Versuchs- u. Beratungsring Baumschulen e.V. Schleswig-Holstein

Chamber of Agriculture Schleswig-Holstein Horticultural Centre

Annual report 2014

Propagation of saplings in the Ercole slotted pot (Distributor for Germany: H. Meyer, Rellingen)

Versuchs- und Beratungsring
Baumschulen e.V.
Schleswig-Holstein
Thiensen 16, 25373 Ellerhoop
Tel.: +49 (0)4120 7068 301/302/303
Fax: +49 (0)4120 7068 319
Email: info@vub.sh
Website: www.vub.sh

Chamber of Agriculture
Schleswig-Holstein
Horticultural Centre
Thiensen 16, 25373 Ellerhoop
Tel.: +49 (0)4120 7068 100
Fax: +49 (0)4120 7068 101
Email: info@lksh.de
Website: www.lksh.de

Board of the Testing and Advisory Council (Versuchs- und Beratungsring, VuB):

Lars Harder
Deputy

Frank Ostermann
Chairman

Bettina Stoldt
Treasurer

Christian Kordes
Committee member
since 4 February 2015

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Committee member

Joachim Ellerbrock
Committee member

Ole Kleinwort
Committee member

Versuchs- und Beratungsring Baumschulen e.V. Schleswig Holstein
Thiensen 16, 25373 Ellerhoop
Tel.: +49 (0)4120 7068 301/302/303
Fax: +49 (0)4120 7068 319
info@vub.sh
www.vub.sh

Chamber of Agriculture Schleswig-Holstein
Horticultural Centre
Thiensen 16, 25737 Ellerhoop
Tel.: +49 (0)4120 7068 100
Fax: +49 (0)4120 7068 101
info@lksh.de
www.lksh.de

Members of the Testing and Advisory Council and the Chamber of Agriculture in Schleswig-Holstein (LK SH):

Dr. Heinrich Lösing
Consultant at the LK SH and VuB Director

Hendrik Averdieck
VuB consultant

Britta Zielke
VuB consultant

Sabine Plüschau-Wöbcke
VuB secretary and accountant

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Summary report 2014

(Dr Heinrich Lösing, Director)

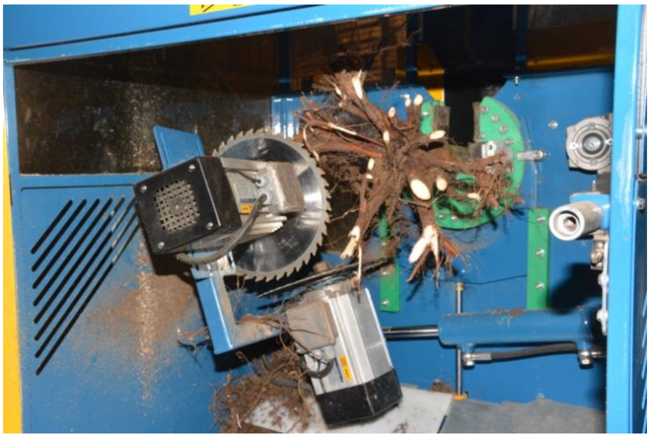
The Testing and Advisory Council was able to continue its successful work in 2014. 288 tree nurseries totalling 3,401 ha and 39 sponsoring members were regularly updated via 35 circular letters, by telephone and fax and at knowledge transfer events on new information gained from practice, science and industry, and in particular about environmentally friendly fertilisation and pesticide measures. Individual advice on demand was continued as previously.

This year, the demonstration of machinery also attracted wide interest. As early as March, the battery and compressed air operated shears used to prune rose stocks were demonstrated at the tree nursery of W. Martens in Appen. Roughly 30 people attended.

Demonstrating the battery and compressed air operated shears at W. Martens in Appen

There was also strong interest in demonstrating the MDE bale and root cutter for avenue trees at the Bradfisch tree nursery in Borstel. Roughly 40 people attended.

Changing the blade of the MDE bale cutter



MDE root cutter for avenue trees

The intensive testing of pesticides was also continued in 2014. The main focus continued to be on trialling alternatives to the herbicide Terano (metosulam 25 g/kg + flufenacet 600 g/kg). The product has been widely used in tree nursery cultivations over the past 10 years.

Test inspection of the seedbeds at the Deutschmann tree nursery

A further focus was trialling alternatives to the Harvesan (125 g/litre carbendazim + 250 g/litre flusilazole) which has been used over the past 15 years or so as the core product against powdery mildew. Appropriate alternatives have, in the meantime, been developed.

Inspection of the powdery mildew trial on *Quercus* at the tree nursery of E. Vogt in Pinneberg

The study trip of the VuB in 2014 resulted in 40 participants travelling to the Netherlands. Apart from the Plantarium and Groen-Direkt trade fairs, both of which were held in Boskoop, 12 tree nurseries in the regions of Zundert, Opheusden, Boskoop and North Holland were also visited. The study team as a whole was very impressed by the dynamism and innovative energy of the nurseries.

Tour of the container operation of the Lodders tree nursery in Zundert

Another trip attended by 29 people was to Denmark for two days to attend the Egedal-Technology day at the Hojgard tree nursery in Hojslev.

Egedal mechanical weed combating machines on transplant beds

The licensing situation for pesticides is undergoing marked, permanent change. By dividing Europe up into zones, the transfer of licences from one country to another in the same zone is to be simplified in future.

As many pesticides do not have the necessary licence for tree nurseries, the collective applications under section 22 (2), formerly section 18b of the German Pesticides Act, have continued to be processed. Overall, there are at presently 36 pesticides approved for members of the VuB for areas in Schleswig-Holstein.

Joint further training events with the Schleswig-Holstein Chamber of Agriculture and DEULA in Rendsburg were conducted as part of employee training. The seminar for forklift truck drivers is still in heavy demand.

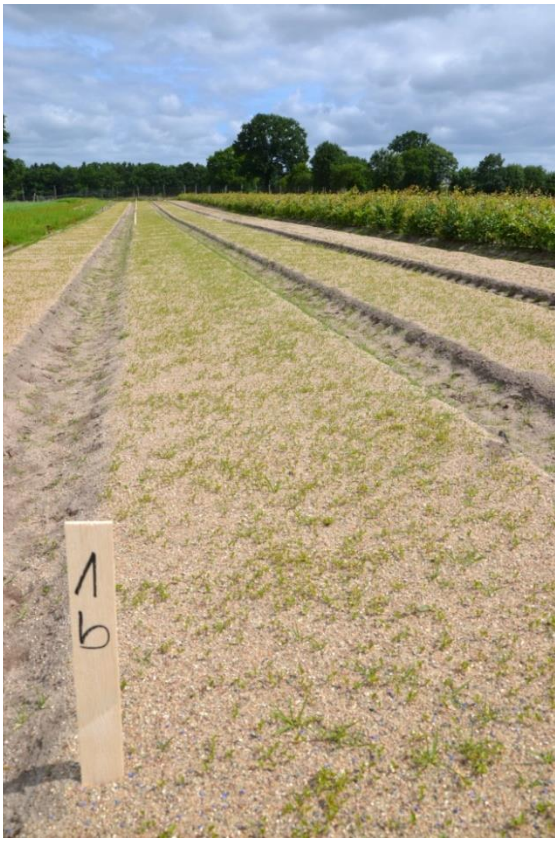
Newly included in the programme four years ago and jointly implemented with the German Red Cross, is further training in First Aid for so-called first aiders at nurseries.

A refresher course is prescribed every two years. The costs are borne by the Gartenbau-Berufsgenossenschaft (German Horticultural Health & Safety Association).

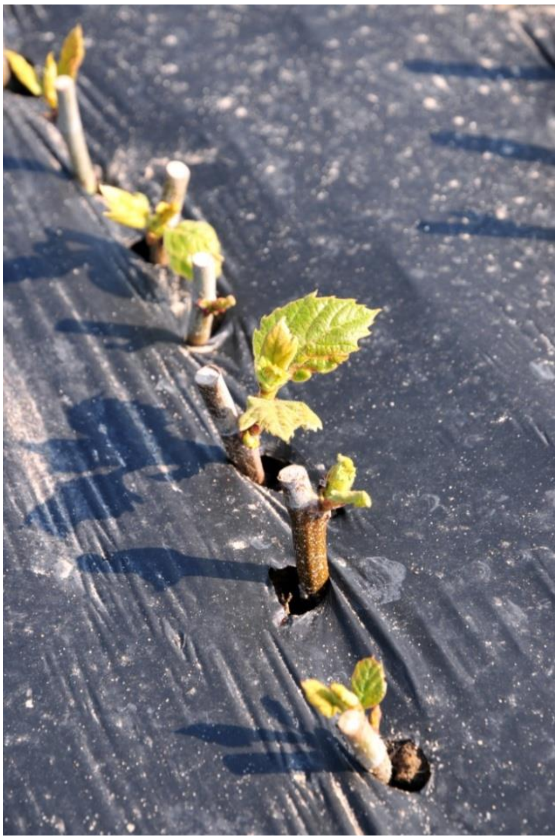
Advice on fertiliser input provided to tree nurseries represents a major part of the consultancy work. Fertiliser recommendations were given for approx. 350 substrate samples of container cultivations and approx. 1,200 outdoor soil samples. This large number of samples shows the strong awareness on the part of the tree nurseries of appropriate and environmentally conscious fertilisation. In addition, the guide values, which have to be calculated once a year, were determined for nitrogen in the soil in accordance with the German Fertiliser Regulations, section 3. For this purpose, the nitrogen content of representative sites was determined for the main cultivation groups and was made available to all nurseries. The costs of sampling and analysing the 40 N_{min} samples were borne by the Horticultural Department of the Chamber of Agriculture. This means that the individual tree nursery has met its compulsory annual examination required under the Fertiliser Regulations. Over and above this, fertilisation recommendations were given during the course of the vegetation period for 220 N_{min} tests at the tree nurseries. Therefore a highly targeted supply of nitrogen to the cultivations was achieved, based on the nitrogen available in the soil.

