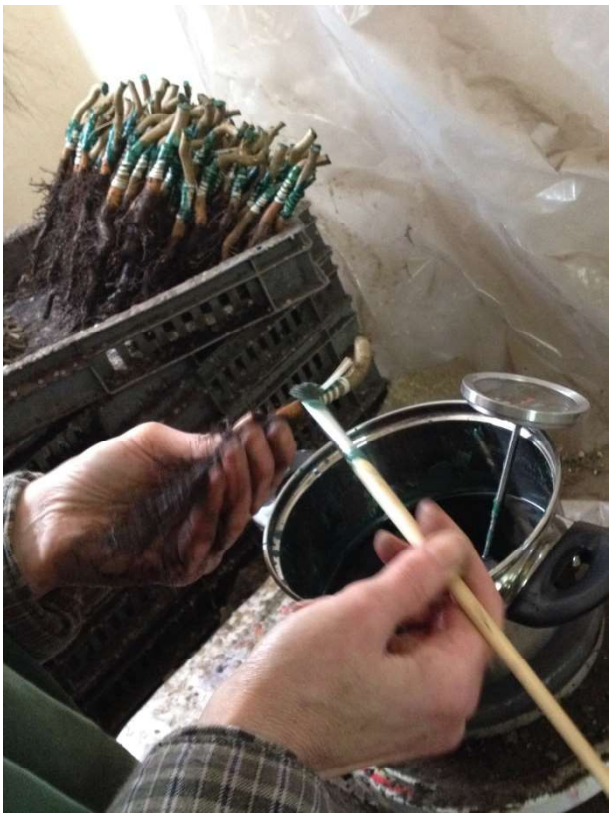


Fig. 3: Applying PP 140

Initial observations were made on 3 May 2016 and 30 May 2016. Grafts that did not shoot were counted and the suitability of the graft site was assessed.
The final assessment of the trial was undertaken in November. The grafts that had grown were counted and the length of the new shoot was measured. While the waxes and the grafting rubber bands had completely dissolved in all cases of the plant species planted in the field, the frequency with which the grafting band was required to be cut off was counted for the *Corylus* potted in the glasshouse. The grafts of *Corylus* that had not grown were also opened and a check was carried out to determine whether callus formation had occurred.

Overview 1: Treatments

Product/ manufacturer	Colour	Structure	Active substance	Temp. Upper/lower	Container Price	Amount used*
Rebwachs Pro Chauvin Agro	Red	Pellets	Hormone	62°C / 75°C	-	120g.
Rebwachs N Chauvin Agro	Red	Pellets	-	63°C / 80°C	-	120g.
PP140 Chauvin Agro	Green	Pellets	-	59°C / 65°C	20 kg 5.60 €/kg	220g.
Trigol Schacht	Yellow	Block	-	63°C / 65°C	2.5 kg 6.96 €/kg	270g.
Proagriwax RH-Ester Norsk Wax	Red	Block	Hormone	63°C / 78°C	-	120g.
Proagriwax 60/66 W Norsk Wax	White	Block	-	61°C / 76°C	-	180g.

*Amount used determined during the trial for 375 grafts

3. Results

After planting or potting the grafts were grown on in the standard manner. All the treatments were applied equally.

Fig. 4-5: Trial planting on 3 May 2016; *Malus* and *Prunus* were planted in beds in open land and *Corylus* was potted in a glasshouse.

The colours of the Rebwachs N, PP140 and Rebwachs Pro very quickly faded under field conditions. Some ‘wax shells’ rapidly developed cracks as a result of the growth in thickness of the grafts. This was generally observed more frequently in *Prunus* than in *Malus*.

The following figures show *Prunus* grafts coated with various waxes on 3 May 2016.

Proagriwax RH-Ester

Proagriwax 60/66 W

Rebwachs N

PP 140

Rebwachs Pro

Trigol

Fig. 6-11: *Prunus* grafts coated with various waxes on 3 May 2016

Initial differences in the growth rate could be observed in the field-grown plants at the end of May.

In many cases, the *Prunus* had shoot lengths of 10-15cm, and overall the growth levels appeared to be better in this subject than in the case of *Malus*. These not only grew more poorly, but were also less well developed. *Malus* had shoot lengths of 5-10cm.

By late May, the best results were seen in grafts that had been coated with Rebwachs N. About 110 grafts per species appeared to have grown on for the two species planted in the field.


Fig. 12-13: *Malus* grafts on 30 May 2016, on the left treated with Rebwachs N (good growth rate), on the right treated with Proagriwax RH-Ester (evidently greater levels of failure of grafts)

Fig. 14-15: Final evaluation of field-grown material on 24 November 2016

The final results were recorded in November. Figure 16 shows the number of grafts that grew per species. The product Rebwachs N performed the best overall. More than 100 grafts grew in all of the species trialled. *Malus* achieved a level of only a single graft coated with this wax that did not grow. Even the waxes PP 140 and Proagriwax 60/66 W showed good results over all of the species examined.

The *Corylus* cultivated in the glasshouse achieved noticeably good results with the wax Trigol. Particularly good growing results were achieved in the genus *Prunus* with Rebwachs N and Proagriwax 60/66 W.

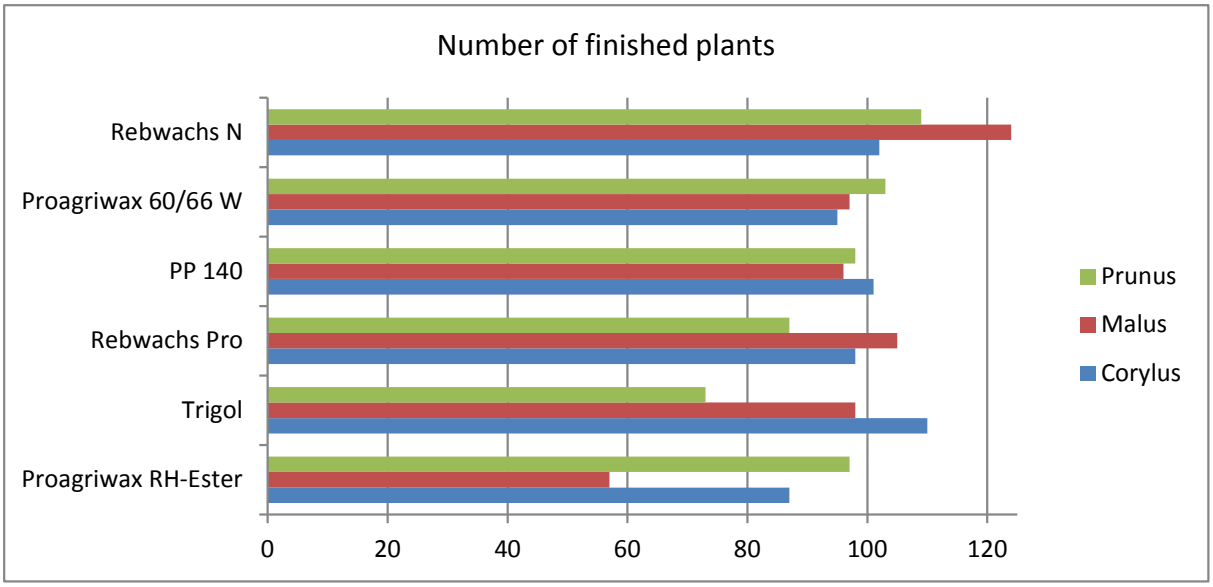


Fig. 16: Number of finished plants. A total of 125 samples were grafted for each species and wax type.

In addition to the growth rate, the length of the shoots was also determined as part of the final assessment. The mean values were identified. There were almost no differences in mean shoot length in the *Corylus* potted and cultivated in the glasshouse.

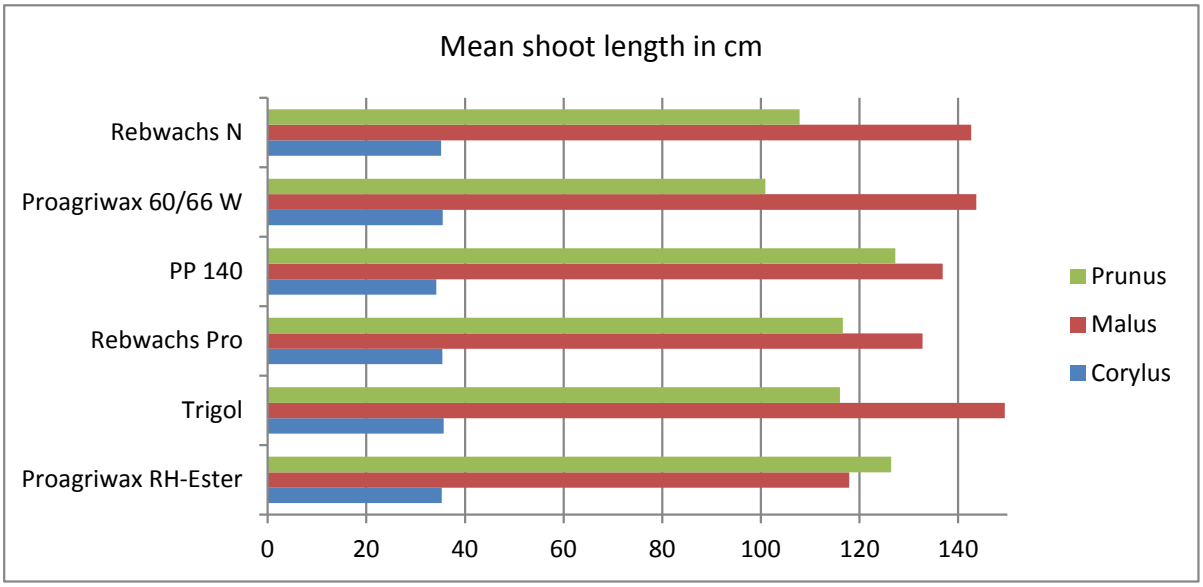


Fig. 17: Mean shoot length in cm. Only the grafts that grew were measured.

There was one treatment applied to the *Malus* that on average resulted in around 20cm shorter shoots than the other treatments. This was the Proagriwax RH-Ester treatment. More than half of the *Malus* plants showed more than one strong shoot in comparison to 35-40% of the other plants. Around half of the plants had several shoots when grown with the Proagriwax 60/66 W treatment too, but this did not have a detrimental effect on the plant size.

There were also slight differences in shoot length in *Prunus*. In some cases, this showed a negative correlation with the growth rate. The treatments which resulted in good development (e.g. Rebwachs N, Proagriwax 60/66 W) led to more plants on the production bed and therefore

a greater fertiliser demand over the plot area and the shoots remained shorter accordingly. This link was not able to be established in all cases.

During the assessment all of the grafts were inspected to determine whether the grafting rubber bands had dissolved or not. In the field, the Fleicoband had dissolved in all cases as a result of the weather conditions and UV light. The opposite was true with the *Corylus* grown in the glasshouse. The rubber band had to be cut through with most grafts to prevent it from restricting growth. A number of rubber bands had only dissolved with the Rebwachs Pro (nine grafts) and Proagriwax RH-Ester (26 grafts) treatments.

4. Summary

In February 2016 a trial of the suitability of different waxes for use on grafts was carried out using the woody species *Corylus*, *Prunus* and *Malus*. The best and most uniform results in terms of growth were achieved following coating of the grafting sites with the hormone-free products Rebwachs N, PP140 and Proagriwax 60/66 W.

The product Trigol, which is also hormone-free, produced excellent results but only in the case of *Corylus* grown in the glasshouse. The wax PP 140, which was listed as a plant strengthener, and the product Trigol were available to gardeners for the 2016/2017 grafting season. The hormone-free products Proagriwax 60/66 W and Rebwachs N may shortly be marketed. Rebwachs Pro (formerly Rebwachs WF) received an emergency authorisation for 120 days for grafting. In practice, there is widespread experience of immersing the entire graft with this product. This method has not been tested with the products PP 140 or Trigol. More wax per graft was needed to coat with both of these products compared with Rebwachs Pro. It is possible that immersion in the waxes that are currently available forms a wax coat that is more difficult for the buds to break through. A further trial on this issue is planned for 2017.

Insecticides against root aphids on pines and currants
(B. Zielke, Dr H. Lösing)

1. Introduction

Root aphids occur in woody crops in nursery production, particularly with pines and currants. Both of these species of aphid have alternate hosts. The currant root aphid (*Eriosoma ulmi*) lays winter eggs on elms in the autumn. Starting from this species of tree, winged aphids colonise the roots of currants in June/July.

The pine root aphid (*Stagona pini*) colonises the roots of species of pine over the entire year in addition to the leaves of its main host, the hawthorn (Alford, Colour Atlas of Pests on Ornamental Plants, 1997). In addition to having a negative impact on growth, the damage caused by the aphids is also visual in nature. Customers complain if they see aphids on the roots.

Figure 1: Root aphids on currant plants

Trials aimed to clarify whether mixing insecticide granules into the substrate had an impact on aphid infestation. In addition to this, the aim was also to check the effect of spray treatment with the systematic insecticide Movento OD on aphids.

2. Trial design

On 4 March, 3000 *Pinus uncinata* were potted into 9 cm pots for the trial. The substrate was mixed with 500g/m³ Met 52 granules in 600 plants. The substrate of 600 further plants was mixed with 400g/m³ Exemptor granules. The remainder of the plants were potted in conventional white peat without any additives, with some of them to be treated with insecticides later in the summer.

Around one month later, on 08/04/2016, rooted cuttings of *Ribes* ‘Jonker van Teets‘ were potted by hand. The standard substrate was mixed with some of the insecticide granules as described above.

Fig. 2: Insecticide granules, Met52 on the left, Exemptor on the right

The product Met52 contains the fungus *Metarhizium anisopliae var. anisopliae, strain F52*, which infects and kills *Otiorhynchus* eggs and larvae. Grains of rice are carriers of the fungal spores. The bioinsecticide Met52 is authorised to prevent *Otiorhynchus* by mixing into the substrate before potting. Trials in Denmark show that the fungus may infest other insects in the substrate such as thrips pupae. Nothing was previously known about an effect on root aphids.

Exemptor is authorised as a substrate addition against *Otiorhynchus* and fungus gnat larvae. The product is also authorised to prevent whiteflies and aphids that damage the above ground parts of plants. The systematic active substance thiacloprid is absorbed by the roots and distributed in the plant within the sap. Depending on the pest and the quantity used, it can offer protection lasting up to 38 weeks.

The active substance of the insecticide Movento OD (spirotetramat) is characterised by the fact that it is particularly systematic and is shifted to the tips of the roots in plants that are actively growing.

Spray treatments were carried out on 14/07 and 28/07/2016 after a slight infestation of aphids was identified. Since no aphids occurred on the pines in summer 2016, these were not treated.

The following table provides an overview of the treatments.

Table 1: Treatments

Treatment	Active ingredient	Quantity used	ZL	Notes
Control	-	-	-	-
Exemptor*	Thiacloprid (100 g/kg)	400g/m³ substrate	ZP	N, Xn, B3
Met 52*	*Metarhizium anisopliae* var. *anisopliae* F52 (20 g/kg)	500g/m³ substrate	ZP	B3
Movento OD⁺	Spirotetramat (150 g/l)	0.3L/ha	B, ZP	N, Xn, B1
Movento OD⁺	Spirotetramat (150 g/l)	0.6L/ha	B, ZP	N, Xn, B1

*Mixed into the substrate during potting, ⁺two spray applications of 500L of mixture per ha

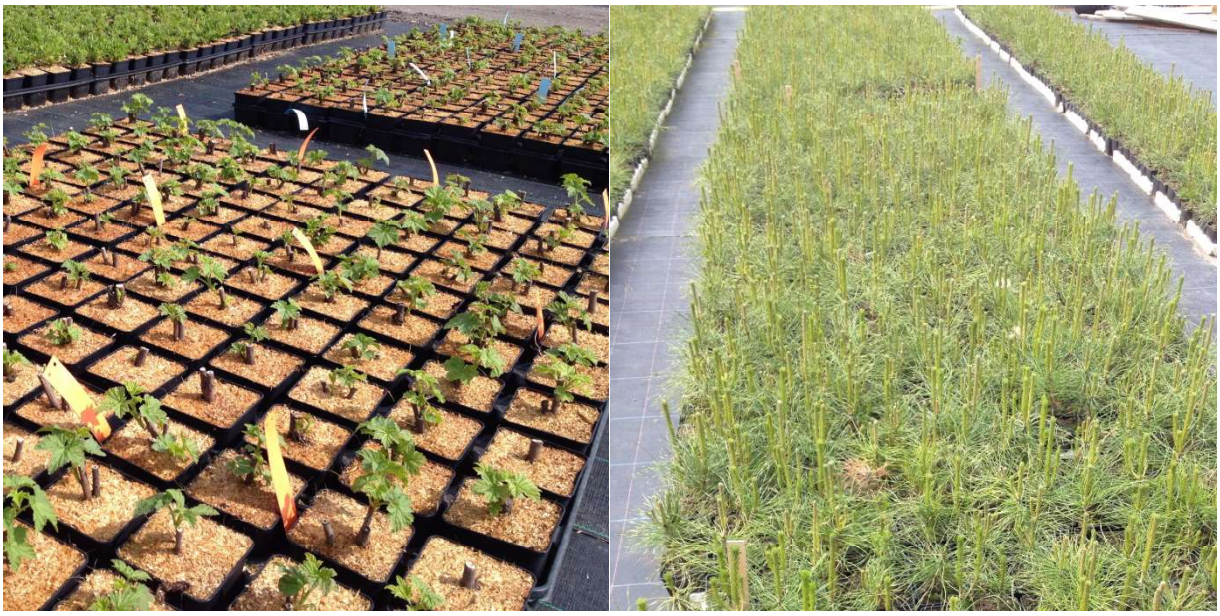


Fig. 3-4: Trial plants in May

3. Results

3.1. Plant tolerance

No damage caused by the insecticide granules was observed over the entire trial period until mid-October. Even the two spray treatments with Movento OD administered at an interval of two weeks (single and double application quantities) were tolerated by the plants.

3.2. Efficacy

Colonies of aphids were initially found on *Ribes* in early July. Twenty randomly selected plants were potted on 12/07 and the aphid infestation was assessed. The degree of infestation per pot was broken down into one of four classes: 0 = no infestation, 1 = slight infestation, 2 = moderate infestation, 3 = severe infestation.

No differences were able to be identified between the treatments. There was an average of a slight infestation.

Fig. 5: Classification into infestation classes, from left to right for every two plants: 0 = no infestation, 1 = slight infestation, 2 = moderate infestation, 3 = severe infestation

Further assessments of this type were carried out two weeks after the first and therefore immediately before the second treatment with Movento OD and three weeks after the second treatment.