Experiments with boron fertiliser in an area of stone fruit production.

Tree nursery sites continued to be intensively examined with respect to the contents of calcium and trace nutrients. The calcium contents were determined in 370 areas and the copper supply of the soil in 658 samples. Zinc and manganese contents were measured on approximately 364 areas. Attention should increasingly be paid to the supply of boron in field production. The analysis of the total of 425 boron tests revealed that approximately 40% of the field areas suffered a lack of boron. Therefore, the boron fertilisation tests, which had started in 2013, were continued. The efficacy of various boron fertilisers was tested when scattered or sprayed.



Experiments with an organic-mineral fertiliser on *Alnus* seed beds



Experiments of part-coated Field-Cote CRF products on beds under film

Intensive experiments in open fields took place using an organic-mineral fertiliser (DynaTer Plus, 12- 5-11-3.3). Because of the good results, the product represents a useable alternative to mineral fertilisers.

The tests on the usability of part-coated Field-Cote CRF types were continued with 4 or 6 month release periods on beds under film. As a change from last year's tests, the fertilisers were not scattered on the finished beds prior to covering with film but were worked into the soil beforehand.

The tests to improve the final colour of conifers in autumn or to prevent the yellow colouration over the winter, were also continued. Apart from potassium, magnesium and iron, nitrogen also appears to play an important part.

Experiments on the foliage colour of conifers (particularly pines) in autumn/winter

In container cultivation, new, coated controlled release fertilisers were intensively tested with respect to their efficacy compared with known standard products, mainly also on behalf of fertiliser companies. Successful experiments also took place with new granules for nutrients for mixing into substrates.

Experiment on conventionally used and new, controlled release fertilisers in the production of ground cover plants.

Many experiments were supported by manufacturers of fertilisers and pesticides, substrate suppliers and dealers in tree nursery requisites. Special thanks are extended for 2014 to the companies Agrosolution, BASF, Bayer CropScience, Belchim, Compo Expert, DowAgroSciences, DuPont, Everris International BV, FCS, Haifa North West Europe NV, Heinrich Harden, HHG Heisterner Handelsgesellschaft mbH, Jost Mikronährstoff- u. Spezialdünger, Klanz Systeme, Knochen- u. Fettunion KFU, H. Meyer, Mivena BV, Neudorff, Plantacote BV, Syngenta, Spiess-Urania Chemicals, Stender AG, Vereinigte Kreidewerke Dammann and Yara.

The intensive experimental work was not possible without the assistance of practitioners.
We thank the organisations named below for their support in 2014:

BKN Strobel, Holm
Brandt, A., Prisdorf
Breckwoldt, Ellerbek
Cordes, Holm
Deutschmann, Pinneberg
Diercks, Pinneberg
Ellerbrock, Schenefeld
Flessau, Halstenbek
Glismann, Bullenkuhlen
Goldhagen, Bullenkuhlen
Hachmann, Barmstedt

Heydorn Söhne, Klein-Nordende
Heydorn, Bevern
Hofmann, Rellingen
Kirschke, Barmstedt
Kleinwort, Wedel
Kordes Rosen, Klein Offenseth-Sparrieshoop
Kordes, Bilsen
Krohn, Halstenbek
Kudenholdt, Ellerbek
Lohse, Lutzhorn
Lüdemann, Pinneberg
Martens, Appen
Michelsen, Pinneberg
Mohr, Bullenkuhlen
Ostermann, J., Ellerbek
Ostermann M., Ellerbek
Pein, H., Appen
Pein, T., Ellerhoop
Pein, U., Appen
Schrader, Kölln-Reisiek
Schröder, H., Ellerbek
Schuldt, J. & A., Ellerhoop
Seidler, Elmshorn
Stahl, Groß-Nordende
Thies, Seeth-Ekholt
Timm & Sohn, Tangstedt
Vogt, E., Pinneberg
Vogt, H., Rellingen
Zorn, Tangstedt

Co-operation with the Chamber of Agriculture, Horticultural Department and consultants in the pesticide industry was continued, paying particular attention to environmental protection. Special emphasis was given to collecting and disseminating information. As a result of the merger of the Ellerhoop site, co-operation has been further intensified.
Throughout the BdB assistance was provided by the “Production and the Environment”, “EDP” and “Deciduous Trees” committees and by the “Tree nursery working group”.
Experts and groups of visitors from Belgium, Denmark, Poland and the Netherlands, as well as groups of school children and students, were guided through the tree nursery sector and corresponding viewing programmes were prepared. Written and telephone enquiries, at home and abroad, were answered as before.
Attending conferences, seminars and exhibitions, as well as viewing experiments in Augsburg, Jork, Osnabrück, Rendsburg, Bad Zwischenahn and Holland directly formed part of the consultancy work.

Large brown weevil – alternative control methods

(Dr Heinrich Lösing, Horticultural Centre of the Chamber of Agriculture, Schleswig-Holstein)

The use of chemical pesticides in forests is subject to stringent requirements associated with the aim of minimising or even fully dispensing with their use.

However, following planting in the forests, the large brown weevil (*Hylobius abietis*) can wreak even greater havoc. The weevil predominantly eats the bark in the lower area of the plant up to a height of approx. 10-15 cm. Where there is strong infestation, complete failures can be expected. Amongst other plant species, *Pseudotsuga, Larix* and *Picea sitchensis* are particularly at risk. Damage is also frequently encountered in *Picea abies*.

Fig. 1: Large brown weevil

Fig. 2: Feeding damage on the *Pseudotsuga*

Where there is an established risk, it is possible to use insecticides as a means of treating individual plants after planting, using a so-called hollow-cone nozzle. This guarantees even wetting of the plants in the lower area. Depending on infestation, a further treatment in late summer may be necessary. Immersion treatment prior to planting is likewise possible. The products in question are shown in Overview 1.

Merit Forest WG (active ingredient: imidacloprid) and Gazelle (active ingredient: acetamiprid) are also used throughout Europe.

Overview 1: Authorised pesticides to combat the large brown weevil in Germany

Product	**Active ingredient**	**Manufacturer/licence**
Fastac Forst, 4% Fastac Forst Profi, 4%	15 g/l alpha-cypermethrin	BASF, until 2016
Forester, Cyperkill, 2%	100 g/l cypermethrin	Plantan, until 2016
Karate Forst Flüssig, 0,5%	100 g/l lambda cyhalothrin	Syngenta, until 2018

Alternative methods

For all the currently known alternative methods, a barrier is applied to the bark of the plant in the lower area, which the weevils cannot penetrate.

1. Use of special wax

The lower area of the plant (15-20 cm) is briefly held in a special wax manufactured by Norsk Wax, at a temperature of approx. 80°C whereupon it is cooled down to avoid damage. For smaller numbers of plants one can also use “double fountains” from Italy. The equipment was originally used for vine grafting (see Figure 4).

Fig. 3: Plant waxed at H. Schröder, Ellerbek

Fig. 4: Use of wax with the double fountain at H. Schröder, Ellerbek

The first steps to plant dipping automation have been achieved. At the Schrader tree nursery an industrial robot has been in use since last year for dipping the plants in wax (see Figure 5). This is a joint development with Assi Plantskydd AB. A further development comes from Norway from the Tronrud Engineering AS, Honefoss. Here, the plants are dipped in the wax with the help of conveyors (see Figure 6). In both systems, the plants have to be placed on special belts by the operators. A first prototype is in operation at the NPC Arbetorium in Laholm, Sweden.

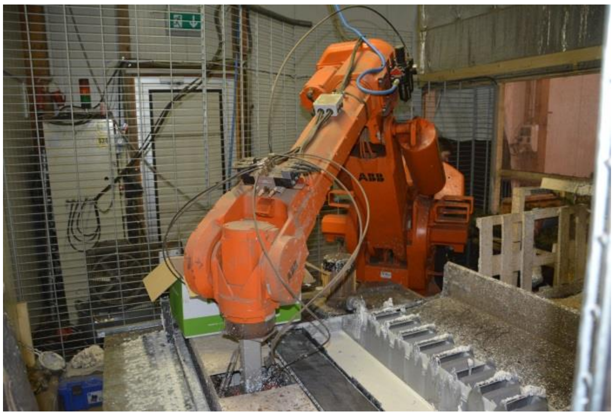


Fig. 5: Converted ABB industrial robot used for wax dipping

Fig. 6: Wax application for pines using the Tronrud Engineering machine

The use of wax is suitable for bare-root plants and plants in cone container trays. The price for the special wax is quoted at approx. EUR 4.50/kg. 4-10 g of wax per plant are required, depending on plant thickness.