While the infestation was still slight on 28/07 and only slight differences were able to be observed between the treatments, it increased in the first few weeks of August. On 18/08 the control plants and those in the substrate containing Met52 received an average infestation level score of 2. Plants in the substrate containing Exemptor, and those which had been treated twice with the product Movento OD in an application quantity of 0.3L/ha tended to have lower levels of infestation. The lowest infestation level of aphids was recorded after two treatments with the insecticide Movento OD at double the application quantity. Figure 6 provides an overview of the results.

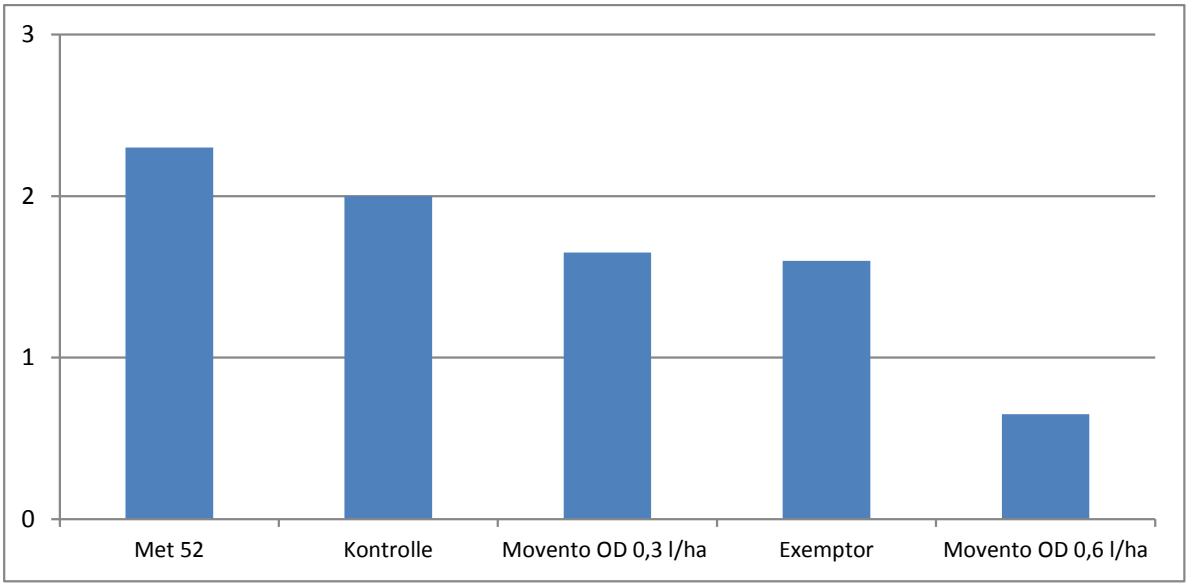


Fig. 6: Colonisation with aphids, average infestation level scores on 18/08/2016: 0 = no infestation, 1 = slight infestation, 2 = moderate infestation, 3 = severe infestation (n = 20)

Fig. 7-8: Treatment with a double application quantity of Movento OD at the start of the infestation and again 14 days later prevented the spread of the aphid colonies three weeks after the second treatment

The trial was assessed again on 10/10/2016. During this final assessment, 120 plants per treatment were potted on and inspected for their level of aphid infestation. Only a very small number of plants were still had an infestation level of 0 (no infestation). There were no longer any differences between the treatments by early October. All treatments had a moderate level of infestation on average.

4. Summary

A potting trial with *Ribes* and *Pinus* was carried out to compare the effect of the insecticide granules Met52 and Exemptor against root aphids.

Some of the plants potted into untreated substrate were intended to be sprayed with the insecticide Movento OD at the point at which the first colonies of pests occurred in order to test the efficacy of this product on aphids.

Aphids only occurred on *Ribes* in the year in which the test was carried out (2016). The insecticide granule Met52 applied during potting had no effect on the colonisation of the roots with currant root aphids, infestation levels where similar to the untreated control. The plants that had been potted into the substrate containing Exemptor granules showed temporarily lower levels of aphids than plants in the untreated control. This effect, however, did not last until the end of the trial, which was 27 weeks after potting. The two spray treatments of the

insecticide Movento OD from the start of the infestation in this trial also only worked temporarily, and significantly only after double the quantity was used.
By early October the aphid infestation was equivalently severe in all the treatments examined in the trial.

Production of container roses with plant protection products in accordance with the "EU Eco-Regulation" (834/2007)

(B. Zielke, Dr H. Lösing)

1. Trial objective

The subject of 'bees' has increasingly been a focus both in the media and among consumers in the past few years. People's interest in protecting bees and bumblebees in their own gardens has increased, and this is reflected in the large number of products advertised as 'bee-friendly' (seed mixtures, plants that feed bees, insect nesting boxes etc.).

The aim was to carry out a trial to determine whether container roses could be produced without the use of conventional plant protection products in order to be able to market them as 'bee-friendly'. Among other things, the compatibility of various ecological plant protection products was trialled.

Fig. 1: Bumblebee visiting a 'Snow White' rose
Fig. 2: Landgard exhibition stand at IPM 2017; bees are a key theme

Trial design

On 07/05/2016, 80 bare-root roses of the species 'Sinea' and 'Snow White' from conventional cultivation were potted into white peat substrate in 5 L containers and placed onto a production bed. These roses were only treated with alternative plant protection products until the point at which they were sold in mid-July. There was no untreated control.

The treatments were given using a Birchmeyer Flox backpack sprayer with a sprayer boom consisting of four Teejet 11002 nozzles. A water quantity of 500 l/ha was used.

At the points of treatment application the plant surfaces were dry and the products were able to dry out after application. The following tables provide an overview of the treatments with the date, quantities applied and weather conditions.

Table 1: Treatment, date and weather condition

No.	Date	Products	Quantity used	Weather
1	27/05/2016	NeemAzal TS + Phos 60 EU	3 l/ha + 2 l/ha	15°C, cloudy
2	03/06/2016	Neudosan Neu Blattl. + Serenade ASO	10 l/ha + 8 l/ha	20°C, sunny
3	10/06/2016	Neudosan Neu Blattl. + Serenade ASO	10 l/ha + 8 l/ha	18°C, sunny
4	17/06/2016	Spruzit Neu + Serenade ASO	2.5 l/ha + 8 l/ha	22°C, sunny
5	23/06/2016	Kumulus WG + Funguran Progress	2 kg/ha + 1 kg/ha	28°C, sunny
6	01/07/2016	NeemAzal TS + Serenade ASO	3 l/ha + 8 l/ha	20°C, cloudy
7	07/07/2016	Spruzit Neu + Serenade ASO	2.5 l/ha + 8 l/ha	19°C, sunny

Table 2: Product, active ingredient and target

Products	Active substance	Target	Notes
NeemAzal TS	Azadirachtin (10.6 g/l)	Sucking and biting insects	(4 x), B4
Neudosan Neu Aphid-free	Fatty acids Potassium salts (515 g/l)	Sucking insects, aphids	(5 x), B4, Xi
Spruzit Neu	Pyrethroid (4.59 g/l) Rapeseed oil (825.3 g/l)	Sucking and biting insects, spider mites	(8 x), B4
Funguran Progress	Copper hydroxide (537 g/kg)	Leaf spots	(4 x), N, B4, Xn
Kumulus WG	Sulphur (800 g/kg)	Powdery mildew	(15 x), B4
Phos 60 EU	Phosphoric acids (671 g/l)	Downy mildew	As a fertiliser
Serenade ASO	*Bacillus amyloliquefaciens*	Grey mould, EM, FM	Only for vegetables (6 x)

(The maximum permissible number of applications is listed in brackets under “notes”)

3. Results

3.1. Plant tolerance

All of the mixtures tested were technically permissible. No coagulation or blockage of the spray nozzle occurred. Moderate burns occurred to the new leaves of the rose species ‘Sinea’ after the treatment on 23/06, which occurred in sunny weather and at 28°C. A clearly visible deposit was also visible on the buds of these plants after this treatment with both contact fungicides, and this only washed off as a result of precipitation.

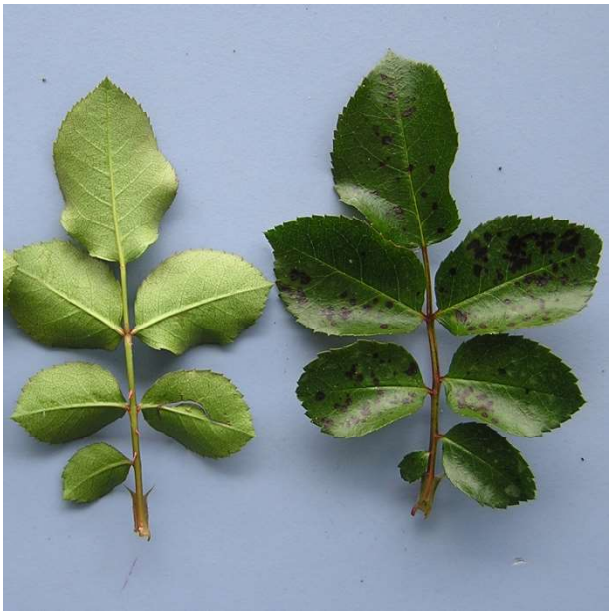


Fig. 3: Spray deposit and damage to the leaves with *Rosa* ‘Sinea‘ after the use of the combination of Kumulus WG and Funguran Progress applied on 23/06 during sunny weather and at 28°C. The deposit could be seen one week after treatment but the damage was not yet visible.

Fig 4: Two weeks after treatment the deposit had mostly washed off but the damage to some of the newest leaves at the point at which the treatment was carried out had become more apparent. The spots were now downy mildew (they could also be seen on the underside of the leaf), and an infestation would start on the inside of the plants.

3.2 Efficacy

The plants used in the trial were a batch of roses that were potted at a late stage and had a very short culture duration. The plants were potted bare-root from the cold storage facility in mid-May and two months later were sold with buds that were showing some colour.

During this period from potting to marketing the plants were able to be kept free from fungal pests and aphids by means of seven spray treatments at intervals of approximately one week. The plants were inspected weekly over the duration of the test. Individual aphids (*Macrosiphum rosae*) occurred on leaves and shoots in July in particular, but no extensive colonies formed.

Fig. 5-6: “Eco roses” at the start of the test on 27/05/2016 and at the end of the test on 07/07/2016

It is important that the plants are free of aphids when the container roses are delivered to the garden centre. It is difficult for garden centres to fight aphids on the plants in the sales area. Despite the interest in bees and the increased awareness of insects, plants with aphids are not accepted by end users. Large populations can quickly develop from just a few aphids if the weather conditions are favourable. Complaints are therefore received about plants that are identifiably colonised by aphids.

Fig. 7-8: The maximum aphid infestation that occurred during the test on 10/06/2016

Fig. 9: Container roses that are ready for sale on 07/07/2016 produced without using conventional plant protection products

4. Summary

In this practical trial, it was possible to produce good quality container roses without using conventional plant protection products over a two month period. Since there was no untreated control, it is not possible to make a statement about the efficacy of the alternative plant protection products.

Knowledge was able to be gained about the miscibility and tolerance of the products.

The active substances of conventional plant protection products can be seen in plants long after their use. Gardeners' trading partners sometimes ask for declarations of renunciation of certain plant protection products. The topic of 'alternative plant protection products' is becoming increasingly significant.

Residual herbicides for use on soil-covered seed beds prior to emergence
(B. Zielke, Dr H. Lösing)

1. Trial objective

In addition to use in established woody HNS crops before budding, one area of use of the residual herbicide Terano was on seed beds of large seeded species before germination. The herbicide was well tolerated by the rapidly-germinating species *Fagus*, and offered the advantage of good weed control (VuB Annual Report for 1999, page 11 et seqq.). In *Quercus* and *Corylus* there were problems with dying germ shoots as a result of the slow germination process (VuB Annual Report for 2003, page 35 et seq.)

Authorisation for the herbicide Terano ended in December 2014, and the herbicide could be applied until June 2016. Against this background, new herbicides or herbicide combinations were trialled to determine their suitability for use in seed beds of large seeded species as far back as 2015. Due to the good tolerance results recorded with oak and beech the trials were repeated in 2016 and additional plant genera and herbicide treatments were included.

Fig. 1: Winter seed bed at the start of the trial on 17/03/2016

2. Trial design

Seed beds of the species listed in the following table were treated on the relevant date over the course of the spring. The herbicides and herbicide combinations listed in table 2 were applied with a plot spraying device with Lechler injector nozzles IDN 120-025 purple and a water quantity of 512L/ha. The trial on each plant species were replicated two or three times.

Table 1: Species examined and treatment date

Plant species	Sowing time	Date	Replication	Treatments
Acer pseudoplatanus	Spring	27/04/2016	2	1,2,3,6,7, 10-14
Castanea sativa	Autumn	17/03/2016	3	1,2,3,6,7, 10-14
Fagus sylvatica	Spring	04/05/2016	3	1,2,3,6,7, 10-14
Fagus sylvatica	Spring	05/05/2015	3	1,2,4,5,7,8,9,13,14
Prunus myrobalana	Spring	28/04/2016	2	1,2,3,6,7, 10-14
Prunus spinosa	Spring	28/04/2016	2	1,2,3,6,7, 10-14
Quercus petraea	Autumn	27/03/2015	2	1,2,4,5,7,8,9,13,14
Quercus rubra	Spring	05/05/2015	3	1,2,4,5,7,8,9,13,14
Quercus robur	Autumn	17/03/2016	3	1,2,4,5,7,8,9,13,14
Quercus petraea	Spring	13/04/2016	3	1,2,3,6,7, 10-14

Table 2: Treatments

	Product	Quantity used	Active substance	Authorisation	Notes
1	Untreated	-	-	-	-
2	Artist	1kg/ha	Metribuzin (175g/kg) + flufenacet (240g/kg)	Potatoes, asparagus	N, Xn, B4
3	Bandur	4L/ha	Aclonifen (600g/l)	Potatoes, vegetables	N, Xn, B4
4	Betanal Maxx Pro + Gallant Super	4.5kg/ha 0.5L/ha	Desmedipham (47g/l) + ethofumesate (75g/l) + lenacil (27g/l) + phenmedipham (60g/l) Haloxyfop-P (104g/l)	Section 22 (2) B B	N, Xi, B4
5	Boxer + Goltix Gold	5L/ha + 5L/ha	Prosulfocarb (800g/l) Metamitron (700g/l)	Article 51 ZG Section 22 (2) B	N, B4, Xi B4
6	Dual Gold + Flexidor	1.25L/ha + 0.75L/ha	S-metolachlor (960g/l) Isoxaben (500g/l)	Section 22 (2) B, St B	N, Xi, B4 N, B4
7	Dual Gold + Stomp Aqua	1.25L/ha + 2L/ha	S-Metolachlor (960g/l) Pendimethalin (455g/l)	§ 22 (2) B, St Art. 51 B	N, Xi, B4 N, Xn, B4
8	Fresco	1.875L/ha	Metobromuron (400g/l)	-	-
9	Fresco	3.75L/ha	Metobromuron (400g/l)	-	-
10	Fresco + Spectrum	1.875L/ha + 0.6L/ha	Metobromuron (400g/l) Dimethenamid-P (720g/l)	- Article 51 ZP	- N, Xn, B4
11	Fresco + Spectrum	3.75L/ha + 1.2L/ha	Metobromuron (400g/l) Dimethenamid-P (720g/l)	- Article 51 ZP	- N, Xn, B4
12	Malibu	4L/ha	Pendimethalin (300g/l) + flufenacet (60g/l)	Grain	N, Xn, B4
13	Spectrum + Stomp Aqua	0.6L/ha + 2L/ha	Dimethenamid-P (720g/l) Pendimethalin (455g/l)	Article 51 ZP Article 51 ZG	N, Xn, B4
14	Spectrum + Stomp Aqua	1.2L/ha + 3L/ha	Dimethenamid-P (720g/l) Pendimethalin (455g/l)	Article 51 ZP Article 51 ZG	N, Xn, B4

= both years = only 2016 = only 2015

3. Results

3.1 Plant tolerance

After application of the Betanal Maxx Pro + Gallant Super treatment in 2015, abnormalities were observed on a number of oak seedlings after emergence in both the autumn and the spring sowing. Some of the seedlings on plots of treated land had deformed leaves. In 2013, similar symptoms were seen after the use of 4.5 l/ha Betanal Maxx Pro on seedlings of *Quercus rubra* (VuB P08/2013).

In 2016, the herbicide Bandur, which was not trialled in 2015, led to quite significant damage to the seedlings at the full application rate trialled. While the damage expressed itself as a mild chlorosis with *Quercus* and both *Punus* species that were sown in spring, seedlings of the genus *Acer* were very sensitive, and there were major losses after the use of the product Bandur.

Fig. 2-3: Mild chlorosis on *Prunus spinosa* and *Quercus petraea* seedlings after the use of 4L/ha Bandur

Damage was also observed after the use of the full quantity of the herbicide mixture Fresco + Spectrum. This was expressed as poor emergence results and individual stunted seedlings of *Castanea*, *Quercus* (autumn sowing) and *Fagus*. *Prunus* seedlings also exhibited symptoms to a somewhat lesser degree and had temporarily darker tips.

Fig. 4-5: Incomplete emergence and individual stunted seedlings of *Fagus sylvatica* and *Quercus robur* after the use of Fresco + Spectrum (3.75L/ha + 1.2L/ha)

A number of atypically branched oaks occurred in 2016 in areas sown in spring after the use of 4L/ha Malibu (corresponding to 240g/ha flufenacet). Since the active substance flufenacet is also in the product Terano and is present in the product Artist (1kg/ha Artist contains 240g/ha flufenacet), the performance of the oaks in the Artist treated plots were critical. However, no damage was observed in the oak seedlings after the use of 1kg/ha of Artist on them in either 2015 or 2016.

Fig. 6: Atypical branched oaks after the use of 4L/ha Malibu

No damage to the subject plants was otherwise observed in this trial.

3.2 Efficacy

Autumn sowing

No weeds were present in the trial areas for autumn sowing (*Quercus, Castanaea*) at the start of the trial. The weeds which developed were primarily chickweed, shepherd's purse and annual meadow grass with a diameter of 2-5cm. The degree of coverage of weeds was less than 1%. However, these weeds were critical in terms of the degree of coverage from them over the course of the trial. A very good contact effect of more than 95% against the dicotyledonous weeds (shepherd's purse and chickweed) compared to the untreated control was obtained by the herbicides Artist, Betanal MaxxPro, Bandur, Boxer and Fresco. The herbicides Artist, Boxer, Malibu and Spectrum worked against the annual meadow grass.