2. <u>Use of wax coated board – Multipro system</u>

The system consists of white, waxed cardboard wraps which are put over the plants from the top.


Fig. 7: Multipro wrap is manually pulled from the tip over the larch


Fig. 8: Multipro-wrap showing the green shoots after planting

Depending on the thickness of the plants, openings of 22, 24 or 26 mm can be used. The system was developed by Svenska Skogsplantor in Sweden. The plants are packed in boxes of 150. The boxes can be cut open by the planter in the field thereby producing a carrying basket (see Figures 9 and 10).

Fig. 9: Plants with Multipro wrap are packed in cardboard boxes

Fig. 10: Cut open carrying box for planting in the wood

The system is ideal for plants in cone containers and for bare-root plants. However, applying the wrap is very time consuming; initial extrapolations assume 200-260 plants per employee per hour.

3. Use of adhesive with sand, Conniflex system

The system was developed by the Swedish company, BCC, Landskrona, especially and exclusively for plants in cone containers. The lower part of the plant is initially coated with adhesive and then immediately sprinkled with fine sand. After a drying phase of approx. 10 minutes in a drying machine, the plants are ready for planting.

Fig. 11: Application of adhesive, BCC works photograph

Fig. 12: Sprinkling with fine sand, BCC works photograph

The manufacturer indicates an output of 6 crates of 54 plants per minute. five machines are currently in use in Sweden. The cost of each machine is set at approx. EUR 900,000.

4. Other methods

Intensive work is currently being carried out to find other methods to optimise efficacy and application. These methods are still in the trial phase, such as for example the P. Protect system of the Schjott tree nursery in Denmark.

Summary

As a result of the FSC and PEFC certification systems, pressure to use alternative methods to protect against pest damage caused by the large brown weevil will also continue to increase in German forests. In Sweden, the most intense efforts are currently being made in this respect. It is certainly expected that the method will “radiate out” to other European countries in the near future.

All alternatives currently used are associated with high cost. The use of wax and waxed cardboard wraps is up to now either not at all possible or only possible in part using machines. Depending on method, an employee can process between 200 and 500 plants per hour. This results in a considerable increase in cost.

All alternatives currently available only offer protection in the lower area of the plant. Where there is greater risk of infestation, however, plants are even damaged above the protective mantel. There is, as yet, no solution available to deal with this problem.

Widely discussed are silvicultural measures to prevent infestation by weevils. This will certainly also include treating the soil prior to planting. Consideration is also being given to the use of stronger plants and increasing plant density.

Extensive tests are currently taking place at a wide variety of locations in Europe. A final assessment, regarding efficacy and practicability of use, will probably only be possible in the next 3-5 years.

Testing the efficacy of fungicides against *Fusicladium* leaf spot in forsythia

(Dr Heinrich Lösing, Director of the Chamber of Agriculture, Schleswig-Holstein; Christina Hilger, BTB GmbH)

1. Aim and structure of the experiment

Fusicladium leaf spot has been noted on forsythia leaves for some years. It is highly probable that it is of the *F. oleagineum* type. Up to now, this fungal pathogen has not been observed in Germany. The disease is characterised by light spots and in part by a blistery distension of the leaves. The spots appear to be slightly oily on the undersides of the leaves. As the infection progresses the affected areas dry out to form brown spots. Severely infected plants are unsaleable when in leaf.

Fig. 1: Light spots on the leaves caused *Fusicladium*

Fig. 2: Advanced infection of the leaves with *Fusicladium*

Fig. 3: Oily spots on the underside of the leaf caused by *Fusicladium*

Fig. 4: Manifestation of the infection by *Fusicladium* at the test site

In the present test, various fungicides of different efficacy classes were compared with regard to their possible effectiveness against the fusicladium leaf spot pathogen. This test should be regarded as an initial tentative attempt in preparation for an exact experiment to be set up next year.

On 30 July 2014, the test was set up with two replications. The test plants were infected forsythia in a stock plant area. There were clear differences in initial infection in the prepared plots.
The fungicides listed in table 1 were applied with a knapsack sprayer to the point of run-off at three treatment dates roughly two weeks apart.

Table 1: Test treatments

Preparation	**Quantity used**	**Active ingredient**	**Licence**	**Notes**
Control	-	-	-	-
Amistar Opti	2.5 l/ha	80 g/l Azoxystrobin 400 g/l Chlorothalonil	section 22 (2) B, St	N, Xn, B4
Cercobin FL	1 l/ha	500 g/l Thiophanate-methyl	section 22 (2) B, St	Xn, B4
Dithane Neo Tec	2 kg/ha	750 g/kg Mancozeb	PA	N, Xn, B4
Folicur	1 l/ha	250 g/l Tebuconazole	section 22 (2) B	N, Xn, B4
Luna Sensation	0.8 l/ha	250 g/l Fluopyram 250 g/l Trifloxystrobin	section 22 (2) B applied for	N, Xn, B4
Mirage 45 EC	1.2 l/ha	450 g/l Prochloraz	section 22 (2) B, St	B4

Table 2: Treatment dates and weather conditions

Date	**Temperature**	**Wind**	**Weather conditions**
30/07/2014	22°C	2-3 m/sec	Cloudy, slightly squally
13/08/2014	23°C	2-3 m/sec	Sunny
26/08/2014	22°C	0-1 m/sec	Cloudy

The summer in Schleswig-Holstein was marked by low quantities of precipitation, sunny weather and warm temperatures. As a result, only slight growth was recorded during the observation period from 30 July 2014 to the beginning of September.
On 13 August 2014 and 26 August 2014 the plants in each plot were classified according to their degree of infection with fusicladium leaf spot disease. Classification was undertaken as follows: 1 = less than half the plants in a plot affected, 2 = more than half of the plants in a plot affected, 3 = severe infection – almost all plants in a plot affected. On 1 October 2014 the shoots showing new growth were graded. For this, 10 shoots with new growth were observed in each plot. The level of infection of these shoots, i.e. of the youngest leaves, was rated as

follows: 0 = no symptoms, 1 = 1 to 25% of leaves with symptoms, 2 = 26-50% of leaves with symptoms, 3 = > 50% of leaves with symptoms.

2. Results

During the first four weeks of the experiment, no significant differences were observed between the treatments. Many of the plants were heavily infected and, because of the low rainfall, only grew slowly. Plant infection rose during this period of observation in all plots, with the exception of the plot treated with Folicur.

During the final grading on 1 October 2014, differences were seen amongst the shoots exhibiting clear growth, between the control and the other treatments.

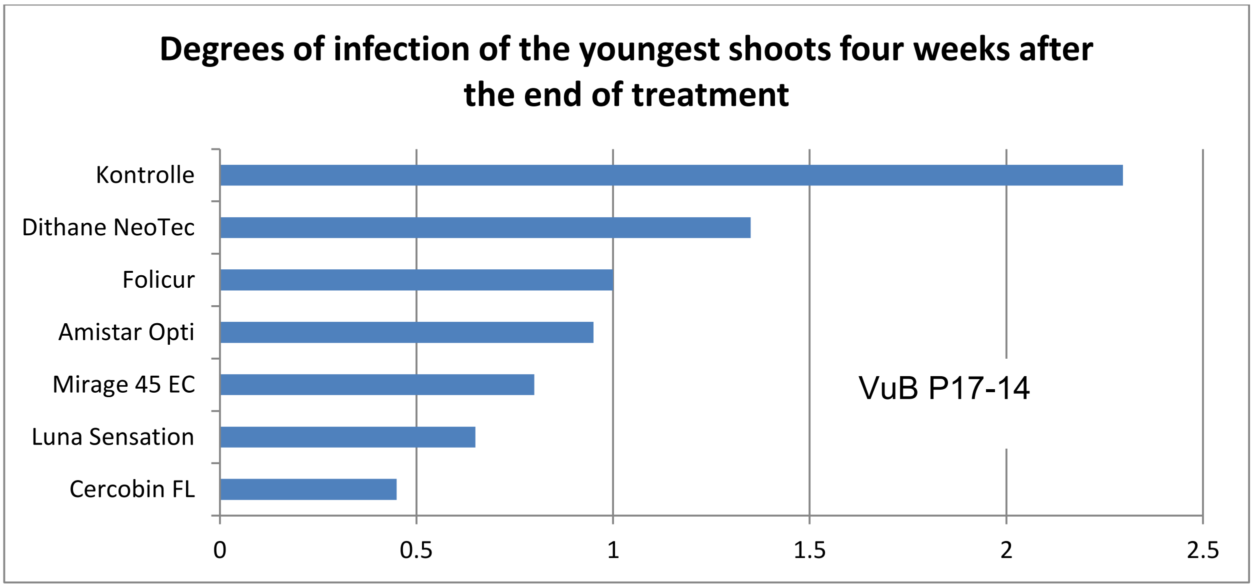


Fig. 5: Degrees of infection with fusicladium leaf spot disease on the youngest shoots (0 = no symptoms; 1 = up to 25% of leaves with symptoms; 2 = 26-50% of leaves with symptoms; 3 = > 50% of leaves with symptoms), mean value of grades from two replications

In the control plots there were clearly fewer new shoots following the precipitation and dew conditions than in the treated plots. The shoots were also smaller and more stunted than the youngest shoots in the treated plots.