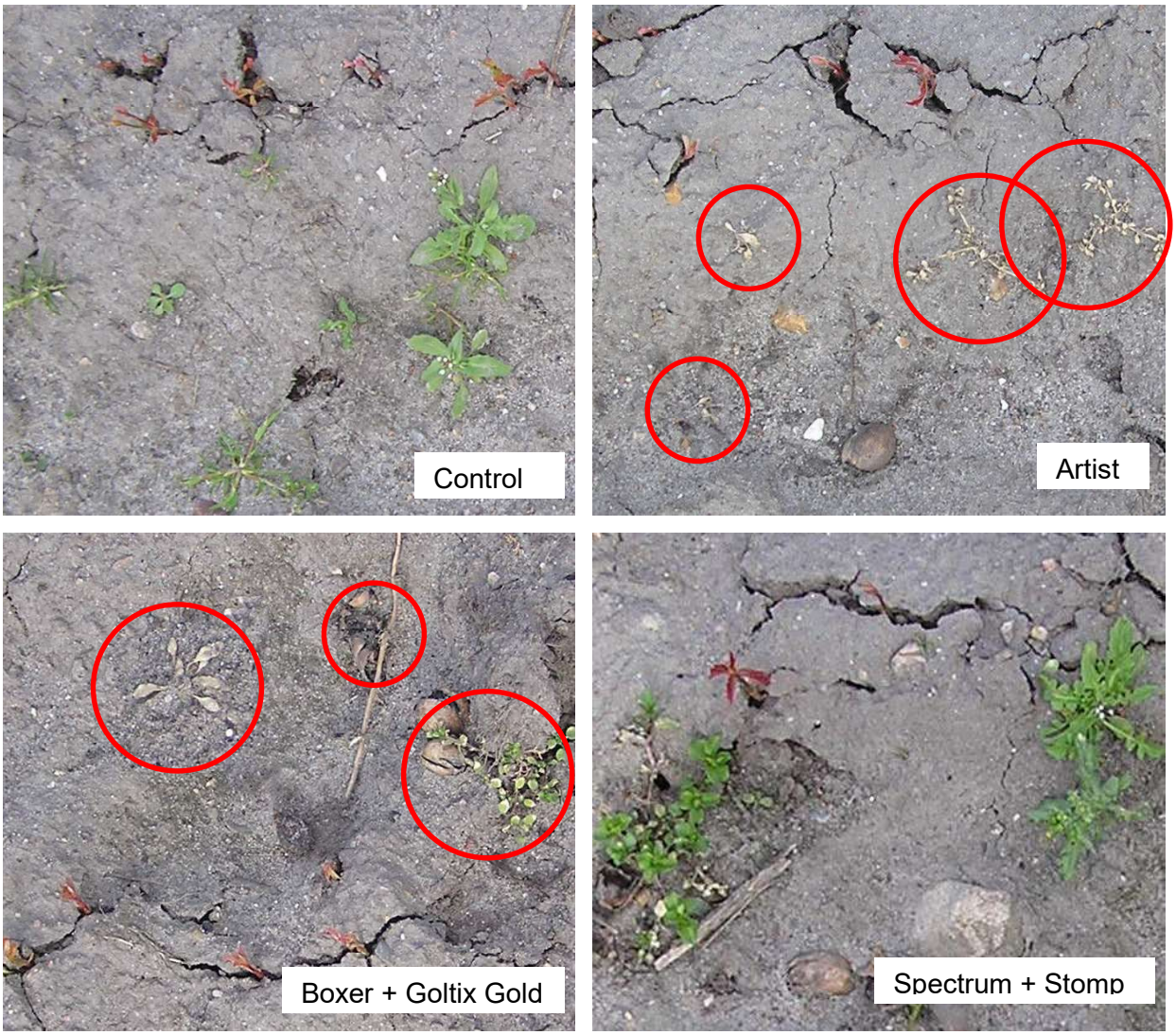


Fig. 7-10: Autumn sowing: sections of the trial plots on 22/04/2015 approximately four weeks after the start of the trial. The different contact effects of the residual herbicides can be seen

If the herbicides or herbicide combinations had a contact effect on the weeds that were present, the degree of coverage up to ten weeks after treatment was low. If the contact effect was weak, small weeds continued to develop and soon took up a great deal of space.

Fig. 11-12: Autumn sowing: trial plots of land on 26/05/2016, ten weeks after the start of the trial. Plots of land treated with the herbicide Artist showed the lowest average degree of coverage with weeds. The herbicide combination Spectrum + Stomp Aqua did not control chickweed seedlings at the time application.

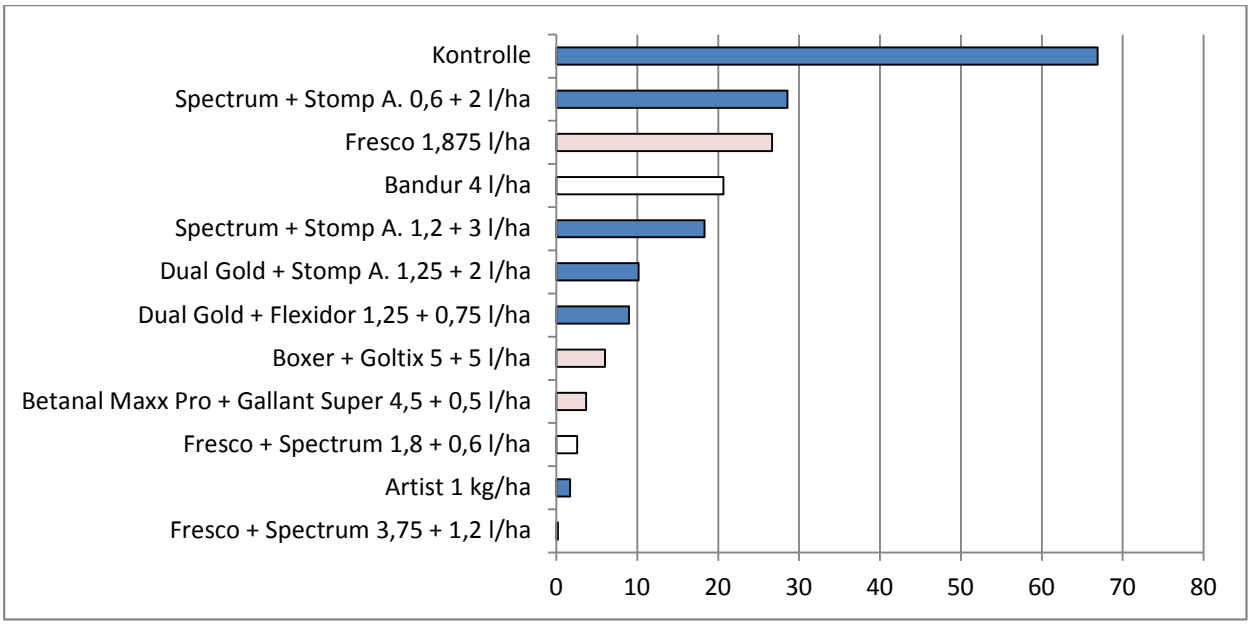


Fig. 13: Percentage average weed coverage on seed beds sown in autumn, approximately ten weeks after the start of the trial (mean value from two years in three locations with three replications), blue bar = results from the years 2015 and 2016; pink bar = results from the year 2015; white bar = results from the year 2016

Spring sowing

Treatment with herbicides occurred on all locations just a few days after sowing. At the start of the trial there were therefore barely any weeds that had germinated. It was the residual effect of the products that was significant for the effect on the weeds in the beds sown in spring.

Rapid-growing summer weeds quickly germinated in the freshly-prepared soil on the beds sown in spring.

Dirtweed (fat hen) dominated in both trial locations in 2015. It made up around half of the weed coverage.

In 2016, black nightshade and species of knotweed occurred in the trial locations in addition to dirtweed. Barnyard grass, chamomile and common groundsel also germinated.

Overall, the lowest levels of weed coverage over the course of the trial on the seed beds sown in spring were achieved by treatments that had a good residual effect against a variety of summer weeds. This included the herbicide combination Fresco + Spectrum, the full application quantity of which was often not tolerated. The herbicide combination Spectrum + Stomp Aqua (1.2 + 3L/ha) also produced good results. A reduction in the application quantity decreased the effect. Plots that were treated with reduced application quantity, however, were still among the best products trialled in terms of their residual effect in the soil.

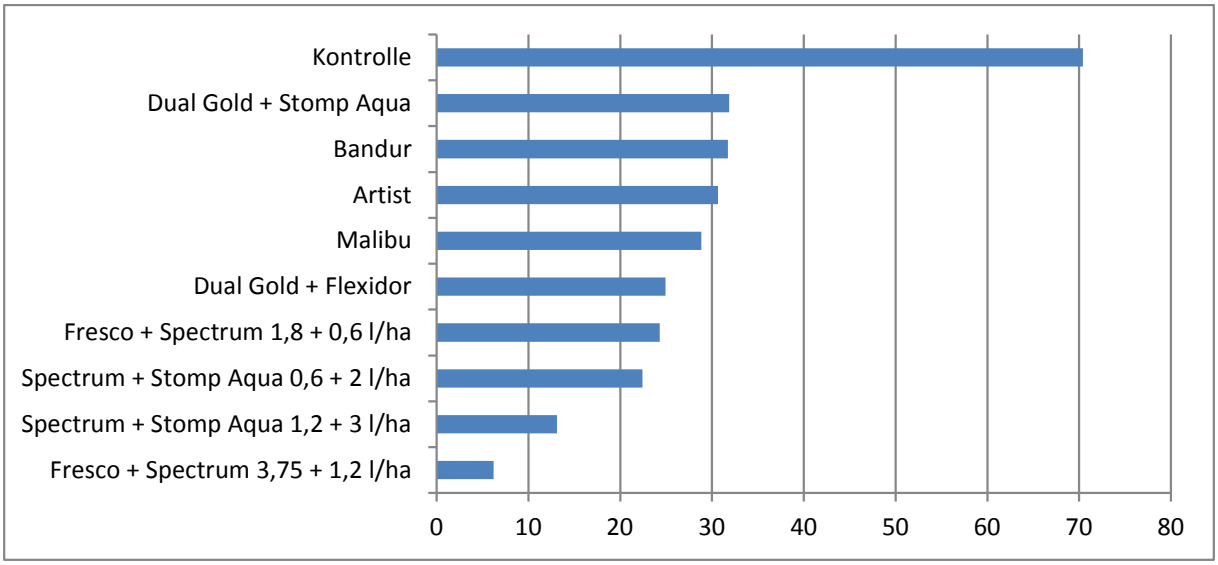


Fig. 14: Percentage average weed coverage on seed beds sown in spring 6-9 weeks after treatment (2016 test, mean values from four locations with 2-3 replicates)

In addition to the overall effect, which was determined on the basis of the degree of coverage with weeds, the effect on the individual weeds was also identified in 2016. Figure 15 shows which herbicides or herbicide combinations were effective against which weeds.

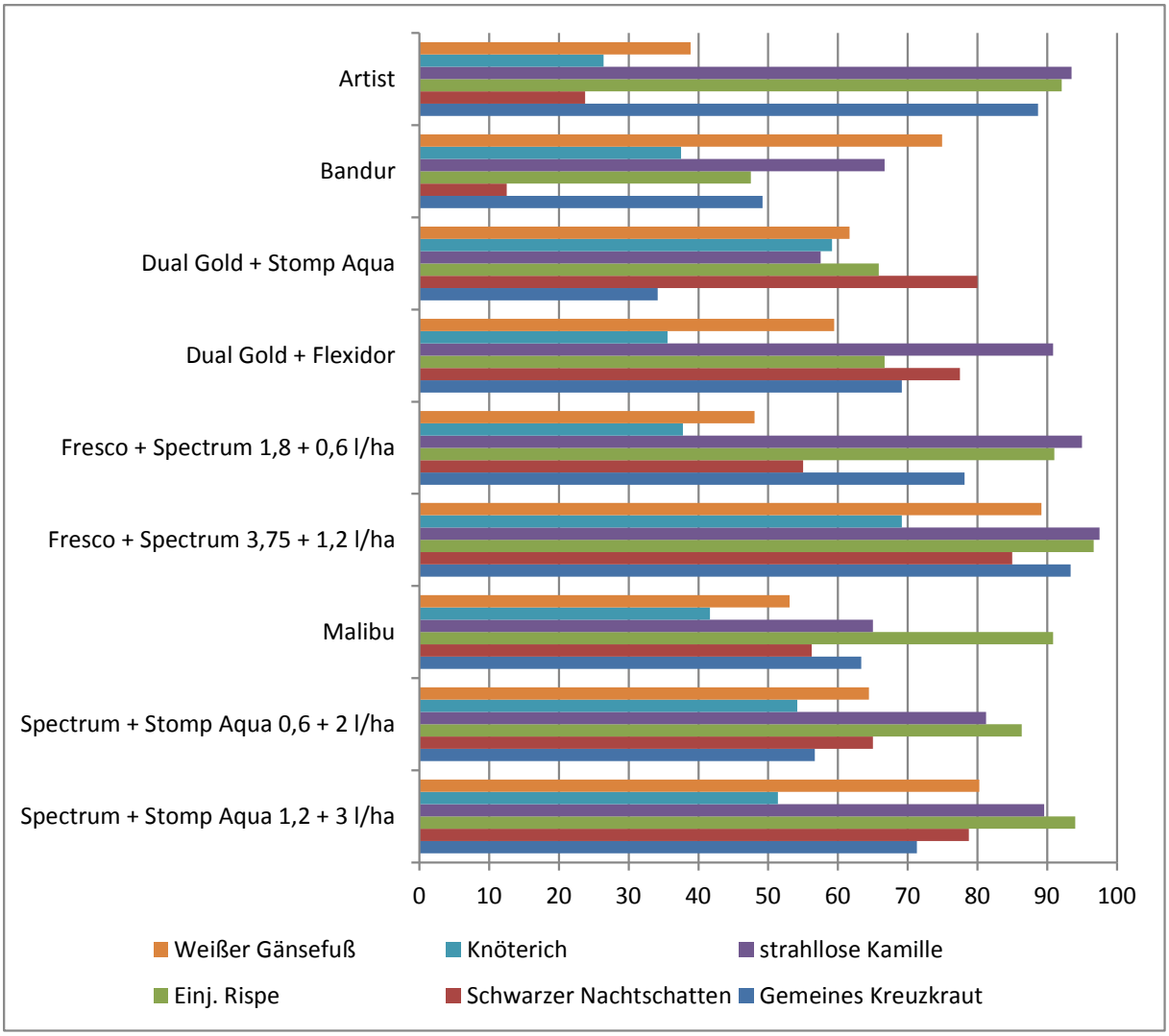


Fig. 15: Effect of the residual herbicides in terms of percentage weed germination by species in spring (mean values of 2-3 locations with 2-3 replications depending on the species of weed). Fat hen, knotweed, rayless camomile, barnyard grass, black nightshade, groundsel

Fig. 16-17: Beds of *Prunus spinosa* planted in spring approximately six weeks after treatment. The different effect of the residual herbicides on dirtweed can be seen.

4. Summary

Trials on seed beds sown in autumn and spring were carried out over a period of two years to test the efficacy and tolerance of pre-emergence residual herbicides on soil-covered seed beds. Beds of oak and chestnuts planted in autumn and beds of oak, beech, sycamore, sloe and myrobalan planted in spring were treated with various herbicides and herbicide combinations before germination.

The herbicides Bandur (4L/ha) and Fresco + Spectrum (3.75L/ha + 1.2L/ha) caused the greatest problems in terms of phytotoxicity. Oak seedlings were also sensitive to the herbicide Betanal Maxx Pro. The other treatments were tolerated in the crops examined.

An assessment of the trial demonstrated that the initial weed situation before treatment played a key role in the subsequent degree of weed coverage.

At the start of the trial, beds sown in autumn showed small weeds that germinated over winter such as chickweed, groundsel and annual meadow grass were problematic. In the trial, the herbicides with a good contact effect such as Artist or Fresco + Spectrum (including at half the application quantity, which was tolerated) had the best effect on the degree of weed coverage. In practice, a contact component (e.g. 1L/ha glyphosate) are often added to the soil herbicides to remove the weeds that are initially present.

In the case of freshly sown, weed-free seed beds sown in spring, it was primarily rapidly-growing weeds such as chickweed, black nightshade or species of knotweed that grew. The herbicide combination Spectrum + Stomp Aqua (0.6L/ha + 2L/ha) tested over a period of two years in oak and beech beds proved to be both tolerated and effective. This herbicide combination was also able to be used successfully in *Acer pseudoplatanus*, *Prunus myrobalana* and *Prunus spinosa*.

The herbicide Protugan (active substance isoproturon) has lost its authorisation. In addition to the herbicide combination Spectrum + Stomp Aqua (0.6L/ha + 2L/ha), Flexidor + Stomp Aqua (0.5L/ha + 2.5L/ha) can also be used.

Katana as a residual herbicide in larches and Douglas firs

Dr H. Lösing, B. Zielke

1. Trial objective

The aim was to investigate information from abroad that showed that the herbicide Katana was tolerated by larches before bud development. A further aim was to determine whether the herbicide Artist is also tolerated by larches. A trial was carried out on larches grown in nurseries.

Fig. 1: Area with various species of larch on the day of treatment. The plants had already broken dormancy

2. Trial design

The trial was carried out on nursery beds of *Larix decidua* and *Larix kaempferi*, and each trial was replicated twice. The residual herbicide was applied using a plot spraying device on 31 March 2016 when the larches started to bud. The European larch already had bundles of green needles in the lower part of the plants.

The weather was cloudy, it was 12°C and there was a wind speed of 0-2 m/sec.

Observations of plant tolerance were carried out until mid-July.

Overview 1: Treatments

Preparation	Rate	Active substance	Authorisation	Notes
Untreated	-	-	-	-
Artist	2kg/ha	240g/kg Flufenacet + 175 g/kg metribuzin	Section 22 (2)	N, Xn, B4
Katana	50g/ha	250g/kg Flazasulfuron	Article 51 coniferous wood	N, B4
Katana	100g/ha	250g/kg Flazasulfuron	Article 51 coniferous wood	N, B4
Terano	0.8kg/ha	600g/kg Flufenacet + 25g/kg metosulam	-	-

3. Results

The first observation was carried out approximately two weeks after treatment on 12 April 2016. At this point, the needles of the side shoots had developed in both species of larch. The European larches were generally more developed.

Fig. 2: Minor burns caused by the herbicide Artist to needles that had already developed in the lower area of the plants at the point at which the treatment was applied.

These minor burns were visible on some needles that were already visibly green at the point at which the treatment was applied. The pattern of damage was less evidence in Japanese larches as they had developed to a lesser degree at the point at which the treatment was applied.

Fig. 3-4: Test plots on 12 April 2016. No differences between the untreated *Larix decidua* and that treated with 100 g/ha Katana.

In terms of the stage of development of the plants, there were no differences between control plots and those treated with herbicides.

Individual sticky needles were observed on plants in plots treated with the herbicides Terano or Artist like those that had been observed on spruce trees after the use of the herbicide Terano. The previous year, damage of this type occurred to a massive extent on a nursery that used the herbicide Terano at the point of bud development.

Fig. 5-6: Individual areas of damage to European larches following the use of the herbicides Artist or Terano

There was no further damage other than the needle burns caused by the product Artist and the needle adhesion caused by the products Artist and Terano, which both contain flufenacet. There were no differences in terms of either the stage of development or the size of the untreated plants in July.

4. Summary

A trial was carried out on a nursery to investigate tolerance of the soil herbicides Katana and Artist on the genus *Larix* before bud development. The European larches that were more developed at the start of the trial experienced minor needle burns and needle adhesions that were ‘typical of Terano’. Neither of these, however, impaired the growth or the vitality of the plants. The herbicide Katana was applied at rates of 50g/ha and 100g/ha before bud development. This was tolerated by the European and Japanese larches until the end of the trial in July.

Herbicide tolerance of perennials and ornamental grasses grown in 9 cm pots
(B. Zielke, Dr H. Lösing)

1. Trial objective

A number of nurseries also grow herbaceous plants in addition to woody crops. Perennials and ornamental grasses are grown in containers for garden centres or as groundcover in 9cm pots for horticultural and landscaping purposes. Weed pressure can be minimised by using clean pots and substrate and keeping production areas weed free. The duration of growth is comparatively short, and the risk of a weed infestation decreases as soon as the crop begins to cover the surface of the pot. Until this point, the development of rapidly-germinating willow or poplar seeds can be expected, depending on the season.

The trial aimed to show whether treatment with Flexidor was tolerated in a range of perennials and could therefore be used as a preventative measure against air borne weed seeds. An additional treatment, the product Dual Gold, was also tested for plant tolerance on the genera *Geranium* and *Waldsteinia*.

Fig. 1: Perennials around a week after potting, at herbicide application

2. Trial design

The trial commenced on 7 July 2016 on eleven species of perennials and grasses. The trial plants were monocotyledonous and dicotyledonous, perennial, herbaceous plants that had been potted from plug trays into 9cm pots just under a week previously. The herbicides Flexidor (quantity applied 0.5L/ha or 1L/ha) and Dual Gold (quantity applied 1.25L/ha) were applied using a parallel spraying device equipped with a Lechler injector nozzle 120-025 purple and a water volume of 512L/ha.

The weather was cloudy but dry when the treatment was carried out, and the temperature was 18°C. It did not rain. Assessments were carried out ten days and three weeks after the treatment and on 25 August 2016. The following table lists the trial plants.

Table 1: Trial plants

Perennials	Ornamental grasses
Alchemilla mollis *Epimedium* ‘Frohnleiten‘ *Geranium* ‘Ingwersen‘ *Geranium* ‘Spessart‘ *Waldsteinia ternata*	*Carex* ’Irish Green’ *Carex* ‘Icedance’ *Carex* ‘Variegata’ *Luzula* ‘Nivea’ *Luzula sylvatica* *Miscanthus* ‘Gracillimus’

3. Results

No differences between the treated and untreated grasses were observed either ten days nor three weeks after the treatment.

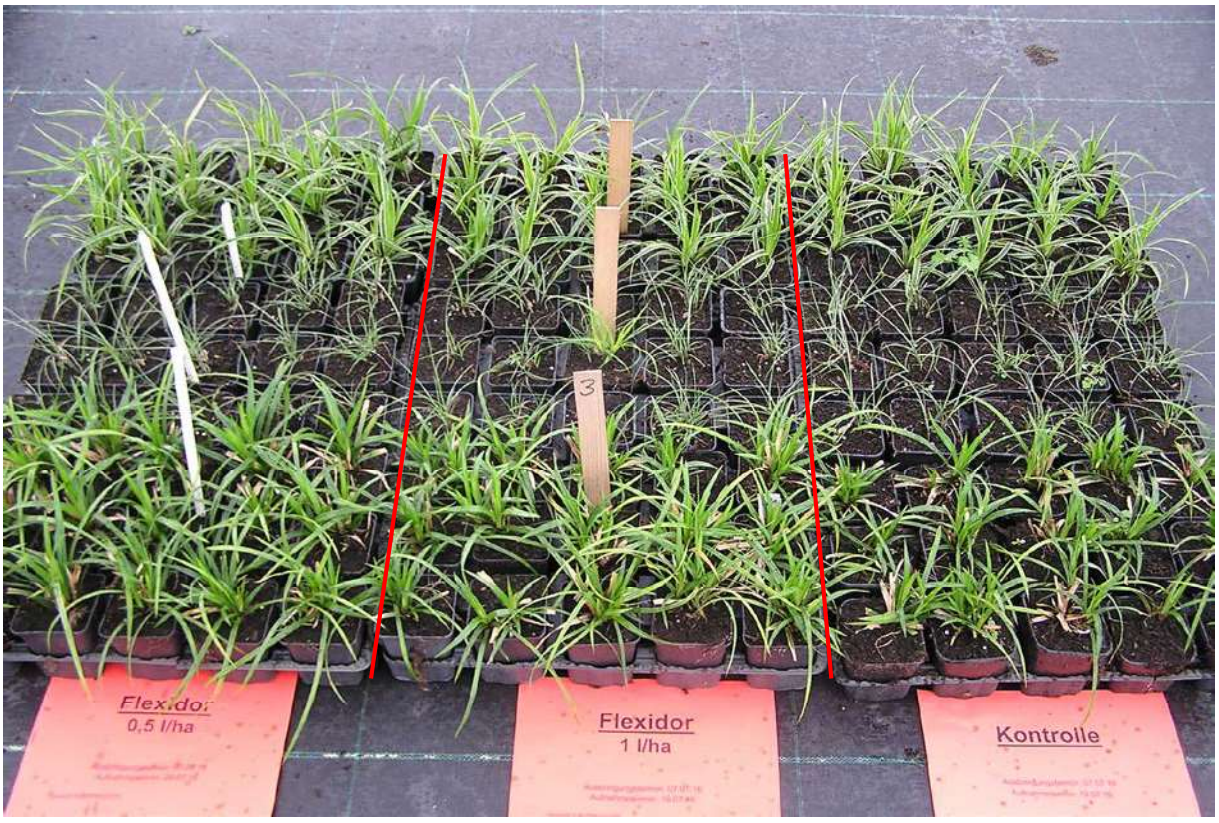


Fig. 2: Ornamental grasses three weeks after the start of the trial.

Even the dicotyledonous plants that were trialled developed quickly, with no differences between the treatments. The majority of the plants had covered the surface of the pot by three weeks after treatment.

Fig. 3: *Waldsteinia* and *Geranium* three weeks after the start of the test

The plants had developed good roots and were ready for sale at the final assessment on 25 August 2016. The exceptions that showed slower development were *Epimedium* 'Frohnleiten' and *Miscanthus* 'Gracillimus'.
No differences were identified between the treated and untreated plants in any case.

4. Summary

In a trial to check herbicide tolerance, ground-covering perennials and ornamental grasses were treated with the herbicide Flexidor (0.5L/ha or 1L/ha) approximately one week after potting. No damage occurred to any of the genera trialled.

Distance requirements when using plant protection products
(B. Zielke, Dr H. Lösing)

1. Introduction

There are a series of requirements that must be complied with when using plant protection products in order to protect surface waters, the ground water and the ecosystem. These could be general distance requirements, slope requirements, drainage requirements or restrictions on use based on season or soil type.

The risks of plant protection products getting into bodies of water and the ground water vary depending on the plant protection product and the quantity applied and the behaviour of the active substance in the environment, but also on the crop that is treated and the application technique.

2. Protection of bodies of water (NW and NG requirements)

The most common route by which plant protection products penetrate bodies of water is drainage from the nursery when filling and cleaning sprayers, runoff in the event of heavy rain or from treated surfaces with slopes or penetration via the drainage system or seepage and leaching.

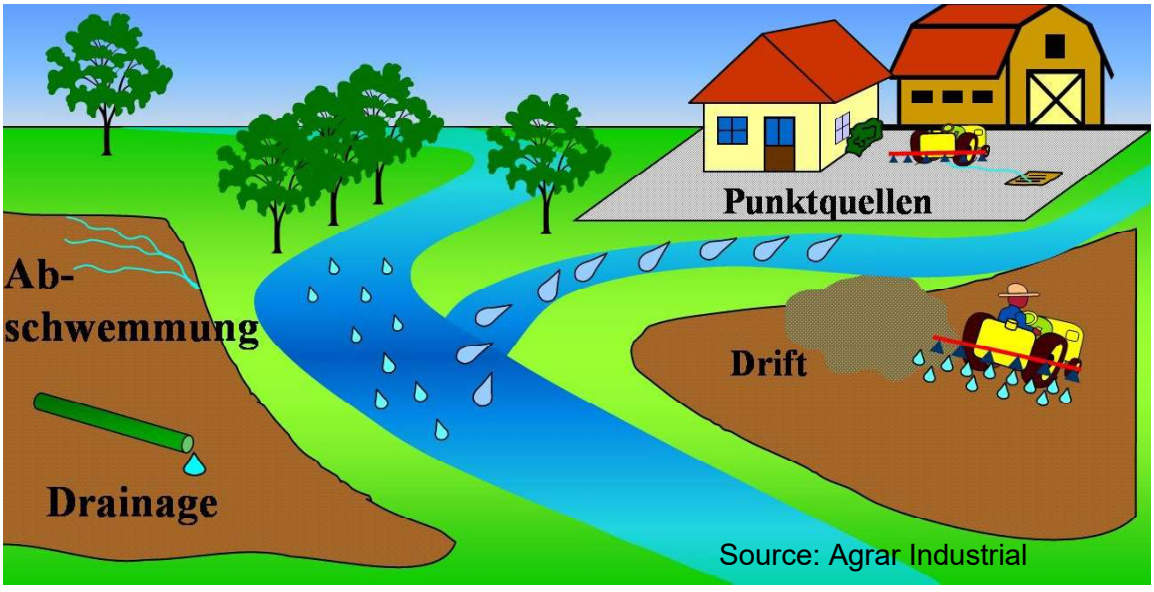
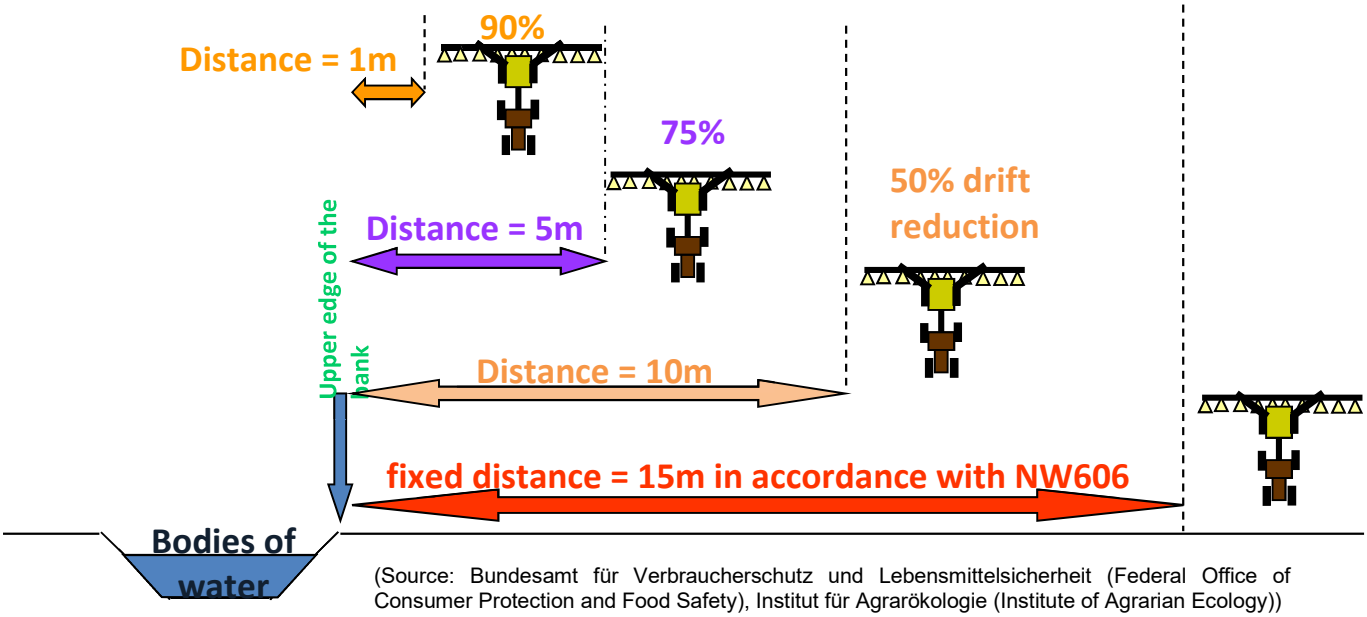


Fig. 1: Penetration of plant protection products into bodies of water should be prevented!

A new minimum distance for application away from bodies of water has been applicable in Schleswig Holstein since 1 November 2013. In accordance with the Federal Water Act, the use of plant protection products is prohibited on an edge strip surrounding bodies of water with a width of 1m measured from the upper edge of the bank. These minimum distances also apply in other federal states such as Lower Saxony or North Rhine-Westphalia. Further distance

requirements from bodies of water should also be complied with for various plant protection products, depending on the use of drift-reducing nozzles.

Requirements NW 605, 606 and 607 set out minimum distances from bodies of water regardless of the use of drift-reducing technology. The distances in metres to be complied with can be found in the relevant instructions for use. Infringements of this may be prosecuted with a fine of up to 50,000 euros.



(Source: Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (Federal Office of Consumer Protection and Food Safety), Institut für Agrarökologie (Institute of Agrarian Ecology))

Fig. 2: Example of an application regulation. If drift-reducing technology is used, the minimum distance from bodies of water to be complied with decreases

If there are slope requirements (NW 701, 705 and 706 and NG 402, 404 and 409), the corresponding plant protection products may only be used on areas with an incline of more than 2% if there is an overgrown edge strip between the area treated and any bodies of water. The width of this strip must be between 5 and 20m.

3. Protection of hedgerows (NT requirements)

A predefined distance of 3m must sometimes be maintained in the event of field copses and hedgerows. This applies in municipalities that do not have a high enough percentage of hedgerows. In the county of Pinneberg, the percentage is too low in the municipalities of Haselau, Moorrege, Neuendeich, Raa-Besenbek and Seester. Requirements NT101 to NT106 must be complied with in these municipalities. These requirements set out distances of between 5 and 20m from hedgerows depending on the use of drift-reducing technology. Requirements NT107 to NT 109 also set out minimum distances from hedgerows and apply in all municipalities.

You can find the most important requirements in our ‘yellow list’ of plant protection products for Integrated Nursery Production.

Nitrogen contents in nursery soils – guideline values in accordance with the Fertiliser Regulations, Section 3 for 2016

(Sebastian Heise)

The amended Fertiliser Regulations will probably be passed by the Bundesrat on 31 March 2017. It is expected to include simplifications for nurseries in terms of the determination of fertiliser requirement and the recording obligations.
For the time being, however, the specifications of the Regulations as at 24 February 2012 continue to apply. According to this, before applying fertiliser at levels of more than 50kg/ha nitrogen (total-N) and more than 30kg/ha phosphate (P_2O_5) per year, the quantity of nutrients available to plants in the soil must be determined.
For nitrogen, the quantity of nitrogen available in the soil should be determined once a year; for phosphate one soil analysis per area is required at least once every six years.
However, the determination of the available quantity of nitrogen does not necessarily have to be in the form of a number of N_{min} tests on the area, but rather values from representative locations determined by the advisory ring can be used for the company's own areas.

In 2016, a further 40 nurseries divided into the main crop groups were examined to determine their N_{min} content in mid-February.
The results were provided to companies via newsletters and publications. The costs of these tests were borne by the Horticultural Department of the Schleswig-Holstein Chamber of Agriculture.

The results of the N_{min} tests listed in the table can be used as guideline values in accordance with the Fertiliser Regulations. If the companies have not carried out their own nitrogen tests of the areas, the values mentioned should be deducted from the intended nitrogen fertiliser quantity depending on the crop and soil type. This procedure is used to ensure that the crop is provided with the nitrogen quantity necessary for its needs and excessive quantities of nitrogen are not applied.

Furthermore, nursery companies in Schleswig-Holstein carried out N_{min} tests on a further 332 areas over the course of 2016.

N_{min} – guideline values 2016		
Crop	**Soil type**	NO_3-N +NH_4-N [kg/ha] (0 - 60cm soil depth)
Field-grown cuttings, rose rootstocks and fruit tree rootstocks	Clayey sands and sandy clays	**37**
Deciduous woody seedlings and transplant beds	Clayey sands and sandy clays	**14**
Coniferous woody seedlings and transplant beds	Clayey sands and sandy clays	**11**
Roses	Clayey sands and sandy clays	**13**
Shrubs, light feathers and hedge plants	Clayey sands and sandy clays	**19**
Standard and fruit-bearing trees	Clayey sands and sandy clays	**22**
Conifers	Clayey sands and sandy clays	**26**
Evergreen/deciduous trees	Clayey sands and sandy clays	**24**
Avenue trees	Clayey sands and sandy clays	**17**
Christmas tree crops	Clayey sands and sandy clays	**13**

This table is evidence of the knowledge of nitrogen contents in the soils for your crops. In the case of an inspection, it must be presented in line with the individual company's recording obligation if you have not carried out your own N_{min} tests on the areas.

Initial experience of fruit thinning with ATS (ammonium thiosulphate)
(Sebastian Heise)

1. Trial objective and design

Treatment with ATS is regularly provided in orchards to prevent alternation in fruiting years and to thin out the fruit. ATS is a leaf fertiliser containing nitrogen that is authorised in accordance with the Fertiliser Regulations.

A high fruit set, particularly in crab apples (*Malus* species), *Sorbus* and *Crataegus* can lead to branch breakage under extreme weather conditions and therefore increased wastage. In 2016 a trial was carried out on the reduction of fruit on *Sorbus aucuparia* `Edulis`. The aim was to obtain knowledge about the quantity of product that was needed and the efficacy of it.

The mode of action of ATS is described as follows in the literature:

- The high hygroscopic effect draws water from the stigma, leading to the drying out of the flower organs. The growth of pollen tubes is inhibited. This results in a lack of flowering. (Source: Mechanisms of action of ATS, J. Vigl, Laimburg Test Centre 2009)
- The application of ATS to open flowers burns the stigma and other areas. This means fertilisation can no longer occur.

Avenue trees of the *Sorbus aucuparia* `Edulis` with a trunk circumference of 14-16 to 18-20cm were used as trial plants in 50 or 65 litre containers. A total of 100 avenue trees were used for the trial, half of which had been treated with ATS. At the start of flowering, the selected trees had low flower/umbel formation per tree. Pure ammonium thiosulfate ($(NH_4)_2S_2O_3$) – ATS crystals (98%) were used for the chemical thinning of the fruit. Table 1 shows the application dates and the weather conditions. The optimal temperature range for ATS application is from 15°C to 22°C. Higher temperatures lead to rapid drying of the spray and therefore to a decreased effect. Wet leaves or subsequent rain increases the risk of leaf burning.