The youngest shoots of the treated plants were, in part, completely free of symptoms. The least infection was discovered in the youngest shoots of the plants treated with Cercobin FL, Luna Sensation and Mirage 45 EC.

Development of the symptoms in the lower part of the plants, i.e. in the area where there was no new growth, was unchanged in all plants when the grading was undertaken on 26 August 2014.

The following figures reflect the results shown graphically above.

Fig. 6-7: Taken from the test plots on 1 October 2014 – left, untreated plants, right, plants treated with Cercobin FL

3. Summary

In order to combat fusicladium leaf spot, the effect of various fungicides was compared in an initial tentative test as the forerunner to a more detailed experiment.

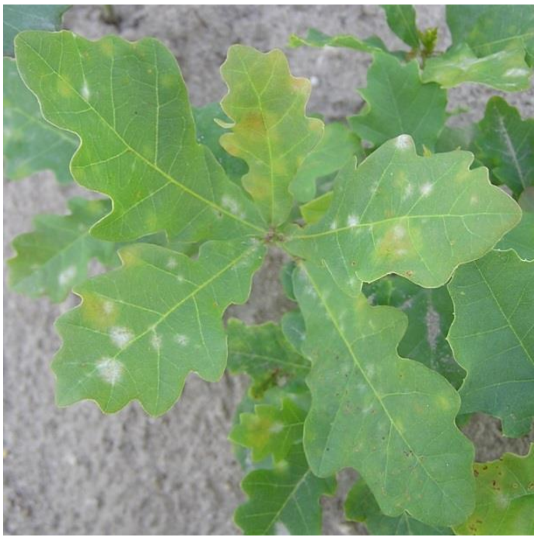
At the end of the experiment, all the treated plants showed distinctly less infection in the young shoots, compared with the control.

During the course of treatment, no change in infection was discovered amongst the older shoots. It is therefore possible to ascribe a preventative effect of varying degrees to the fungicides used in the experiment. Accordingly, the Cercobin FL, Luna Sensation and Mirage 45 EC fungicides appear to have a more pronounced effect than the comparative treatments. All the fungicides should be examined again in a future exact experiment. It is recommended that the test be set up when the initial symptoms occur.

<u>Examining the efficacy of fungicides against powdery mildew in oaks</u>
(Britta Zielke)

1. Aim and structure of the experiment

Powdery mildew in oaks (*Microsphaera alphitoides*) is marked by the characteristic white coating on the leaves and young shoots. It causes deformation of the leaves and can lead to reduced growth especially in seedbeds and nursery beds. In the past, the Versuchs- und Beratungsring carried out repeated tests to treat powdery mildew fungi. Products that were developed for crop cultivation were tested in tree nurseries and allowed an extension of the treatment intervals of 7-14 days to more than 28 days (see Annual Report 1994, p. 37 et seq. and Annual Report 1997, p. 35 et seq.). Even in later years, regular tests against powdery mildew were carried out using new products (see Annual Report 2011, p. 14 et seq., AR 2012, p. 15 et seq.). The fungicide, Harvesan, which was used following approval to section 22 (2), played an important part for many years and became the standard. Against the background of the revocation of the licence for Harvesan, a large number of fungicides was again tested for efficacy and compatibility.



Figs. 1 – 2: Experimental area and initial infection at the start of the experiment

The experiment was carried out using three replications on *Quercus robur* seedlings (1/0). Starting on 12 June 2014 the experimental fungicides shown in summary 1, were applied during five spraying sessions at roughly three weekly intervals (see summary 2) using a plot sprayer with Lechler injector nozzles IDN 120-025 lilac, at a pressure of 5.5 bar and with 512 l/ha water.

Summary 1: Test treatments

Preparation	Quantity used	Active substance	Licence	Notes
Control				
Askon	1 l/ha	Difenoconazole (125 g/l) Azoxystrobin (200 g/l)	section 22 (2) ZG, St	N, Xn, B4
Bayfidan	0.5 l/ha	Triadimenol (250 g/l)	section 22 (2) B	Xn, B4
Ceralo	1.2 l/ha	Tebuconazole(167 g/l) Triadimenol (43 g/l) Spiroxamine (250 g/l)	Cereals	N, C, B4
Harvesan	0.8 l/ha	Carbendazim 125 g/l) Flusilazole (250 g/l)	Use by March 2015!	N, T, B4
Test treatment A			-	
Luna Experience	1 l/ha*	Fluopyram (200 g/l) Tebuconazole (200 g/l)	section 22 (2)* B, St	N, Xi, B4
Luna Privilege	0.5 l/ha	Fluopyram (500 g/l)	Vine	N, B4
Luna Sensation	0.8 l/ha	Fluopyram (250 g/l) Trifloxystrobin (250 g/l)	Asparagus, lettuce, strawberry	N, Xn, B4
Pronto Plus	1.5 l/ha	Tebuconazole (133 g/l) Spiroxamine (250 g/l)	Cereals	N, Xi, B4
Test treatment B			-	Xi, B4
Talendo Extra	0.4 l/ha	Proquinazid (160 g/l) Tetraconazole (80 g/l)	Vine	N, Xn, B4
Vertisan	1.5 l/ha	Penthiopyrad (200 g/l)	-	-
Test treatment C			-	

*maximum quantity approved under section 22 (2): 0.25 l/ha, or 0.125 l/ha*mKh

Summary 2: Treatment dates and weather conditions

Date	Temperature	Wind	Weather conditions
12/06/14	25 °C	2-3 m/sec	Sunny
03/07/14	22°C	2-3 m/sec	Occasionally cloudy
23/07/14	26°C	1-3 m/sec	Sunny
13/08/14	22°C	2-3 m/sec	Sunny
02/09/14	19°C	1-2 m/sec	Sunny

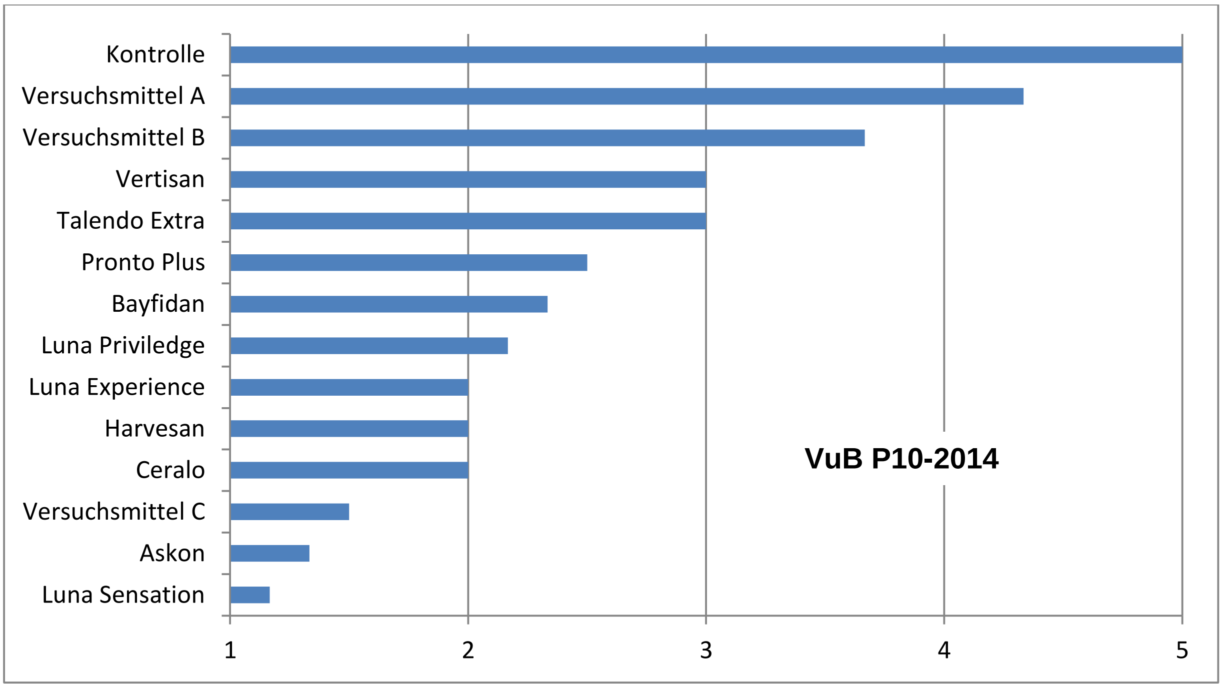
Summer 2014 in Schleswig-Holstein was marked by low precipitation, sunny weather and warm temperatures. In practice, very severe pressure from powdery mildew was observed on many trees. There was already slight infection from powdery mildew at the test site on the first treatment date (Figure 2).

Test treatment C was not yet available at the first treatment date. Therefore, the initial application on these plots took place using Kumulus (80% sulphur) at 3 kg/ha.