Table 1: Application dates and weather conditions

Date	Time	Note
20/05/2016	08:00	40-50% of the flowers affected, average daily temperature 14°C, light rain in the afternoon (0.1mm)
23/05/2016	14:00	75-90% of the flowers affected, average daily temperature 17°C, from 5pm light rain that became heavier overnight (15 mm)

The substance was applied using a type S 32 Wanner turboblower spray that was equipped with type ATR 80 blue nozzles by Albuz. A water quantity of 500L/ha and m Kh was used. The ATS was mixed to make a 3% concentration. Visual inspections were carried out at regular intervals.

2. Results

The flowers only showed minor burns on the stamens after the first treatment (20/05/2016) (Fig. 1). The stigma and the sepals had minimal burning in some cases. There was no damage to the leaves. Increased browning of the flowers was identified five days after the second treatment (23/05/2016) (Fig. 2).

Figure 1: Minor burns to the stamens of the flowers on 23/05/2016

Fig. 2: The flowers five days after the second treatment (27/05/2016)

No differences between the treated and untreated *Sorbus* were able to be identified during a further inspection on 20/06/2016. Figure 3 shows fruit production in the treated plots. Fruit formation can clearly be seen. The fruit was fully developed in both treatments by 20/08/2018. The quantity of product used did not lead to sufficient damage to the flower organs.

Fig. 3: Fruit formation in the treated plot on 20/06/2016

Fig. 4: Fully developed fruits on 20/08/2016

3. Summary

The first trial of fruit thinning in 2016 showed that the quantity of product used (3% ATS) did not cause sufficient damage to the flower organs of *Sorbus aucuparia* `Edulis`. Any burning symptoms to the leaves was slight and the trees grew away from the symptoms. The trial trees had low levels of flower formation and numbers of umbels at the time of application. Sufficient flowers must be open on application of the ATS, and the weather conditions must be good. The weather in May 2016, the point at which flowering occurred, was not an ideal condition for treatment. In some cases it is necessary to weigh up the number of open flowers with the local weather conditions. Further tests with ATS for fruit thinning are planned.

Attempts to remedy tip dieback in field-grown privet

(Sebastian Heise)

1. Introduction and trial objective

As far back as 2015, trials were carried out to remedy of tip dieback in field-grown *Ligustrum vulgare* `Atrovirens` (VuB Annual Report for 2015 pages 50-57). Tip dieback symptoms are described in the Annual Report as follows:

- light twisting of the newest leaves at the tips
- claret to violet discolouration starting with the leaves towards the shoot tip
- leaves abscise and fall off
- dieback of the buds around the tip

Figure 1: Twisting of the newest leaves

Figure 2: Violet discolouration of the leaves

Figure 3: Start of shoot tip dieback

Symptoms can often be seen from the second half of the year, often after dry periods. It is mostly older plants such as plants or shrubs that have been transplanted twice that are affected.

It is suspected that this is caused by copper or boron deficiency. Focus is therefore placed on fertiliser products that contain boron. The aim of the trial set out below was to clarify the precise cause of tip dieback.

2.1 Trial design at nurseries 1 and 2

Two areas planted with *Ligustrum vulgare* `Atrovirens` were selected as the trial locations. The transplanted shrubs had been there for two or three years. The lengths of the plots of land in

the test were 8m and 10m. The trials were each replicated three or four times. The soil fertilisers were applied on 06/04/2016 and 18/04/2016. The granulated fertilisers were distributed broadly across the plots of land and not worked in. The foliar fertilisers were applied using a plot spraying device on four different dates: Nursery 1: 16 June, 1 July, 19 July and 2 August, Nursery 2: 15 June, 7 July, 19 July and 2 August. The plot spraying device was equipped with Lechler injections nozzles IDN 120-025 purple. The leaf fertilisers were applied with a water volume of 512L/ha. The fertilisers used are shown in Table 1.

Table 1: Treatment summary

Nursery 1 or 2	Fertiliser products	Quantity used	Nutrient quantity		
			Copper	Boron	Calcium
1 / 2	Excello-Kupfer spezial (5.0% Cu)	100kg/ha	5.0kg/ha	---	---
1 / 2	Excello-331 spezial (1% B, 0.2% Cu)	200kg/ha	0.4kg/ha	2.0kg/ha	---
1	Mivena Hort-Mix (0.6% B, 0.6% Cu)	334kg/ha	2.0kg/ha	2.0kg/ha	---
1 / 2	Haifa Coated Bor 12M (12% boron)	50/100kg/ha	---	6.0/12kg/ha	---
1 /2	Folicin-Bor plus fluid (140 g/l B)	4 x 1.5L/ha	---	0.84kg/ha	---
1 /2	Folicin-Cu fluid (117 g/l Cu)	4 x 2.0L/ha	0.94kg/ha	---	---
1	Folicin-Bor plus fluid (140 g/l B) + Folicin-Cu (117 g/l Cu) fluid	4 x 1.5L/ha 4 x 2.0L/ha	0.94kg/ha	0.84kg/ha	---
1 /2	Wuxal Boron (96 g/l B)	4 x 2.0L/ha	---	0.77kg/ha	---
1 /2	Stefes Bor (150 g/l B)	4 x 1.5L/ha	---	0.90kg/ha	---
1	Stefes Bor Quantum (boron content unknown)	4 x 0.1L/ha	---	? kg/ha	---
2	Solubor DF (17.5% boron)	4 x 1.5kg/ha	---	1.31kg/ha	---
2	Calcium chelate (14% Ca)	4 x 2.5kg/ha	---	---	1.4kg/ha
1 /2	Control	---	---	---	---

2.2 Results from nurseries 1 and 2

The start of tip dieback was identified in the trial area at nursery 2 in late September, and this continued to develop over the course of the season. The initial damage was recorded using A grading system. Grades 0-3 equated to no damage symptoms or light or moderate twisting or

discolouration of the leaves. Moderately pronounced, discoloured and/or twisted leaves were rated as 4-6 and the severe damage as 7-9. The assessments were carried out on the following dates: 6 September, 26 September, 19 October and 2 November. The results of the assessments on 2 November 2016 are shown in Figure 4.

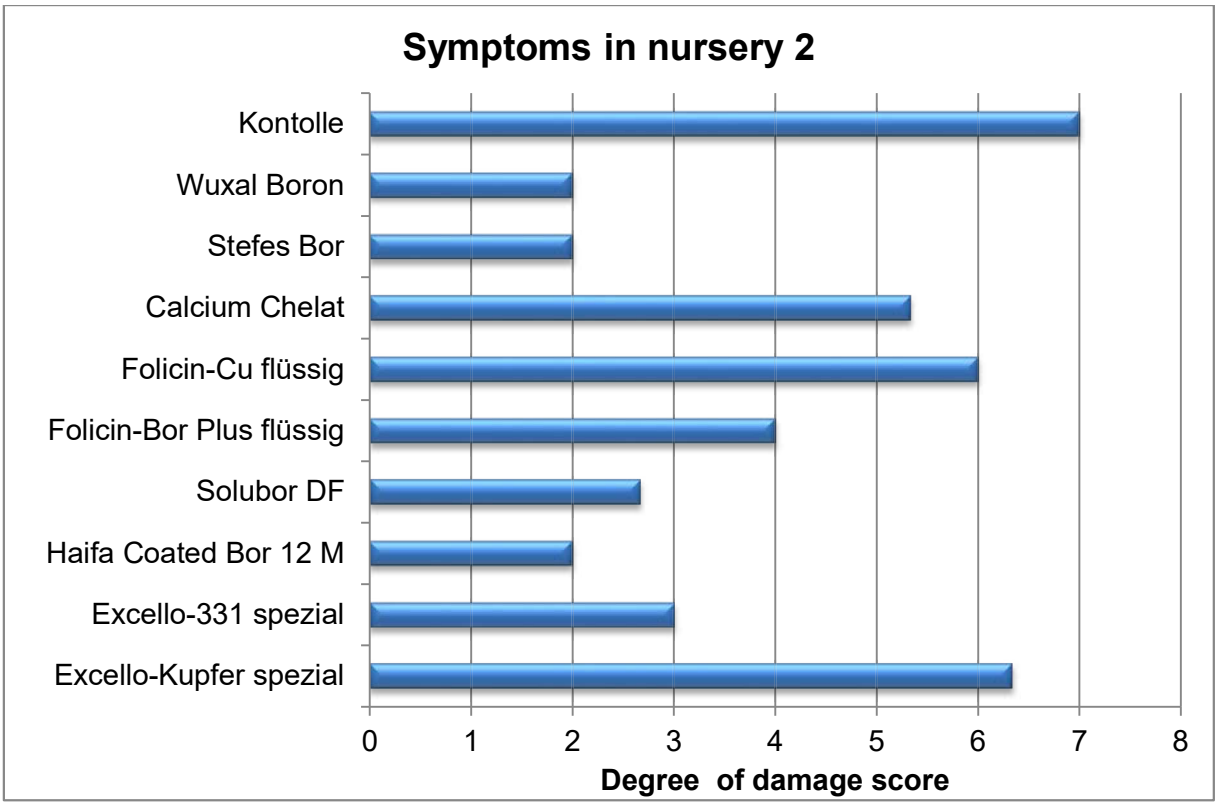


Figure 4: Extent of the damage symptoms on nursery 2 on 2 November 2016.

The untreated control showed the worst symptoms of tip dieback. The fertilisers containing copper had a small effect. It did not make a difference whether these were scattered on the ground (Excello-Kupfer spezial) or applied to the leaves (Folicin-Cu fluid). The calcium chelate also only achieved a slight effect. All fertilisers containing boron had an effect. A reduction in the symptoms of damage was achieved with Folicin-Bor Plus fluid, Excello-331 spezial and Solubor DF. Higher quantities of the boron fertilisers from Haifa were applied than those specified, with the 50kg/ha used in 2015 being increased to 100kg/ha. The increase in the quantity used resulted in a good effect against the damage symptoms. The fertilisers Stefes Bor and Wuxal Boron also achieved a good effect. No symptoms occurred at nursery 1, so it was not possible to evaluate the other trial products.

Fig. 5: Untreated control with early stages of tip dieback

Fig. 6: None to slight damage symptoms in the plots treated with fertiliser containing boron (e.g. Excello 331)

Fig. 7: Early symptoms of damage in the plots treated with fertilisers containing copper (Example: Folicin-Cu fluid)

Fig. 8: Hardly any effect identifiable in the plots treated with calcium chelate

3.1 Trial objective and design at nursery 3

The effect of various foliar fertilisers containing boron was also trialled in plants that had already experienced damage. The trial was carried out on cuttings of *Ligustrum vulgare* `Atrovirens` that had been rooted for two years. The aim was to obtain knowledge about efficacy and plant tolerance. The trial was replicated six times. The plot length was 6m. The fertilisers were applied on three dates. The first treatment took place on 21 September. The second and third treatments were carried out at intervals of 14 days in each case. Table 2 shows the fertilisers that were applied to the plants using a backpack sprayer with a flat spray nozzle and a mixture quantity of 500 l/ha.

Table 2: Treatment summary

Product	Fertiliser products	Quantity of fertiliser applied	Nutrient content
1	Folicin-Bor Plus fluid	3 x 2.0L/ha	140g/l
2	Wuxal Boron	3 x 2.0L/ha	96g/l
3	Profi Bor 150	3 x 2.0L/ha	150g/l
4	Control	---	---

Figure 9 shows that the crops had different levels of tip dieback on 14 October.

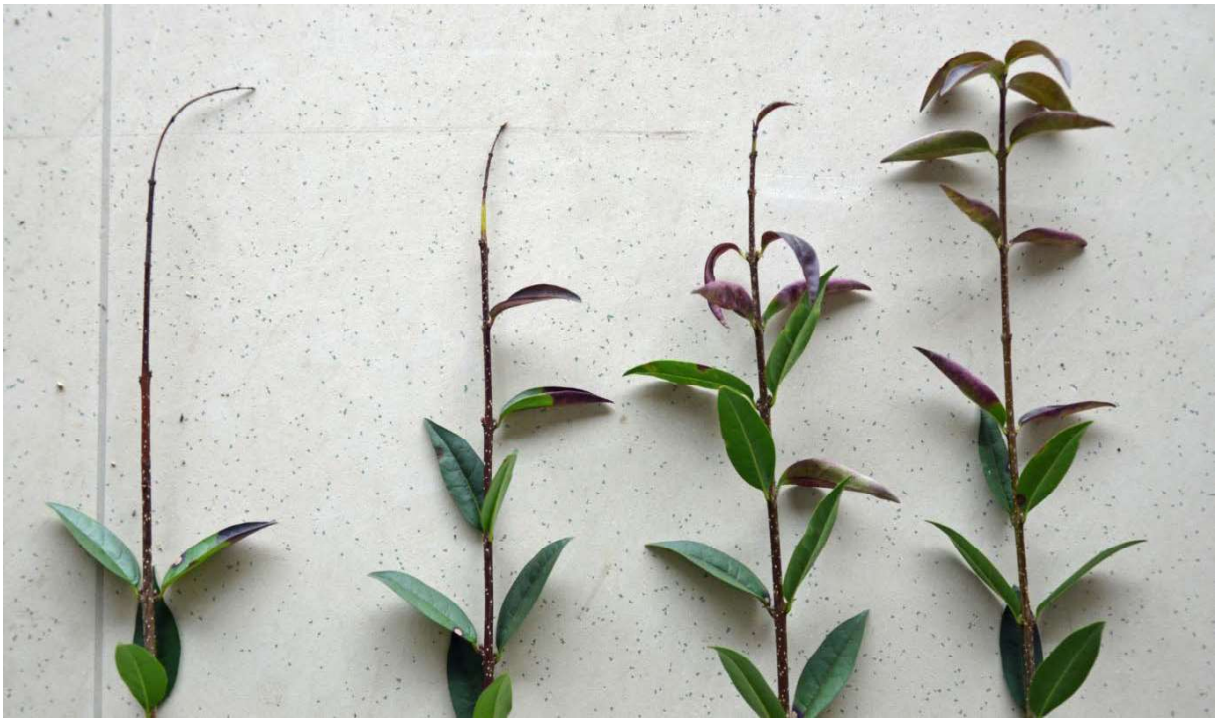


Figure 9: Various stages of tip dieback on 14/10/2016 in the same crop

3.2 Results from nursery 3

Tolerance: The plants tolerated the various trial products at the quantities applied with no identifiable damage. No negative impacts were identified even after three applications.

Efficacy: The damage was too advanced, so no differences were able to be identified between the treatments and the control on the four assessment dates.

3.3 Leaf and soil analysis

Leaf and soil analyses were carried out on the privet crops at nursery 3. The trial area had received only a low level of care in several areas. This was reflected in the leaves in some cases. The results of the leaf and soil analysis did not permit any more precise conclusions to be drawn regarding certain element deficiencies.

4. Summary

Research into the cause of tip dieback in field-grown crops was continued into 2016. Two trials were carried out with soil application and foliar feed fertiliser, with a focus on boron. Fertilisers containing copper were also tested, along with a calcium treatment.

In late September, a damage symptoms in the form of tip dieback occurred in a trial location, and this worsened in the subsequent weeks. The extent of the symptoms in the plots treated with fertilisers containing boron was lower regardless of whether these fertilisers were soil applied or applied to the leaf. Symptoms in the plots treated with fertilisers containing copper were similar to the untreated control. Treatment with calcium did not show a significant effect either.

The trial looked at the efficacy and tolerance of various foliar feed fertilisers containing boron. The foliar fertilisers containing boron were all tolerated by the plants. No negative effects were identified even after three applications. The efficacy could not be determined as the symptoms of damage were too pronounced. A leaf and soil analysis was not able to provide any further information.

Suitability of various rapid testing processes to determine the nutrient content of tree crop saps

(Marie-Luise Schachtschneider, Prof. Diemo Daum, Stephan Dinklage (Osnabrück University), Dr Heinrich Lösing, VuB)

1 Introduction

Leaf analysis is an established method for monitoring the nutritional status of commercial crops. Any environmental impacts that are relevant to nutrient uptake are taken into account here. In the classical approach, the nutritional element contents of the leaves are determined following the drying and pulping of the plant tissue using laboratory processes. Rapid tests in which the contents of plant saps can be determined with special test sticks and/or measuring devices directly in the field are potential alternatives to the relatively time-consuming and expensive laboratory analyses.

The aim of the trial set out below was to check the suitability of various rapid testing methods for the determination of nitrate, ammonium and potassium in the leaf plant sap of woody crops. The tests were carried out on one species of deciduous tree (*Carpinus betulus*) and one conifer (*Abies nordmanniana*).

2 Trial implementation

Nine rapid testing methods that are available to determine compounds containing nitrogen (nitrate, ammonium, chlorophyll) or potassium were included in the trial. Both nutritional elements have a particularly significant impact on the growth of woody crops in nurseries in the district of Pinneberg. The rapid testing methods trialled also varied in terms of the way in which they worked.

Fig. 1: LAQUAtwin nitrate electrode (figure on the left) and flat sensor of the LAQUAtwin nitrate electrode filled with sample fluid

The Horiba LAQUAtwin nitrate and potassium electrodes work with an ion-sensitive electrode. Test sticks for reflectometric and visual assessment were also used. The discolouration of the test sticks was based on a chemical reaction with the nutrient in question. The reflectometer RQflex®10 is suitable for identifying nitrate, ammonium and potassium in plant sap. Nitrachek also evaluates the nitrate sticks in a reflectometric manner. The Quantofix test sticks for ammonium and potassium, however, are interpreted visually by the user. In addition to analysing the fractions of nutrients, a non-destructive method was also used. The SPAD meter is based on an indirect measurement of the leaf chlorophyll content.

Fig. 2: The SPAD meter when measuring the crop

The suitability of the rapid testing methods for plant analysis was examined in a number of different ways. Firstly, the measurement accuracy of the testing method was determined using standard solutions. In order to do this, defined concentrations were placed in aqueous solutions. The saps obtained from the leaves or needles were then examined and the results compared with analytical reference methods (ion chromatography, flame photometry). The matrix flow of the plant saps was also determined using the standard addition method. The impact of the nutrients available in the soil on the nutrient content in the plant sap was investigated as part of a field fertiliser trial with hornbeams. Fertilised and non-fertilised plots were placed in a low-nutrient location in order to do this.

The leaves or needles were separated from the stems in order to obtain the sap. In the next step, the material was broken down using a mixer and squeezed through a garlic press. The process of sap extraction for the Nordmann fir is shown in Figure 3.