On the treatment dates and finally, on 12 September 14, all the plots were rated according to the following grading keys: 5 = very severe infection, 4 = severe infection, 3 = average, 2 = low infection, 1 = no infection of powdery mildew. Also, at the end of the experiment, the size of 50 average plants was determined in two repeat tests in each plot.

2. Results

Even on the second treatment date, infection with powdery mildew had increased significantly in the untreated plots. The differences compared with the control plots and between the treated plots continued to intensify during the course of the experiment. The figure below shows the average infection of powdery mildew at the final grading on 12 September 14.



Kontrolle = control/Versuchsmittel = test treatment

Fig. 3: Degree of infection with powdery mildew, (1 = no infection, 5 = very severe infection). Mean final grading values from 3 repeat tests on 12 September 14

Very many of the new fungicides showed a good to very good action against powdery mildew by the end of the experiment. The effect of some of the products under the test conditions was even better than the old standard, Harvesan. These included the products, Askon, Luna Sensation and Luna Experience, test treatment C and Ceralo. The following Figures 4-9 show sections of the plots.

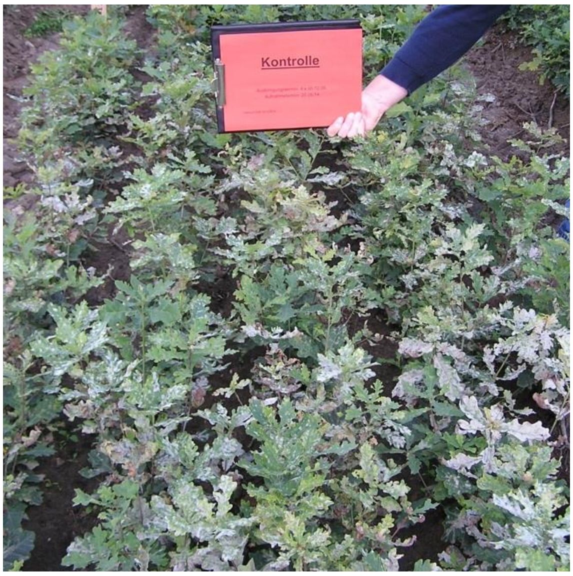


Fig. 4: Untreated plot on 25 August 14

Fig. 5: Harvesan 0.8 l/ha

Fig.6: Ceralo 1.2 l/ha

Fig. 7: Test treatment A

Fig. 8: Luna Privilege 0.5 l/ha

Fig. 9: Luna Sensation 0.8 l/ha

Throughout the entire period of the experiment, no damage to the oak seedlings caused by the fungicides was observed. No inhibiting effects of the tested fungicides on oak growth was observed in this test. Severe infestation with powdery mildew, on the other hand, clearly inhibited the growth of the oaks. This was observed in the untreated control and in the plots treated with test treatment A.

<u>3. Summary</u>

An experiment was conducted against the background of the revocation of the licence for the fungicide, Harvesan, which for years has been a standard product for combating powdery mildew fungi in tree nurseries. 13 fungicides were compared for their effectiveness against powdery mildew in oaks. With most of the experimental products, one-year old, largely mildew-free, seedlings of *Quercus robur* were produced, with five treatments at intervals of roughly three weeks. Only the plots treated with test treatments A and B and those treated with Talendo Extra and Vertisan showed higher degrees of powdery mildew infection.
In the meantime, the use-up period for Harvesan has expired. The VuB has applied in good time for approvals under section 22 (2) for its members with production areas in Schleswig-Holstein. In addition to the licensed or approved products listed in Table 1, these members can now use the fungicides, Ceralo (1.2 l/ha) and Luna Sensation (0.8 l/ha).

Examining the efficacy of pesticides against sooty mould
(Britta Zielke)

1. Aim of experiment

During the years 2012 and 2013, the Testing and Advisory Council conducted extensive tests on combating wax scales in *Taxus* and *Ilex* (see Annual Report 2012, p. 8 et seq. and Annual Report 2013, p. 8 et seq.). The action of repeated oil pesticides against winter stages of the scale insect was confirmed. Moreover, various insecticides were tested against the freshly emerged larvae of the scale insect in summer and overwintered larvae in spring.

Our attention is usually drawn to a scale insect infestation only as a result of sooty mould. The latter develops on the sticky excretions of the scale insects and cover leaves or needles in a stubborn black coating during the course of late summer. The coating is a visual problem and renders plants unsalable, although it can be wiped off and the plant tissue underneath is undamaged. While it is very firmly established during the dispatch period in autumn, it already starts to weather in spring and shows initial cracking.

We read over and over again that we can attack this coating with fungicides. Irrespective of whether this an approved use, this experiment should answer the question of whether such treatments have any effect at all.

Figure1: On leaves of *Ilex* heavily infested with mealy bugs there is a layer of sooty mould, which can, in principle, be wiped off. This does not damage the plant tissue but does represent a visual problem and prevents the plants from photosynthesising

2. Experiment structure

The plants used for the test were *Ilex* x *meservae* grown in the open, 100-125 cm tall, the leaves of which were heavily coated with sooty mould. The experiment was set up on 20 February 2014 in sunny weather and at 8°C with three replications (with two plants each).

The products listed in the following table were applied using the knapsack sprayer to the point of run off. Attention was paid to careful wetting of the plants.

Table 1: Test treatments

Pesticide	Conc.	Active ingredient	Authorisation	Instructions/ Notes
Control	-	-	-	-
Askon	0.1%	Difenoconazole 125 g/l Azoxystrobin 200 g/l	section 22 (2) B, St fungicide	N, Xn, B4
Finalsan	2%	Pelargonic acid 186.7 g/l	section 22 (2) B gg algae	Xi, B4
Folicur	0.1%	Tebuconazole 250 g/l	section 22 (2) B fungicide	N, Xn, B4
Para Sommer Oil	2%	Paraffin oil (654 g/l)	PA	B4
Switch	0.1%	Cyprodinil 375 g/kg Fludioxonil 250 g/kg	section 22 (2) B fungicide	N, B4
“Spüli”	0.05%		-	-

The level of sooty mould was assessed two and five weeks after treatment.

3. Results

Differences could already be observed between treatments two weeks after the start of the experiment. One treatment differed distinctly from all the others. In the case of the plants treated with Para Sommer oil the coating was heavily cracked and began to peel off. All the plants treated with the other products were visually the same as the untreated ones.

Five weeks after the start of the experiment, the plants treated with Para Sommer oil had hardly any sooty mould coatings still on the leaves. Treatment with the mineral oil pesticides caused the plants to have notably shiny leaves. Residues of the sooty mould coatings still stuck to the shoots inside the growing points.

Even in the other treatments, the sooty mould coatings started to fall off. However, the plants still had distinctly more leaf coating and a lifeless appearance.


Fig. 2: Shoot of untreated plant on 14 March 2014
Fig. 3: Shoot of a plant treated with Para Sommer Oil (2%) on 14 March 2014

4. Summary

In order to establish whether fungicides or household remedies, such as Spüli (a dishwashing detergent), are suitable for removing sooty mould coatings on leaves of evergreen plants infested with scale, severely infested *Ilex* x *meservae* were treated in early spring with various products. Apart from the fact that such treatments are not authorised, the tested products overwhelmingly brought about no improvement in the appearance of the plants.

One exception was the product Para Sommer Oil. It had a clear effect and speeded up the cleaning of sooty mould. Following authorised treatment of the scale insect larvae with a mineral oil preparation, a positive side effect was more rapid removal of sooty mould coatings.

Scale infestation inspection, for example when buying plants, and consistent treatment of any larvae present, prevent the problem of sooty mould formation right from the outset.

Herbicides for use on conifer seedbeds prior to crop germination
(Britta Zielke)

1. Aim of experiment

Although special approval could be obtained in previous years for the use of the soil sterilant, Basamid, the future authorisation situation of this product, which is regularly licensed in other European countries, is uncertain. For tree nurseries, soil sterilisation to combat soil fatigue and soil-borne pathogens is essential. In tree nursery production, conifers are only usually sown on areas where Basamid granules have previously been used to sterilise the soil, in order to give the conifer seedlings a pathogen-free start. This has the positive side effect that weed seeds in the soil have also been killed off and considerably less time has to be spent combating weeds during the initial stage. If it is impossible to sterilise the soil, German tree nurseries would be seriously disadvantaged in competition with the rest of Europe.
In any case, it would then be important to have an herbicide strategy in place in order to keep the amount of manual weed removal to a minimum. For compatible species, it is possible at the moment to use the herbicides, Goltix Gold (metamitron) or Pyramin WG (chloridazon), before the conifer seedlings emerge or to use Kontakt 320 SC (phenmedipham) or grass herbicides after the seedlings emerge. In the experiment described below, further herbicides were tested for use before conifer seedling emergence.

Fig. 1: Seedbed of *Picea abies*. What herbicide measures are possible before the conifer seedlings emerge?

2. Experiment structure

The experiment was carried out on 9 May 2012 on sand-covered, decontaminated seed beds of *Abies nordmanniana* and *Picea sitchensis* approximately one week after sowing. On 31 May 2012 the same experiment was carried out on sand-covered, non-decontaminated seed beds of *Abies nordmanniana*, *Picea abies* and *Pseudotsuga menziesii* two days after sowing, again in dry weather conditions. Whilst the compatibility of herbicides can be more clearly observed in decontaminated beds, the herbicide weed spectrums could not be ascertained there.

The experimental treatments listed in Table 1 were applied with a plot sprayer with Lechler injector nozzles IDN 120-025 lilac and 512 l/ha of water and replicated twice. Assessments were carried out several times, in each case, from two weeks after application until the end of August.

Table 1: Test treatments

Test agents	Q'ty/ha	Active ingredient	Licence	Notes
Arelon TOP	1.5 l/ha	500 g/l Isoproturon	section 18 b B	Xn, B4, NG 408
Arelon TOP + Goltix Gold	1.5 l/ha + 2.5 l/ha	500 g/l Isoproturon 700 g/l Metamitron	section 18 b B section 18 b B	Xn, B4, NG 408 N, Xn, B4
Betanal MaxxPro	1.5 l/ha	60 g/l Phenmedipham 27 g/l Lenacil 75 g/l Ethofumesat 47 g/l Desmedipham	section 18 b B	N, Xi, B4
Boxer	5 l/ha	800 g/l Prosulfocarb	section 18 a ZG	N, Xi, B4
Goltix Gold	5 l/ha	700 g/l Metamitron	section 18 b B	N, Xn, B4
Kontakt 320 SC	1.5 l/ha	320 g/l Phenmedipham	section 18 a B	N, Xi, B4
Tacco	0.3 l/ha	100 g/l Metosulam	Maize, potatoes	N, Xn, B4, NG 405
Vorox F	30 g/ha	500 g/kg Flumioxazin	ZG	N, T, B4, NG 405
Vorox F	60 g/ha	500 g/kg Flumioxazin	ZG	N, T, B4, NG 405

NG 405=Not used on drained surfaces.

NG 408=Not used on drained surfaces between 1 June and 1 March.

3. Results

3.1 Compatibility

At both sites the *Abies* seedlings started to emerge a few days after treatment. *Picea* and *Pseudotsuga* seedlings began to emerge one to two weeks after treatment. Problems with respect to the tolerance of some herbicides very quickly became apparent. The two spruce varieties in particular were very sensitive to herbicides. With some treatments, the seedlings germinated very sparsely or died immediately after emergence. 'Thinning out' caused by the herbicides, Arelon TOP, Arelon TOP in combination with Goltix Gold, the herbicide, Tacco, and Vorox F was between 50 and 98% for *Picea sitchensis.* For the treatments, Betanal MaxxPro, Boxer, Goltix Gold and Kontakt 320 EC, a 10-20% reduction in the number of Sitka spruce seedlings was noted in one of the replicates relative to the control. Possible damage caused by the herbicides cannot be ruled out in this case.

Picea abies seedlings were similarly sensitive to the herbicides. Thinning out of the seedlings was between 30 and 70% for the treatments, Arelon TOP, Arelon TOP in combination with Goltix Gold, Tacco and Vorox F.

It was difficult to assess the sensitivity of the *Pseudotsuga menziesii* as a result of the irregular and poor germination result. However, clear damage to the seedlings was observed for the treatments, Tacco and Vorox F 60 g/ha. Damage cannot be ruled out in the case of the other treatments.

A summary of the phytotoxicity results is given in Table 2.

Table 2: Summary of phytotoxicity results

Test agent	**Q'ty/ha**	*Picea sitchensis*	*Abies nordmanniana*	*Picea abies*	*Pseudotsuga menziesii**
Arelon TOP	1.5 l/ha	**-**	**+-**	**-**	
Arelon TOP + Goltix Gold	1.5 l/ha + 2.5 l/ha	**-**	**+-**	**-**	
Betanal MaxxPro	1.5 l/ha	**+-**	**+**	**+**	
Boxer	5 l/ha	**+-**	**+**	**+**	
Goltix Gold	5 l/ha	**+-**	**+**	**+**	
Kontakt 320 EC	1.5 l/ha	**+-**	**+**	**+**	
Tacco	0.3 l/ha	**-**	**-**	**-**	**-**
Vorox F	30 g/ha	**-**	**+**	**-**	
Vorox F	60 g/ha	**-**	**+**	**-**	**-**

- = phytotoxic, + = not phytotoxic, +- = damage possible
*it was not possible to make a statement on sensitivity of *Pseudotsuga* because of the poor germination results in most cases.

For *Abies nordmanniana* sown on decontaminated land, the results with respect to phytotoxicity looked very good four weeks after treatment. 60% of the seedlings shed their seed cases. Seven weeks after treatment the plots treated with Arelon TOP revealed a barely perceptible change of colour compared with the seedlings of the untreated control. This damage was slightly more visible on the seedlings treated with Tacco. The cause of this was revealed when individual plants were pulled out: the plant roots, from the plots treated with Tacco, were shorter and stunted. At the end of August we could also clearly make out that the development of some of these plants was retarded and the foliage was slightly lighter in colour. For the treatments, Arelon Top and Arelon Top in combination with Goltix Gold, possible damage was less clear. The slight discolouration did not become more intense and was only present in one replicate.



Fig. 2: *Picea sitchensis* were very sensitive to herbicides; on many plots, there were extensive failures
Fig. 3: Damage caused by the herbicide, Tacco, barely detectable above ground, is shown by looking at the roots; left: three plants from untreated plots, right: three plants from plots treated with 0.3 l/ha Tacco

3.1 Efficacy

The beds which had not been decontaminated, which had been weed-free at the start of the experiment, became overgrown with weeds by the end of August. The weed population was made up predominantly of chickweed, annual meadow grass, creeping yellow field cress and tufted vetch. The average percentage of weed cover on the untreated plots was 70% at the end of August, 12 weeks after treatment. On average, the treatments, Goltix Gold, Kontakt 320 SC and Betanal Maxx Pro, did not do significantly better. The herbicides had no adequate effects on creeping yellow field cress, tufted vetch and chickweed. A reduction in the percentage of weed cover to below 50% was achieved with the herbicides, Vorox F (30 g/ha), Arelon Top and Arelon Top in combination with Goltix Gold. With an average percentage weed cover of less 30%, the herbicides, Vorox F (60 g/ha) and Tacco, were even more effective (see Figure 4).

The good reduction in the percentage of weed cover for the treatments, Vorox F (60 g/ha) and Tacco, can be attributed to the fact that they were the only ones to have a specific effect on the creeping yellow field cress and tufted vetch, which were two of the dominant weeds. In particular, the effect of the herbicide, Tacco, on creeping yellow field cress is well known and was also notable in this experiment, although at the time of treatment no green parts of the creeping yellow field cress were seen. Unfortunately the good efficacy of the most effective treatments was offset by their phytotoxicity to the tree seedlings.

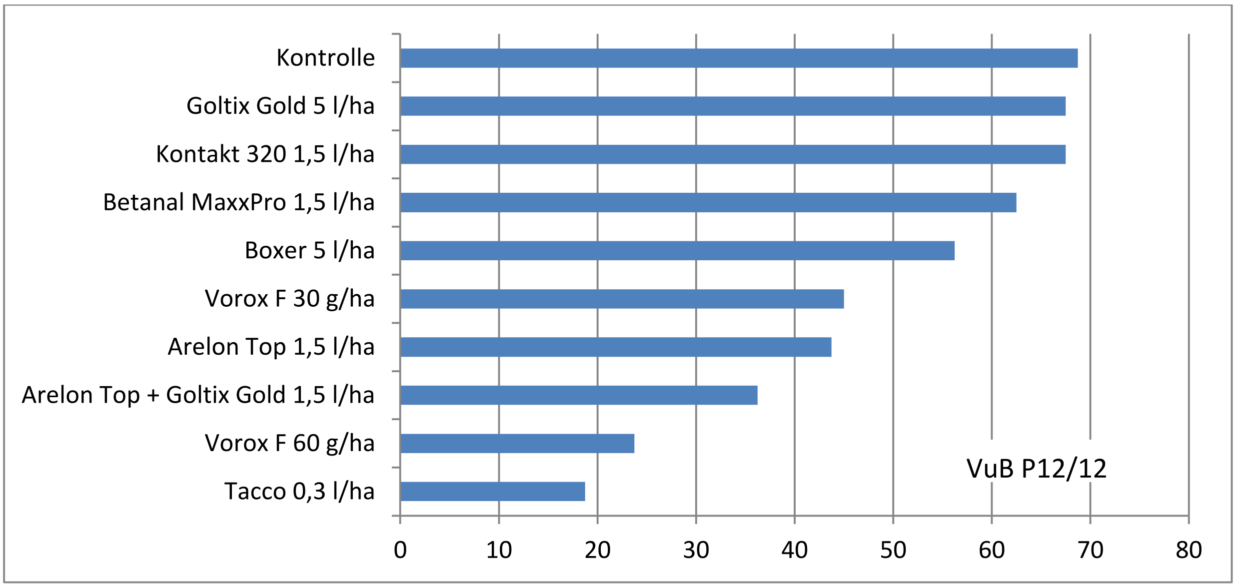


Fig. 4: Average percentage weed cover on non-decontaminated seed beds 12 weeks after the start of the test

4. Summary

Experiments on the phytotoxicity of herbicides prior to seedling emergence on sand-covered sowings of *Abies nordmanniana*, *Picea sitchensis*, *Picea abies* and *Pseudotsuga menziesii,* partly on decontaminated and partly on non-decontaminated land, showed that the most effective treatments were also the most damaging. Furthermore, the tree species differed in their sensitivity to the herbicides from highly sensitive in the case of *Picea sitchensis* to relatively insensitive in the case of *Abies nordmanniana*. At least in the case of seedbeds of *Abies nordmanniana* and *Picea abies*, the herbicides, Betanal MaxxPro (1.5 l/ha), Boxer (5 l/ha), Goltix Gold (5 l/ha) and Kontakt 320 EC (1.5 l/ha), were compatible prior to germination. However, these herbicides had no effect on the dominant weeds of creeping yellow field cress and tufted vetch, which occurred during the experiment. In practice, seedbeds are usually created on land decontaminated by Basamid granules, for phytosanitary reasons. Sites with rhizomatous weeds should be avoided under all circumstances. If it is not possible to use Basamid then herbicide treatments take on a greater importance prior to seedling emergence. Because of the high risk of damage, however, they can only be used to a very limited extent.