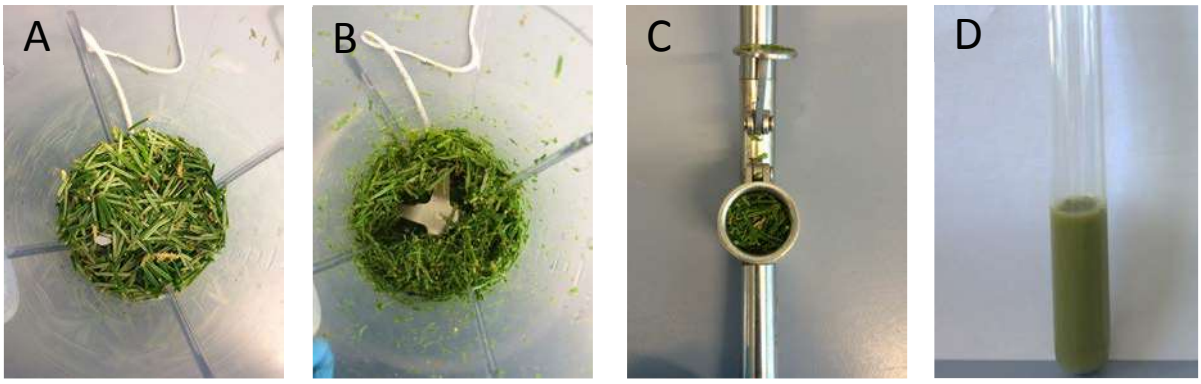


Fig. 3: Process of sap extraction from fir needles (A: needles before mixing; B: needles after mixing; C: sap extraction from the garlic press; D: pressed fir tree sap)

3 Results

The nitrate content in the sap of hornbeam leaves and newly-emerged fir leaves was able to be determined in a reproducible and precise manner using nitrate sticks in combination with a reflectometric evaluation (Nitrachek, RQflex®10 plus). The needles of the year old shoots (sample from early May), however, resulted in a significant underestimation of the nitrate content because of the matrix. Measurements with a nitrate electrode (NO_3^- LAQUAtwin) proved to be susceptible to inaccuracies, particularly with the conifers. This was probably caused by the high resin and other organic substance contents in the needle sap. The ion-selective electrode (K^+ LAQUAtwin) was equally good at determining the potassium content of deciduous and conifer leaves. The ammonium contents of the plant saps were consistently very low and were not able to be quantified sufficiently precisely with the test sticks, even when a reflectometer was used.

In the fertiliser trial, the various levels of fertiliser were clearly reflected in the plant growth. The plants in the unfertilised treatment demonstrated impaired external growth. A significant difference was able to be identified between the two fertiliser levels in terms of the nitrate concentration in the beech sap and the nitrogen content in the soil. At the start of the trial, a nitrate content per litre of sap was able to be identified in the plant sap of the fertilised plots that was twice as high as in the unfertilised plots. The nitrogen content continuously decreased as the duration of the trial continued. The nitrate concentration in the plant sap also steady reduced. The nitrate content in the hornbeam sap showed a close link to the nitrogen content in the rooting layer of the soil. The links were less pronounced between the nitrogen content in the dry mass (the conventional method used for plant analysis) and the nitrogen content in the soil solution. The plant sap analysis is obviously more suitable for evaluating the nitrogen supply.

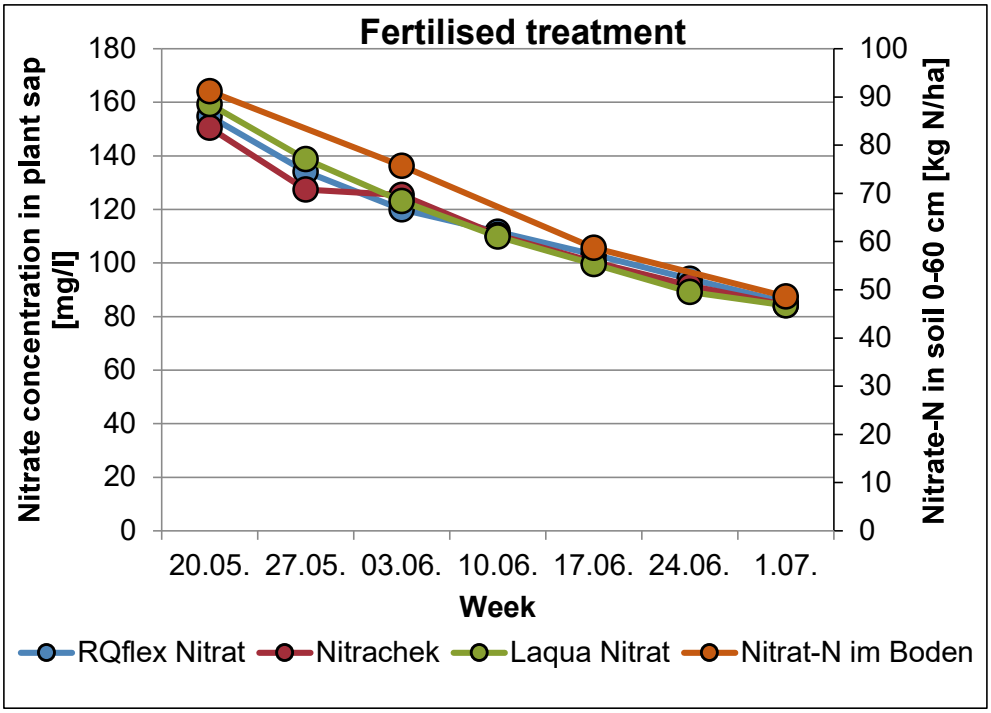


Fig 4: Progression of nitrate concentration in the beech sap and in the soil of the fertilised treatment

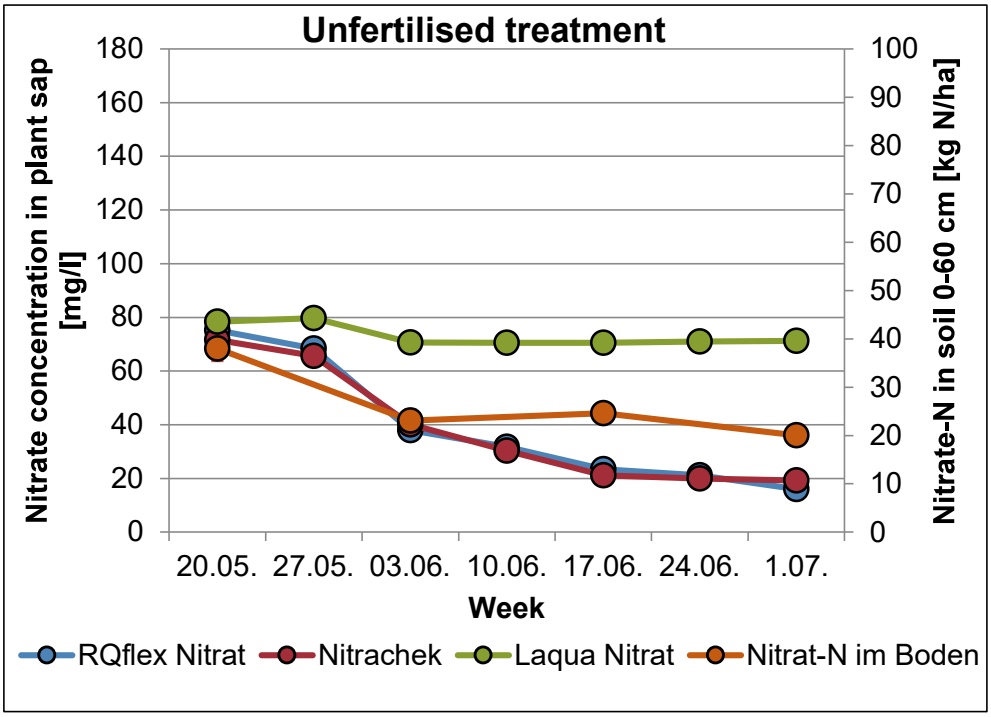


Fig 5: Progression of nitrate concentration in the beech sap and in the soil of the unfertilised treatment

The destruction-free method using the SPAD meter showed differences in terms of the levels of fertilisation, but barely reflected the change in nitrogen content over the course of the trial at all. A reliable statement on the nitrogen fertiliser requirement of the crop can therefore not be made using this method. The potassium content determined in the hornbeam sap was more

sensitive to the potassium in the soil than the potassium in the dry mass of leaves. Ammonium, however, did not show any reaction to the different levels of fertilisation over the course of the measurements. The concentrations of ammonium in the plant sap were also very low, so a determination of the ammonium was neglected. The plan is for reference values for sufficient nitrate and potassium contents in plant saps of selected nursery woody crops over the entire course of the season to be determined through further trials. Conifers were not taken into account in the measurements over the further progression because of the difficulties mentioned.

4 Summary

Four different methods were used to evaluate the rapid testing methods. Work done in the laboratory was primarily used to check the accuracy of the measurements taken using the rapid testing methods. Differences were able to be identified between the two species of tree. The Nordmann fir proved difficult because of the resins in the plant sap. The final part of the trial comprised a field fertiliser test to check the impact of different levels of soil fertilisation on the nutrient contents in the plant sap. Both the nitrate and the potassium concentration in the plant sap showed differences between the two levels of fertilisation. A close linear link was able to be identified between the concentration in the plant sap and the content in the soil. In contrast to this, no clear progression was able to be allocated to the ammonium concentration in the plant sap. The SPAD meter was also used for the indirect measurement of the chlorophyll content over the course of the field trial. Differences between the two levels of fertilisation were able to be identified, but there was no link between the measurement values obtained by the SPAD meter and the nitrogen content in the soil. It would therefore not be possible to evaluate the nitrogen supply to the crop using this method.

Note/acknowledgement: Thank you to H.-J. Ellerbrock nursery for the provision of the plants and production areas and VuB for bearing the laboratory costs. The work was carried out as part of an internship and will be continued in 2017.

Introduction and optimisation of a mobile, continuous process of soil disinfestation for field-grown crops - interim report as part of the EIP project

(Dr Heinrich Lösing, Theresa Hoyer, Marie-Louisa Schachtschneider, Christina Hilger, BTB Baumschultechnik und Beratung GmbH)

Part 1: Effects of temperature on plant growth and weed infestation

1 Introduction

For nurseries, soil disinfestation is essential to fight specific soil fatigue, soil-borne pathogens and weeds. There is currently a ban on the use of Basamid granules and other soil disinfestation products. Reinstatement of these in the future is also uncertain. Thermal soil treatment using a steam machine is therefore currently the only option to replace chemical soil disinfestation in nurseries in order for businesses to maintain their competitiveness on the European market.

The Combimixer steam machine by mobildampf.de is currently used on nurseries (Fig. 1). This device actively injects steam into the soil using blades, and the soil is then mixed using a harrow. A drag of about 20m in length is pulled along behind the machine to keep the heat in the soil, increasing the exposure time and achieving a penetration depth of approximately 25cm. In practice, driving speeds of 120m/hr are standard.

The effect of the thermal soil treatment on germination percentages, plant growth and weed infestation in conifer seed beds at different forward speeds was investigated within the scope of the EIP project.

Trial implementation

Trials have been carried out on at four test locations to date. The first trial started on 06/05/2016, the second on 27/05/2016, the third on 30/05/2016 and the fourth on 10/09/2016. Five trial plots were created on each of these four trial locations.

Fig. 1: `Combimixer´ steam machine by mobildampf.de

The beds were treated at different temperatures (speeds): 80m/hr, 80m/hr (without harrow), 160m/hr and 240m/hr. An untreated control was also created in order to permit a comparison to be made with a non-steamed plot. The reason for the 80m/hr (without harrow) treatment was that technical problems mean the harrow is often out of use, so the effect of the machine without the harrow was explicitly investigated. All of the trial locations were in the district of Pinneberg.

Three weeks after the steaming took place on the nurseries, weed counts commenced in the different plots to check the efficacy of the process. These assessments were carried out using the 'Göttingen counting frame' (this is almost exactly 0.1m²). The frame was placed on different plots four times, and the weeds were counted and identified. These counts were repeated every three weeks until the end of the growing season.

Fig. 2: The 'Göttingen counting frame', used to count the weeds in each plot

The first assessment of the crop seedlings was carried out on 15/07/2016. The 'Göttingen counting frame' was placed on the trial plots four times per plot and the total number of seedlings in the plot in question was determined. The height of the seedlings was also measured with a yardstick. *Abies*, *Picea* and Douglas were sown on the trial areas.

2 Results

Table 1 shows the soil temperatures immediately behind the device and the harrow and at the different driving speeds and locations at depths of 5, 10 and 20cm. The soil moisture content in the trial locations is also listed.

Tab. 1: Soil temperatures behind the device and the harrow at different driving speeds

Trial location	Soil moisture [%]	Driving speeds [m/hr]	Initial temperature [°C] at depths			Soil temperature behind the device [°C] at depths			Soil temperature behind the harrow [°C] at depths		
			5 cm	10 cm	20 cm	5 cm	10 cm	20 cm	5 cm	10 cm	20 cm
Location 1	**13.07**	80	25	21	16	80	75	24	70	64	23
		160				64	52	25	64	48	22
		240				48	38	22	45	33	20
Location 2	**14.53**	80	19	16	15	70	45	20	60	40	25
		80 (without harrow)				75	45	22	65	52	22
		160				60	30	25	60	38	20
		240				50	30	20	55	38	20
Location 3	**12.41**	80	29	26	20	82	70	28	70	55	27
		80 (without harrow)				85	61	29	70	65	26
		160				77	68	27	71	62	25
		240				62	53	27	69	58	22
Location 4	**12.61**	80	28	25	20	80	78	25	72	72	26
		80 (without harrow)				80	73	28	71	69	29
		160				82	76	28	72	56	28
		240				62	54	29	49	45	27

Maximum temperatures of up to 85°C at depths of 5cm were able to be achieved, while the maximum temperature behind the harrow at 5cm was only 72°C. The table also shows that the steam temperatures were lower at a higher soil moisture content, that a decreasing

temperature was observed as the driving speed increased and that switching off the harrow had an insignificant effect on the temperature attained.

Figure 3 provides information on the number of weeds recorded using the 'Göttingen counting frame' on a trial plot on 17/06/2016 at the different driving speeds. The steaming occurred approximately 1.5 months ago at location 1 and 20 days ago at location 2. There was a higher level of weed infestation in the control and 80m/hr (without harrow) and 240m/hr treatments. At location 1, for example, 34 weeds were able to be counted on 0.1m². The number of weeds at the 160 m/hr driving speed appears to be acceptable compared to the slow speed of 80 m/hr with harrow as this only varied slightly or not at all. The type of weeds noted primarily consisted of black nightshade and legumes such as clover and sweet peas. It is suspected that these are stimulated by the heat treatment and start to germinate as a result.

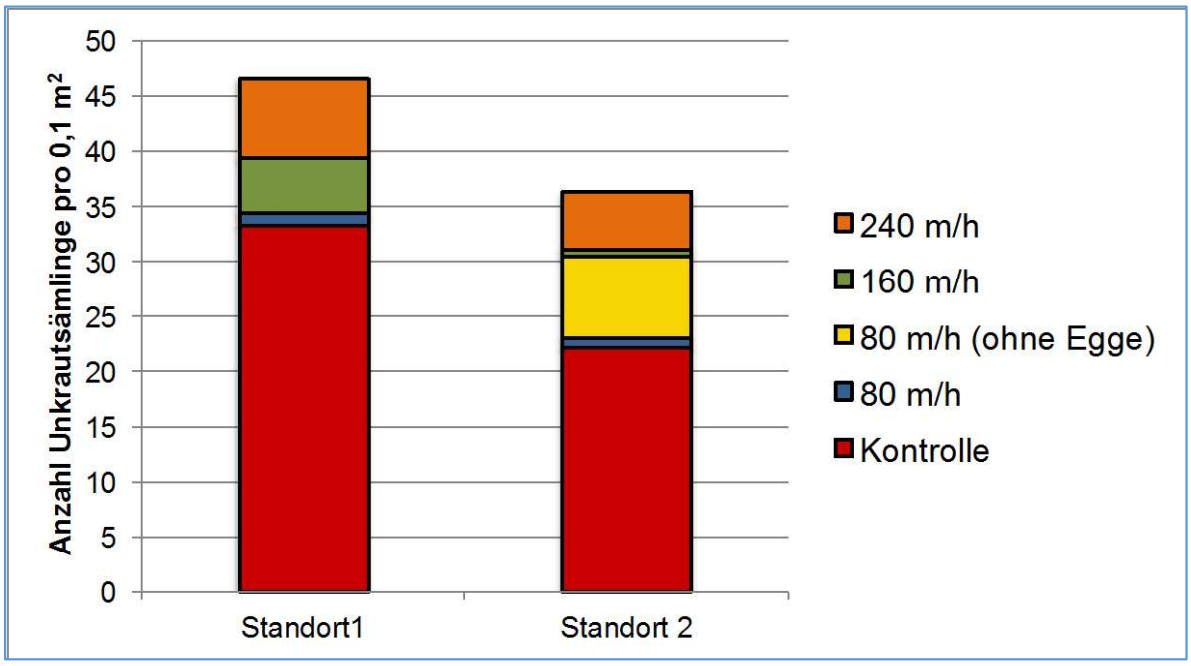


Fig. 3: Average number of weeds per 0.1m² in each trial location at different forward driving speeds on 17/06/2016

Figure 4 shows the percentage seedling germination recorded at the respective driving speeds. Since there is a higher number of seedlings recorded at the slow driving speeds, the slowest driving speed of 80m/hr with a harrow was taken as a reference point and set at 100%. A germination level of around 72% was able to be achieved at location 1 with the 160m/hr treatment, while only just under half of the seedlings germinated in response to the 240m/hr treatment. Location 2 showed that the percentage seedling germination in the control was lowest at approximately 38%, that the 80m/hr without harrow treatment also only achieved 60% seedling germination and therefore the result is 40% lower than in the 80m/hr with harrow

treatment, that only approximately 2% fewer seedlings germinated with the 160m/hr treatment compared with the reference treatment of 80m/hr with harrow and that the 240m/hr had approximately 23% more seedlings than the 80m/hr without harrow treatment. No differences in plant height were able to be identified at any point in the first year for the different treatments with any plant species.

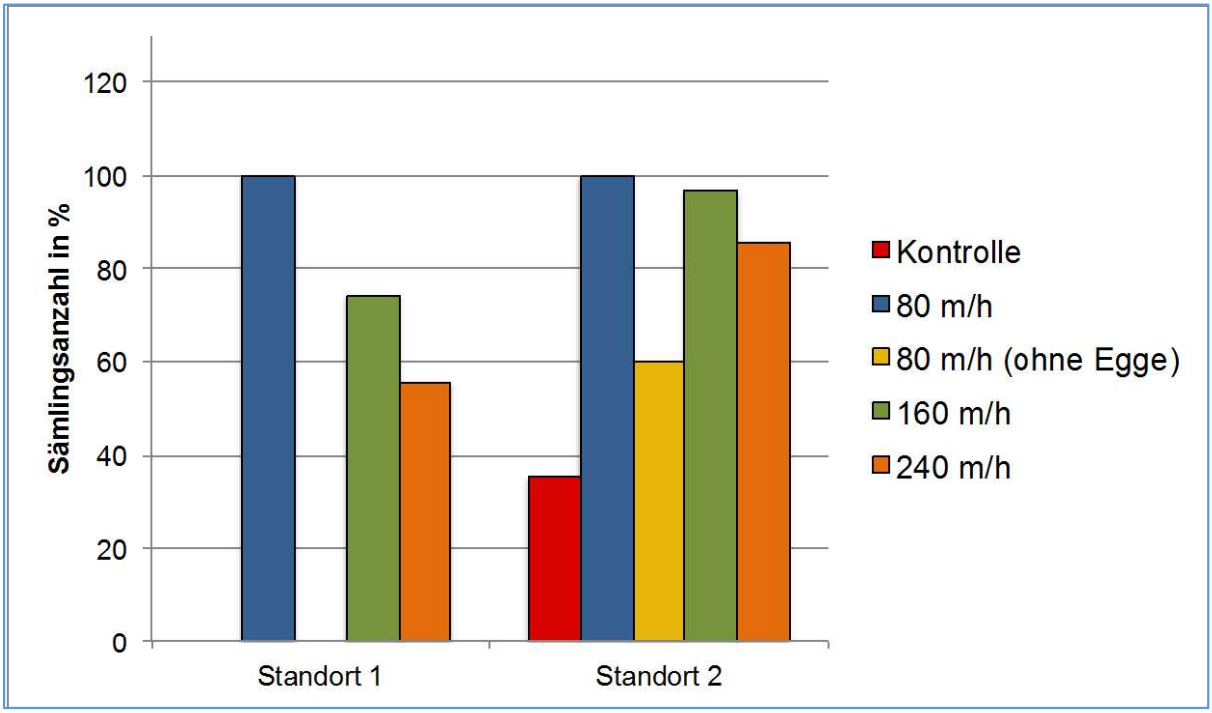


Fig. 4: Percentage seedling germination at the respective driving speeds based on the plot at 80m/hr (= 100%)

3 Summary

The effect of the Combimixer steam machine by mobildampf.de on the germination level, plant height and weed infestation level in conifer seed beds at different speeds was investigated within the scope of this EIP project. Trials were carried out on each of five plots in four locations. A lower level of weed infestation and germination levels were able to be achieved at a higher soil temperature. The effect against black nightshade and species of legumes, however, remains questionable. The plant height was not sufficiently impacted in the first year. In addition to this, it was possible to determine that the germination level and the level of weed control attained were still reasonable at 160m/hr. The harrow appears to be important for mixing the soil when it comes to the effect of the machine.

General statements on EIP projects

European Innovation Partnership (EIP Agri)

The project reported is being supported by the EU within the scope of the European Innovation Partnership (EIP) and the Rural Areas Programme of the Federal State of Schleswig-Holstein (LPLR) for three years. The aim of EIP Agri is to encourage innovation and to increase sustainability and efficiency in agriculture. The requirement for innovation ideally comes from practice, and farmers are actively involved in the development of solutions. Farmers, scientists, consultants, NGOs and economic partners work together in Operational Groups (OG) on the development and trialling of innovative ideas.

www.eip-agrar-sh.de

Machine demonstration: Rath Highlander V70 tractor

(Claudia Kordes, Dr H. Lösing)

In the Rath Highlander V70, the Pinneberg Trialling and Advisory Ring saw a gantry tractor for a variety of applications. Around 50 interested growers and consultants in Pinneberg met on 28 September 2016 for a demonstration of the Highlander V70 on the premises of the Heydorn Söhne GmbH & Co. KG nursery in Klein Nordende. “There is no alternative to this device to meet our needs”. This was the conclusion reached by Niels Heydorn, owner of the nursery, who runs it together with his son Tim Heydorn.

Demonstration of the tractor at the H. H.Heydorn jun. nursery in Klein Nordende

The mechanisation of nursery operations is increasingly an important factor for nurseries and other specialist growers. The Highlander V70 gantry tractor by RATH MASCHINEN from Kärnten in Austria is a tailored solution to this type of production. This machine is manufactured individually and tailored to customer requirements. It is delivered to the most varied of nurseries across Europe and overseas as a package together with additional equipment. Based on practical experience in his family’s own forest nursery, mechanical engineer Michael Rath built the prototype in 1992. The Heydorn Sons Nursery has just purchased the anniversary machine with serial number 100.

One of the advantages of the Highlander is that the driver has a view of everything and optimal oversight as a result of the seat position above the left rear wheel. From this position he also has the best possible oversight of the processing tools installed above the central axle and therefore can carry out precise nursery work in a relaxed manner. The ground clearance, which can be chosen to be over three metres, a permanent, high-torque, continuously adjustable hydrostatic all-wheel drive, hydraulic track adjustment and in the future a modern HATZ turbo diesel engine with common rail fuel injection in the current emission level 3B make up the technical parameters of the new gantry tractor. Depending on the growth of the crop, a central

beam can be mounted on the tractor and three rows processed at the same time. Two rows can be passed over if the row distance is approximately 1.2m, and one row if it is 1.5m.

The additional equipment for mechanical soil cultivation and weed control can be adjusted hydraulically to the row width from the driver's seat, depending on the design. Active tools such as a rotary tiller, mulching device for Christmas tree plantations and the 'TANGO nursery weeder' can also be driven by the high-performance auxiliary drive. The sensitive nursery weeder for the rows, works with double-acting hydraulics, so the tools are actively moved in both directions. A sensing device controls easily exchangeable processing tools such as ploughing boards and shares.

The row spraying system to apply herbicides consists of standard components with different spray nozzle sizes. Spray directors with movable side flaps or conical and rotatably mounted rubber funnels are available for application. Electronic control devices such as the spray computer are important in this equipment to apply the exact dose.

The undercutting share for the horizontal root pruning of conifers and young plants is particularly interesting. On the one hand it can be used to control the growth and the root formation, and on the other they can be used for harvesting, for example in combination with the LOMMERS trimming machine (see image on the left). "Once the roots have been cut successfully the plants can be trimmed in parallel at harvesting as needed - up to 400 plants per hour with white beeches of 1.50/1.75m in height," says Niels Heydorn.

"The machine will become even more valuable for us in future, as the herbicides that will be permitted for use will be further restricted so mechanical weed control will become increasingly important".

Presentation of robots for soil processing in nurseries

(H. Schwarz, Dr H. Lösing)

A presentation was given at the Heydorn Nursery in Bevern on 1 April 2016 to cover new options for the automation of soil cultivation measures in the field, particularly for smaller businesses.

Machine demonstration at the Heydorn Nursery in Bevern generated significant interest

The members of the Trialling and Advisory Ring - Schleswig-Holstein were able to examine the future options for mechanical weed control using a robot presented by the French start-up company “Naio” from Toulouse (www.naio-technologies.com). The company currently employs 20 people, most of whom work on the development and optimisation of the robot’s control software. More than 30 robots are used in vegetable cultivation in France and Belgium and show that the company’s devices have been well received by the market.

Around 30 interested growers used the opportunity to take a look at the future. Over the course of the one-hour demonstration in an area of field-grown shrubs, the possible uses of a robot for cultural work in rows of plants were demonstrated.

In the future, the robots, which were developed for field-grown vegetable cultivation, could also carry out mechanical weed control in woody crop production, reducing the labour costs for such businesses.

Changing the battery in the field

Combined laser and camera control

The ‘Oz-type’ robots, which were primarily developed for mechanical weed control, can be used as ‘harvest helpers’ in other areas of horticulture. The most important information on them includes:

Dimensions:	approx. 45cm wide, 60cm high and 100cm long,
Weight not including the attachments:	150kg,
Drive:	One electric engine per wheel,
Mounting options:	Various tools for mechanical weed control and for transporting loads of up to 300kg (e.g. harvested products),
Orientation:	Using laser and camera technology,
Remote control	Via a light, transportable control panel,
Communication:	In the event of insurmountable obstacles or disruptions via SMS,
Work duration:	3 to 10 hours depending on the performance and the capacity of the lithium batteries used,
Safety elements:	For the protection of people and crops.

When using the robot, a number of basic parameters must be complied with to ensure smooth working of the device. These include:

- as much as possible a flat and straight a tramline between the rows, with a minimum row distance of 60cm (based on the demonstration equipment) and rows of equal length,
- a headland of approximately 1.5 metres on which there are no weeds in order to enable the robot to turn automatically.

In addition to this, the following information must be available to the robot and must be communicated to the control computer before the start of work via the entry keyboard:

- the type of work to be carried out: weed control, transport, accompaniment of a staff member,
- the number of rows to be processed, the distance between them and the length,
- the number of processing operations per row,
- the processing of the rows: one-sided or two-sided,
- the processing distance based on the plants in the row and the driving speed in the crop.

Once the basic information has been entered, several work processes can be undertaken by the robot following the positioning of it at the starting point without any further human input.

According to the manufacturer and based on experience from vegetable production, 10 hectares of cultivated area can be kept continuously weed-free with a single robot. The use of tools (e.g. cultivation depth) is specified by the user. The selection of tools for mechanical weed control should therefore be tailored to the soil conditions in the location in question.
The machine demonstration showed an approach to mechanical weed control that has not been seen before and led to an intensive technical discussion even during the use of the robot. Other possible uses are also conceivable, and the necessary adaptations to individual operations can be made based on the extensive programming capacity. Many of the interested parties feel that there is still a huge potential with the robot, including its use in woody crop production. It is entirely conceivable that other work will also be able to be carried out ‘around the clock’.
Depending on the equipment that is currently available, the investment costs per robot are between EUR 21,000 and EUR 24,000.
The framework conditions needed for the use of the robot can be achieved without any problems on most nurseries. A robot can be integrated into day-to-day operations on many nurseries producing field-grown crops without any problems.

Nursery cold storage monitoring

(Sebastian Heise)

The Trialling and Advisory Ring has been carrying out annual cold storage monitoring on nurseries for more than 35 years. This year, the temperature settings of around 100 businesses were checked. In addition to 128 cold storage facilities, 36 seed cold storage facilities were also measured.

A psychrometers (Fig. 1) was used to determine the relative humidity and temperature. The psychrometer works according to the following principle: two thermometers are permanently ventilated at 3m/s. One of the two thermometers, the one known as the 'humidity thermometer' (Fig. 1 on the right-hand side in yellow) has a sensor that is surrounded by a humidified material (cotton). Greater evaporation of the liquid (distilled water) occurs depending on the humidity. The cooling by evaporation enables a temperature difference between the two thermometers to be determined. The temperature difference can then be used to calculate the relative humidity using a psychrometer table.

Figure 1: Psychrometer

Relative humidity is important, as without it drying damage to the plants can quickly occur. A relative humidity of >95% is recommended in the cold storage facilities intended for the storage of woody crops. In most of the cold storage facilities measured, the humidity was in the optimal range of 96% to 98%. The bagging of plants or entire pallets has otherwise proven to be an effective protection against drying out.

The temperatures of the cold storage facilities measured in 2016/17 and the measurement results from 2000/01 are shown in Figure 2. In 2000/01, 21% of the cold storage facilities were still being operated in the range of 0.0-0.4°C, but by 2016/17 this percentage was in the range from -0.1 to -0.5°C. The advantage of this is that the lower temperatures decrease the infection pressure from fungal diseases. Businesses that do not always have to work with cold storage facilities mostly store their plants at lower temperatures.

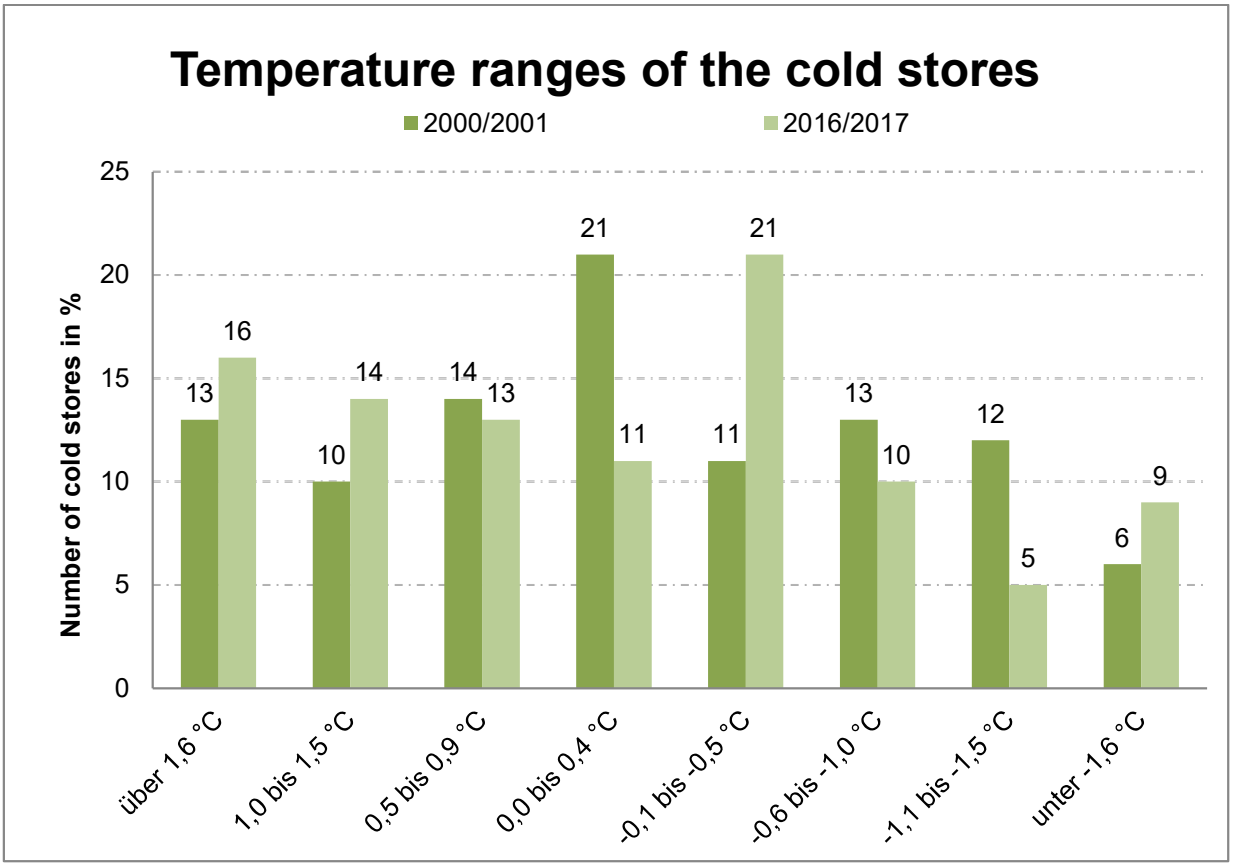


Figure 2: Temperatures in the cold storage facilities

Seeds are often stored in additional seed cold storage facilities. In 2000/01 and 20016/17, the cold storage facilities were in the range from 0.0°C to -5.0°C (Fig. 3) depending on the seeds being stored. Businesses that primarily store oak seeds cool their facilities to -1°C; those that store mixed seeds often have temperatures of between -2.6°C and -5.0°C. Lower temperatures are used for the long-term storage of seeds.

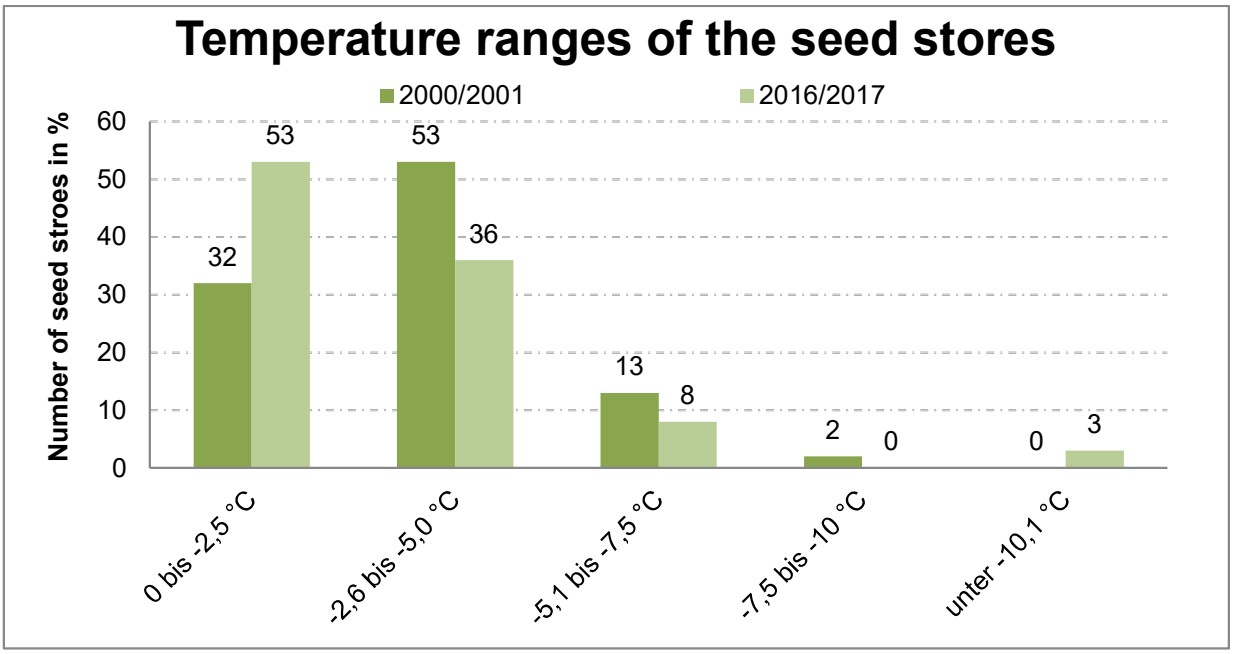


Figure 3: Temperatures in the seed cold storage facilities

Uniform room ventilation and temperatures are not always achieved, particularly where direct cooling is used. The draft that is generated in front of the evaporator causes additional drying in the pallets of plants there. The cold air is not evenly distributed in the room. The installation of air distribution systems has proven to be effective, see Fig. 4 Air hoses have been attached directly to the evaporator. The air is blown through a perforated hose. It is evenly distributed over the entire length of the hose and therefore in the room to be cooled.

Figure 4: Air ventilation system

The cold storage facilities in these businesses run for between five and seven months a year and are one of the main consumers of electricity. Weaknesses, such as wear in the door seal, subsequent installations or simply damage that occurs over years of operation along with invisible thermal bridges contribute to increased electricity consumption. A thermal imaging camera (thermography) can be used to clarify or identify this. Ten cold storage facilities were subjected to a thermography scan for the first time this year. It has been demonstrated that improvements can quickly be achieved using simple means and at a low cost, for example insulating feed lines and discharge lines from evaporators that feed into the cold storage facility. Further cold storage facilities are to be subjected to a thermographic scan in the next storage period.

An annual cold store inspection is important to review the settings and change them where necessary. The inspection is essential particularly in the case of new installations or following repairs to the cold storage facilities. Failures or incorrect settings in the cooling system are sometimes only noticed as a result of the inspection. Temperatures around freezing are increasingly being selected by most businesses for woody crop storage. This can significantly reduce fungal infestations.