Use of Vorox F for the winter treatment of deciduous container-grown trees

(Britta Zielke)

1. Experiment aim

Before covering container-grown plants with membranes or nets or before clustering all the plants together for overwintering, treatment with herbicides is frequently carried out as a precaution. This means that the pot surfaces remain weed-free right into the spring and at the time of peak work in spring, there is less work to remove weeds. In the past, a combination of Kerb Flo (1.5 l-2 l/ha) and Flexidor (0.5-1 l/ha) has proved itself. This herbicide combination tackles existing chickweed, annual meadow grass and impatiens. In addition, the Flexidor herbicide provides yet another action against some germinating dicotyledonous weeds. However, moss and liverwort species as well as common groundsel or hairy willowherb are either not or only inadequately tackled by this herbicide combination.

From 2003, the VuB has conducted experiments with the then still unnamed test treatment, Vorox F. It was revealed that the product has a very good and long-lasting pre-emergence effect on mosses and dicotyledonous weeds and if applied in late autumn, is safe to use on a very large number of coniferous species. The application rates examined were between 0.1 and 3.2 kg/ha.

In the meantime, Vorox F is successfully being used in the field for deciduous species (e.g. avenue trees or single plants) at rates of up to 300-500 g/ha. However, there is no comprehensive safety tests for its use in container cultivation. The experiment described below was intended to clarify to what extent the herbicide, Vorox F, is suitable for treating a large range of container-grown deciduous trees in late autumn.

Fig. 1-2: Pot surfaces after overwintering. The plants in the middle were treated with 200 g/ha Vorox F in late autumn

2. Experiment structure

The experiments were conducted on three nurseries on a total of more than 80 different deciduous tree species and varieties. The test plants were container-grown in a pot size of 9 x 9 cm and a capacity of five litres. At least five trees of each tested species were treated with the herbicide, Vorox F (active ingredient: 500 g/kg flumioxazin) at a rate of 200 g/ha. The same number of plants were left untreated and these were set up adjacent. Application took place on one nursery using the plot sprayer with Lechler nozzles ID 120-025 lilac, at a pressure of 5.5 bar and a speed of 3 km/h. The result was a water volume rate of 512 l/ha. The other two nurseries worked with a Birchmeyer Flox backpack sprayer using a spray boom with three TeeJet 11002 nozzles. By maintaining a spray pressure of 2 bar and a walking speed of 2 km/h, a water volume rate of 500 l/ha was applied. The treatments took place between 25 November 2013 and 10 December 2013 on dry plant surfaces. The weather was sunny to cloudy and the temperatures were between 3°C and 7°C. Some of the plants were placed in tunnels for overwintering before Christmas. Natural precipitation fell between treatment and erection of the winter protection tunnel.

The plants were assessed from the beginning of March at intervals of two weeks. Attention was paid to delayed shoot emergence, damage to the buds or bark and, in the case of evergreen subjects, to leaf damage.

Fig. 3-4: Experimental plants on the day of treatment. Left: one treated and one untreated bed on 26 November 2013. Individual species still had foliage at the start of the experiment, such as *Colutea*, *Forsythia*, *Philadelphus* and *Weigela*.
Right: The plants in the front section of the bed were treated on 10 December 2013; the same plant subjects at the back remained untreated.

3. Results

3.1 Efficacy

In evaluating the experiment, consideration was given to plant susceptibility. Even so, the effect on weeds was noticeable. This effect was observed even in plants where the pot surface had been scattered with sawdust after potting. The development of moss and liverwort in particular, was prevented by treatment with Vorox F. Liverwort that was present at the start of the experiment died as a result of treatment with 200 g/ha Vorox F.

Fig. 5-6: Differences in the degree of coverage with mosses and weeds on 16 April 2014.
The plants in the top image were untreated.
The plants in the bottom image were treated on 10 December 2013 with 200 g/ha Vorox F.

3.2 Plant susceptibility

Plant susceptibility was assessed until 9 May 2014. A summary of the results is shown in the table towards the end of the report.

Treatment with the herbicide, Vorox F, at a rate of 200 g/ha from the end of November, resulted in damage particularly to evergreen test subjects. Some of the leaves of *Prunus laurocerasus* ‘Otto Luyken‘ and *Pyracantha* ‘Red Column‘ showed necrotic marks the spring after treatment.

Plant species with green and coloured barks were frequently but not always, sensitive to treatment with Vorox F in late autumn. Whilst *Cytisus scoparius* showed no damage, and *Kerria* only slightly delayed shooting, the bark of *Vaccinium* and all the *Cornus* species tested were very sensitive and became discoloured.

Fig. 7-10: Damage caused by 200 g/ha Vorox F in evergreens and trees with coloured bark. From top left to bottom right: *Pyracantha*, *Prunus laurocerasus*, *Vaccinium*, *Cornus*.

Dead buds were also observed in *Euonymus alatus* and *E. europaeus* treated with Vorox F. The untreated plants distinctly had more shooting buds than the treated ones. *Syringa vulgaris* was very closely observed for this symptom because of their large green buds. However, in this experiment no differences were discovered between treated and untreated plants.

Fig. 11: Damaged *Eunonymus europaeus* on 3 April 2014. The three plants on the right were treated with 200 g/ha Vorox F on 25 November 2013.

Furthermore, there were slight to distinct delays in shoot emergence in some woody plants and shrubs. The less obvious cases would not have been noticed without the untreated control plants for comparison. The damage cleared up by the beginning of May. The group of plants with slightly delayed shoot emergence included, for example, *Hydrangea arborescens* ‘Annabelle‘, *Philadelphus* ‘Schneesturm‘, *Physocarpos opulifolius* ‘Diabolo‘, *Prunus cistena*, *Spiraea* (various types) and *Weigela* ‘Bristol Ruby‘ and *W.* ‘Variegata’.

Fig. 12: Delayed shoot emergence in a series of deciduous trees on 16 April 2014. The plants in the back row are untreated. The plants in the front row were treated with 200 g/ha Vorox F on 10 December 2013. Two weeks later some of the differences could no longer be seen.

Clearer delays in shoot emergence were observed in deciduous trees, i.e. *Amelanchier lamarckii*, *Colutea arborescens*, all *Cornus* species tested and *Deutzia*. Such damage would not have been acceptable commercially. Likewise distinct delays in shoot emergence also occurred in evergreen shrubs and woody plants in addition to some leaf damage. Examples include *Cotoneaster dammeri* 'Coral Beauty', *Euonymus fortunei* species, *Lonicera* 'Maigrün' and *Pyracantha* 'Red Column'.

Fig. 13: Assessment on 22 April 2014 and damage to ground cover plants. The plants in the front row were treated with 200 g/ha Vorox F on 25 November 2013 and those in the back row were part of the untreated control.

Besides which, however, there were also many hardwood trees which showed no herbicide damage in spring following winter treatment with 200 g/ha Vorox F. Amongst these were *Acer campestre*, *Aronia melanocarpa*, *Carpinus betulus*, *Chaenomeles japonica*, *Corylus avellana*, *Cotoneaster acutifolus*, *Crataegus prunifolia*, *Fagus sylvatica*, *Prunus spinosa*, *Rubus odoratus* and various *Ribes* species. It did not seem to matter what the condition of the foliage of the plants was at the start of the experiment. Even at the time of treatment, plants with leaves, such as *Chaenomeles japonica* or *Corylus avellana,* showed no damaged shoots the following spring (see Figure 14).

Even some ground cover plants tolerated winter treatment with 200 g/ha Vorox F at the end of November without problem. Amongst these were *Potentilla fruticosa* 'Kobold' and 'Red Ace', *Geranium macorrhizum* 'Ingwersen', *Stephanandra incisa* 'Crispa' and *Symphoricarpos x chenaultii* 'Hancock' (see Figure 15).