Study tour to the Czech Republic

(Dr Heinrich Lösing)

Twenty-eight nursery owners from the production region of Pinneberg visited ten nurseries and a park in the Czech Republic from 23-26 August 2016. First of all, here are a few general figures from the country and its nursery production, in each case in comparison to the Federal Republic of Germany.

	Czech Republic	**Germany**
Inhabitants, total	10,627 million	80,621 million
Area, total	78,866 square km	348,540 square km
Population density/square km	134.74	231
Number of nurseries	87 association members 229 forest nurseries	2,241
Nursery production area	Approximately 1,400ha of member areas within the association 1,550ha forest nursery	21,753ha

Interpreter Zbynek Slezacek

We were accompanied by Mr Zbynek Slezacek in order to ensure we did not have any linguistic problems. He is a sales representative for a German substrate manufacturer. His excellent linguistic and technical skills meant he made a huge contribution to the success of the study trip. At the same time he also brought the cultural and culinary elements of his country to life.

There were only people with minimal English or German skills in many of the businesses visited.

On one of the evenings, we were also accompanied and supported by the Chair of the Czech Nursery Association, Mr Jiri Veleba. As a result of the time he spent working as a young assistant at the Strobel Nursery in Schleswig-Holstein, he still feels connected to the Pinneberg production region.

It was the first study trip to the Czech Republic by the VuB. With the exception of the very well developed nursery businesses, the country also impressed those who took part in the trip with its good infrastructure. A brief portrait of the nurseries visited is provided below.

Lesoskolky, Recany nad Labem, www.lesoskolky.cz

The nursery was founded in 1924 and now comprises approximately 200ha of production area spread over seven sites. The annual plant production of the nursery is cited as 20 million field-grown plants and 7 million plug-grown plants.

Conifer production in a greenhouse

Annual oaks in plug containers

Ninety people are employed by the nursery. Additional seasonal workers are also employed by the nursery, primarily from Romania and Ukraine. Spruce, pine, oak, beech, silver fir and larch were mentioned as the most important tree species.

The production of forest plants in plug containers has a long tradition in this business. Across the country the percentage of forest plants grown in plug containers is cited as approximately 15% of production. According to Junior Manager Premysl Nemec the annual requirement for forest plants in the Czech Republic is approximately 110 million plants a year.

Adametz, Opava

The nursery, which specialises in young plant production, was only founded 13 years ago. They currently produce plants on a total area of 8ha. The company has 10 employees. Propagation by cuttings is used as the main propagation method. A number of stock plant areas are available.

Sales are primarily domestic, with some export to Slovakia and Poland. Sales to Russia have very much collapsed as a result of political developments.

View of conifers on production beds

Modern greenhouse facility for propagation

Arboeko, subsidiary in Smrzice, www.arboeko.com

The subsidiary is approximately 300km south-east of the main company in Obristvi. In addition to a cash and carry market for plant sales in the region of Moravia, they also produce 6-8cm and 10-12cm young trees here. A total production area of 70ha is available. This is used for the production of conifers and the cultivation of avenue trees in containers. Particular focus is placed on the use of environmentally-friendly fertilisers. Sorghum is primarily used because of the summer drought. It is chopped at a height of approximately 150cm so it can grow again. This prevents the formation of thick stems.

Avenue trees in an Arbo Strong transportable container

Exemplary field-grown avenue tree production

Tomas Cerbak, Pusta Polom, www.okrasneskolky-cerbak.cz

The nursery was founded 20 years ago and currently covers 8ha, 6ha of which is made up of container-grown plants. The company has 9 employees. The focus of production is grafting. Approximately 100,000 plants a year are produced as winter grafts. These are stored in a cold storage facility at 0 to 5°C until they are potted.

View of the nursery premises

The majority of the container plants are stored in a warehouse nearby in order to protect them from regular winter frosts with temperatures of -20 to -25°C.
Container beds have been created on terraces because of the slope in the facility.

Jan Holub, Bouzov, www.janholub.cz

The nursery was founded in 2000 and moved to the current location eight years ago. It covers a total of approximately 5ha. The company has 10 employees.

The focus of production is in micropropgation. There has been a significant shift in the genera cultivated in the past few years. It was originally primarily rhododendrons that were produced, and now is various species of soft fruit. In addition to micropropagation, plants are also propagated by means of cuttings.

Plant production on agar cultures

Further container production on beds

Lescus Cetkovice, Cetkovice, www.lescus.cz

The nursery was founded in 1993 and covers an area of approximately 35ha of fields. Woody forest crops in plug containers have been grown on an area of 1.5ha since 2010. The annual plant production is 8 million plants. The company has 25 employees.

Devices made by the Swedish manufacturer BCC are used to fill the trays with substrate and seed the woody crops. The main argument for growing plants in plug containers was said to be the possibility of extending the planting time. The plants were only fed with liquid fertilisers as the irrigation water has a high EC value.

Production of field-grown spruce trees

View of the plug containers on production beds

Skolky-Montano, Prerov nad Labem, www.skolky-montano.cz

Following the political change in the country, what was formerly a cooperative with 45 owners has now become a nursery with 2 owners. The undefined ownership structures of businesses is still causing problems. The production area consists of 20ha of fields and 14ha of container beds. The company has 45 employees. An additional 30 people come from the Ukraine as seasonal workers. Production comprises a broad programme of ornamental trees and forest trees, generally plants that are propagated within the nursery.

Sales are primarily wholesale. The company has had its own garden centre since 2003.

View of the container plant production

Cutting propagation with a fog system

Vojenske lesy a statky, Lhota, www.vls.cz

The state forest nursery produces field-grown plants on over 80ha spread over a total of five locations. Forest plants are produced in plug containers on over 2ha. All of the plants are used to replant areas used by the military. The figure given was 130,000ha. The total wooded area in the Czech Republic is approximately 3 million ha, of which 60% belongs to the state. Thirty-five employees and additional seasonal employees work at the forest nursery.

The annual plant production fluctuates between 3.5 and 6 million plants. The cultivation of plants in plug containers has recently been included in the programme. Devices made by the Swedish manufacturer BCC are used for filling the trays and sowing seeds.

Field production of copper beeches

Pines in plug containers

Arboeko, Obristvi, www.arboeko.com

The nursery was founded in 1993 and has been supported by investors from the Netherlands since 2007. The company has five owners. The production area is approximately 200ha, of which 10ha is set aside for container plants. Along with its corresponding subsidiaries it is the largest nursery in the Czech Republic.

View of the container plant production with greenhouses in the background

A total of 80 people work in production and a further 20 in the office. A further 150 people work there during the season.

The focus of field production is 16-18 and 18-20cm trees. The production of young trees is carried out at the subsidiary in Smrzice.

The sales market is predominantly domestic. The percentage exported to Germany, for example, is low.

View of an area with avenue trees

Cultivation of field grown conifers

Pruhonice Park, www.pruhonickypark.cz

Transport problems meant we were unfortunately not able to visit the park.

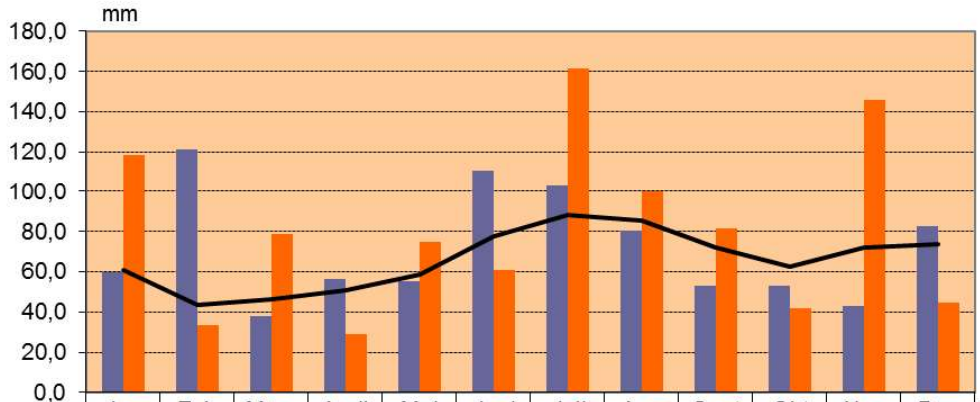
Trip participants along with the Chair of the Czech Nursery Association Mr Jiri Veleba (centre) and the interpreter Zbynek Slezacek

Data from the weather station in Thiensen

Comparison of the years 2015 and 2016 with the 30-year average (1960 – 1990)

Monatliche Niederschlagsmengen, Thiensen 2016 und 2015

(Im Vergleich zum 30-jährigen Mittel 1960-1990)

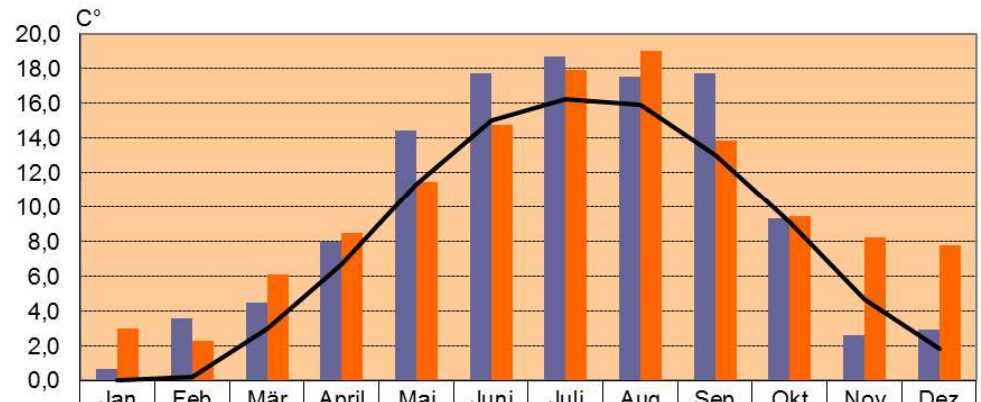


	Jan	Feb	März	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Dez	Summe
2016	59,8	121,5	37,8	56,2	55,4	110,7	103,3	80,6	53,0	53,2	42,9	82,4	856,8
2015	118,2	33,5	78,8	29,0	75,0	61,0	161,4	99,9	81,5	42,0	145,9	44,8	971,0
30-jähriges Mittel	60,8	43,3	46,5	50,7	58,5	77,6	88,1	85,4	72,2	62,4	72,0	73,6	791,1

2016 2015 30-jähriges Mittel

Mittlere Temperatur (2 m Höhe), Thiensen 2016 und 2015

(Im Vergleich zum 30-jährigen Mittel 1960-1990)

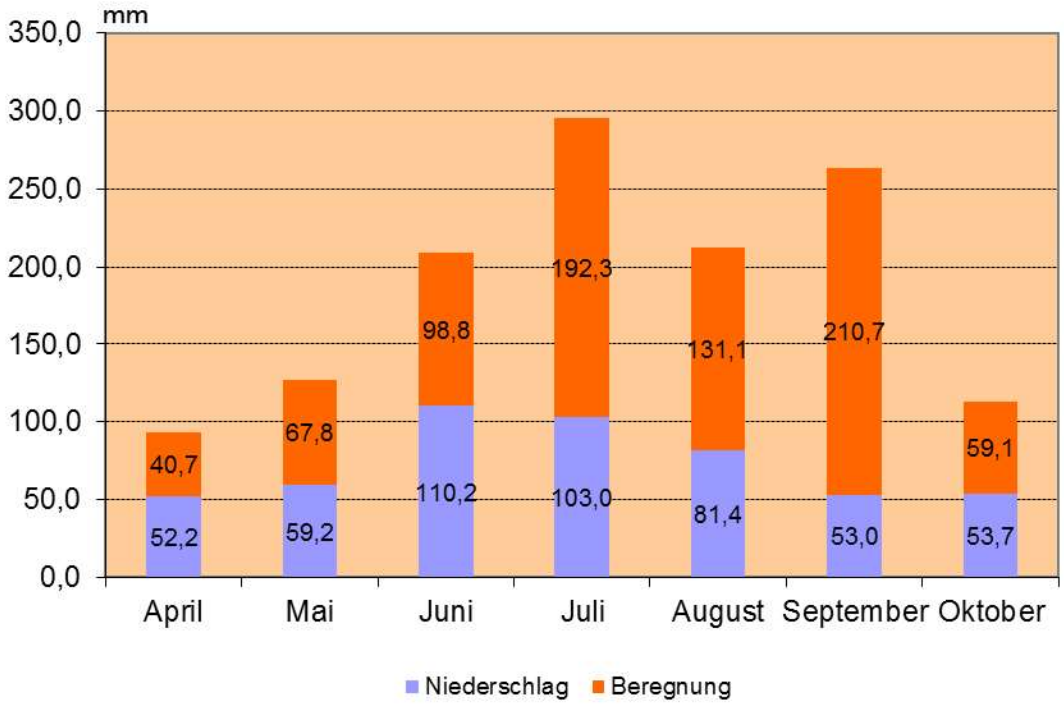


	Jan	Feb	Mär	April	Mai	Juni	Juli	Aug	Sep	Okt	Nov	Dez	Ø
2016	0,7	3,6	4,5	7,9	14,4	17,7	18,7	17,5	17,7	9,3	2,6	2,9	9,8
2015	3,0	2,3	6,1	8,5	11,5	14,8	17,9	19,0	13,8	9,5	8,2	7,7	10,2
30-jähriges Mittel	0	0,2	3	6,7	11,3	15	16,2	15,9	13	9,1	4,7	1,8	8,1

2016 2015 30-jähriges Mittel

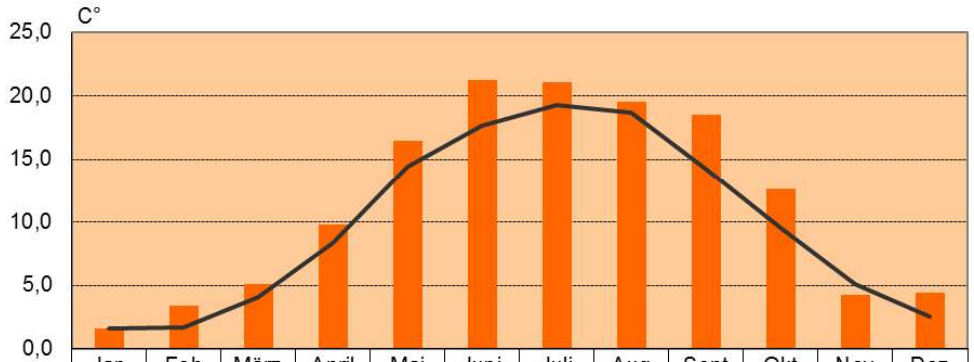
Niederschlag und Zusatzberegnung in Containerkulturen

Rosen, Co 3-4 l (Standort Rellingen 2016)

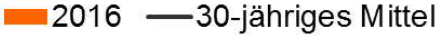


Mittlere Bodentemperaturen (10 cm Tiefe), Thiensen 2016

(Im Vergleich zum 30-jährigen Mittel 1960-1990; Standort: DWD, HH-Fuhlsbüttel)



	Jan	Feb	März	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Dez
2016	1,6	3,5	5,1	9,8	16,5	21,2	21,1	19,5	18,5	12,6	4,2	4,5
30-jähriges Mittel	1,6	1,7	4,1	8,4	14,4	17,7	19,3	18,7	14,3	9,6	5,1	2,6



Explanation of the symbols:

You can find an extensive explanation of the symbols in the 'yellow list' of plant protection agents for Integrated Nursery Production.

ZP = Zierpflanzen (ornamental plants), ZG = Ziergehölze (ornamental shrubs), B = Baumschule (nursery), O = Obstbau (orchard), F = Forst/Forstgehölze (forest/forest trees),
St = Stauden (shrubs), nur uG = nur unter Glas (only under glass)

Xi = irritant, Xn = harmful to health, T = toxic, T+ = very toxic, F = highly flammable,
C = corrosive, N = harmful to the environment

Explanations of the bee protection regulations:

B1	(= NB661 and NB6611) harmful to bees
B2	(= NB662) harmful to bees except when used after the daily bee flight until 11pm
B3	(= NB663) bees are not at risk from the use of the agent in line with the authorisation
B4	(= NB664 and 6641) not harmful to bees

The harmfulness to bees changes in the case of mixtures of insecticides, particularly in the case of the products Karate Forst, Karate Zeon, Mavrik, Mospilan SG and Trafo with a fungicide from the group of ergosterol biosynthesis inhibitors (e.g. Folicur, Luna Experience, Matador, Mirage 45 EC). Mixtures must be used in such a manner that flowering plants are not treated.

The **new bee protection regulations NB501, NB502, NB504** apply to the B1 products Dantop, Confidor WG 70 and Warrant 700 WG. Confidor WG 70 and Warrant 700 WG may only be used on plants that will not flower again in the year of treatment outdoors. This also applies to weeds in the stocks. Treatment of plants under glass with Dantop, Confidor WG 70 and Warrant 700 WG is only permissible before flowering if the plants remain inside during the year of treatment.

Labelling to protect bodies of water:

NW 468	Sprays and their residues, products and their residues, empty containers and packaging and cleaning and rinsing fluids should not get into bodies of water. This also applies to indirect entry via the sewage system, farmyard and street run-off and rain and waste wastewater pipes.
NW 642	The use of the product in or immediately adjacent to above ground bodies of water or artificial bodies of water is not permissible (Section 6 paragraph 2 of the Plant Protection Act). Separately of this, the minimum distance from surface waters set out in a binding manner in accordance with state legislation must also be complied with. Infringements of this may be prosecuted with a fine of up to 50,000 euros.
NG 403	No application onto drained areas between 1 November and 15 March.
NG 405	No application onto drained areas.
NG 407	No application on the soil types pure sand, slightly silty sand and slightly clayey sand.
NG 408	No application onto drained areas between 1 June and 1 March.

The herbicides Stomp Aqua, Stomp Raps and Boxer have received new requirements (NT 145, NT 146, NT 170). In accordance with these, the water volume must be at least 300L/ha, the wind speed must not exceed 3m/sec and the driving speed may not exceed 7.5km/h. Furthermore, spraying must be carried out with a device to decrease drift with a drift reduction level of at least 90%.
For more details see the 'Yellow List'.

Information on the handling and storage of plant protection agents is available online at http://www.iva.de/praxis/pflanzenschutz.

More information explaining additional distance requirements can be found online at http://www.bvl.bund.de where you can enter them in the search function 'code list'.

You can find more information on the definition of storage classes from VuB.

Important note: Disclaimer

We call attention to the fact that all of the recommendations made and information provided by us are given to the best of our knowledge to the exclusion of any liability.

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 the specific production 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 treatment 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 such as the weather. Since these conditions and the proper use are outside the control and potential influence of the Trialling and Advisory Ring for Nurseries, liability for the efficacy and the consequences of use is excluded.