Fig. 14: Assessment on 22 April 2014, a large number of plants showed no damaged or delayed shoot emergence in the spring following winter treatment with 200 g/ha Vorox F. The plants in the front row were treated with Vorox F and those in the back row form part of the untreated control.

Fig. 15: On 22 April 2014 the ground cover plants illustrated showed no damage after winter treatment with 200 g/ha Vorox F. An initial slight delay in shoot emergence with *Spiraea* had already disappeared. The plants in the front row were treated with Vorox F and those in the back row formed part of the untreated control.

The plants were divided into three groups following evaluation. The table below gives an overview of the plant susceptibility discovered in this experiment. The “Condition at the start of the test” column lists in what stage the plants were at, at the time of treatment. Some of the plants had already lost their foliage and others revealed their autumn colouring or were still covered in green foliage.

Species and varieties of plants shaded green in the table are those with no observable damage from Vorox F at any of the assessment times. Those shaded yellow are those species and varieties of plants where there were initially slight delays in shoot emergence. However, this damage was transient and disappeared during the assessment period. Red shaded species and varieties showed distinct damage during the course of the experiment, which could not be tolerated in practice. The last column of the table shows, by abbreviations, how damage to the plants manifested itself. (A = delayed shoot emergence, B = leaf damage, R = bark damage, K = bud damage).

Table 1: Overview of the condition at the time of treatment and plant susceptibility.

Plant	**Condition on treatment date**	**Rating**
Acer campestre	Without foliage	
Amelanchier lamarckii	Cut back, without foliage	A
Aronia melanocarpa	Without foliage	
Berberis buxifolia 'Nana'	Evergreen	A
Berberis thunbergii 'Atropurpurea'	Coloured foliage	
Carpinus betulus	Without foliage	
Chaenomeles japonica	Covered in green leaves	
Colutea arborescens	Covered in green leaves	A
Cornus alba 'Elegantissima'	Cut back, without foliage	A R
Cornus alba 'Sibirica'	Without foliage	A R
Cornus alba 'Späthii'	Cut back, without foliage	A R
Cornus sanguinea	Almost without foliage	R
Cornus sericea 'Flaviramea'	Without foliage	A R
Cornus sericea 'Kelsey'	Coloured foliage	R
Corylus avellana	Covered in green leaves	
Cotoneaster acutifolius	Without foliage	
Cotoneaster dam. 'Coral Beauty'	Evergreen	R
Crataegus prunifolia	Fast without foliage	
Cytisus scoparius	Evergreen	
Deutzia gracilis	Coloured foliage	A
Deutzia 'Mont Rose'	Without foliage	A
Euonymus alatus	Almost without foliage	K
Euonymus europaeus	Almost without foliage	K
Euonymus fort. 'Coloratus'	Evergreen	A
Euonymus fort. 'Emerald Gaiety'	Evergreen	B A
Euonymus fort. 'Emerald'n Gold'	Evergreen	B A
Fagus sylvatica	Coloured foliage	
Forsythia x int. 'Spectabilis'	Covered in green leaves	
Geranium mac. 'Ingwersen'	Covered in green leaves	
Hydrangea arb. 'Annabelle'	Cut back, without foliage	A
Kerria jap. 'Pleniflora'	Coloured foliage	A
Kolkwitzia amabilis	Covered in green leaves	
Lavandula angustifolia	Evergreen	

Ligustrum ovalifolium	Wintergreen	B A
Ligustrum vul. 'Atrovirens'	Almost without foliage	A
Lonicera nitida 'Maigrün'	Evergreen	B A
Lonicera xylosteum	Without foliage	
Lycium barbarum	Without foliage	
Malus sylvestris	Covered in green leaves	
Philadelphus 'Schneesturm'	Cut back, without foliage	A
Philadelphus 'Schneesturm'	Covered in green leaves	
Physocarpus opu. 'Diabolo'	Cut back, without foliage	A
Potentilla frut. 'Kobold'	Covered in green leaves	
Potentilla frut. 'Red Ace'	Covered in green leaves	
Prunus cistena	Cut back, without foliage	A
Prunus lau. 'Otto Luyken'	Evergreen	B
Prunus spinosa	Almost without foliage	
Pyracantha 'Red Column'	evergreen	B
Ribes alpinum 'Schmidt'	Without foliage	
Ribes Fruchtsorte red	Cut back, without foliage	
Ribes Fruchtsorte black	Cut back, without foliage	
Rosa canina	Without foliage	
Rosa multiflora	Almost without foliage	
Rosa rugosa	Without foliage	A
Rubus odoratus	Without foliage	
Salix purpurea 'Nana'	Without foliage	
Sambucus nigra	Almost without foliage	
Sorbus domestica	Coloured foliage	
Sorbus torminalis	Almost without foliage	A
Spiraea jap. 'Little Princess'	Almost without foliage	A
Spiraea x arguta	Without foliage	
Spiraea x bill. 'Triumphans'	Cut back, without foliage	A
Spiraea x bum. 'Anthony Waterer'	Covered in green leaves	A
Spiraea x cin. 'Grefsheim'	Almost without foliage	A
Spiraea x vanhouttei	Cut back, without foliage	A
Stephanandra incisa 'Crispa'	Without foliage	
Symphoricarpos x chen. 'Hancock'	Covered in green leaves	
Syringa vulgaris	Without foliage	
Tamarix parviflora	Cut back, without foliage	A
Tamarix ramosissima	Cut back, without foliage	
Tilia cordata	Without foliage	
Vaccinium corymbosum	Cut back, without foliage	A R
Viburnum opulus	Without foliage	
Viburnum opulus 'Roseum'	Cut back, without foliage	
Weigela 'Bristol Ruby'	Covered in green leaves	A
Weigela florida 'Variegata'	Cut back, without foliage	

A = Delayed sprouting, B = leaf damage, R = bark damage, K = bud damage

4. Summary

In order to examine the potential of Vorox F herbicide at a rate of 200 g/ha applied overhead to container-grown plants before overwintering, approximately 80 deciduous species and varieties were treated in late autumn.

At the assessments in the following spring, it turned out that even this low rate can lead to considerable damage. Treatment of evergreen or coloured-bark plants often, but not always, caused damage to the foliage or bark and delayed shoot emergence the following year.

Even deciduous species such as *Amelanchier lamarckii*, *Colutea arborescens* and *Deutzia gracilis* and *D.* 'Mont Rose', reacted in this experiment to treatment with 200 g/ha Vorox F with clear delays in shoot emergence.

However, quite a few hardwood trees in containers, some of which still had green foliage at the time of treatment, tolerated the herbicide treatment very well. In some cases there were slight delays in shoot emergence, which quickly disappeared. Against the background of the big advantages, which treatment with Vorox F offers with regard to its action on weeds and moss, nurseries, which only produce a small number of lines, can conduct their own tolerance tests.

<u>Safety of the herbicides Spectrum and Vorox F applied overhead (followed by irrigation) to container-grown deciduous trees prior to growth</u>
(Britta Zielke)

1. Experiment aim

Manual weed removal is one of the most tiresome and expensive jobs in the tree nursery. Clean standing areas and weed-free young plants help to keep the work down as much as possible. Further measures, including in particular, protecting against windborne weed seeds include covering the tops of the pots with discs, spreading mulch or the use of herbicides.
After potting, Flexidor can be used as an herbicide treatment, for example, once the substrate has settled. There is an extensive tolerance list for this herbicide.
The task of the experiment described below was to test the herbicides Spectrum and Vorox F for their use in container-grown deciduous trees after potting.
As freshly potted plants already have swollen buds or small leaves depending on the time of potting and storage of the young plants, watering was carried out after treatment in order to improve herbicide safety.

Fig. 1: Container area after potting. Herbicide treatment can save a lot of work but if applied incorrectly, it can cause severe damage.

2. Experiment structure

The experiments were carried out on two nurseries on a total of 21 different decidous species. The test plants were grown in containers with a pot size of between 1.5 and 3 litres. At least 15 plants of each species tested were each treated with the Spectrum and Vorox F herbicides. The herbicides were applied with a Birchmeyer Flox knapsack sprayer with a Teejet 11002 nozzle. A water volume of 500 l/ha was applied. The treatments took place on 27 March 2014 when the plant surfaces were dry. The weather was sunny and the temperatures were around 10°C.

Directly after treatment, a watering can was used to apply water at a rate of 5 l/m². At least 15 adjacent plants were separated out as a control from the nursery's normal herbicide treatment (where these were carried out).

Table 1: Test treatments

Test agents	Quantity/ha	Active ingredient	Licence	Notes
Spectrum	1.2 l/ha	720 g/l dimethenamid-P	Section 51 ZP	N, Xn, B4
Vorox F	200 g/ha	500 g/kg flumioxazin	ZG	N, T, B4 NG 405

At the time of treatment, the test plants were at various stages of development. This is illustrated by the examples in Figures 2-7. The maximum stage of development of the test plants on the day of treatment is shown in the safety table on page 8.
The plants were graded every two weeks from the date of treatment. Note was taken of delayed shoot emergence, bud or bark damage and, in the case of evergreens, foliage damage.

Fig. 2: BBCH 01 Start of bud swelling

Fig. 3: BBCH 03 End of bud swelling

Fig. 4: BBCH 09 Bud tip open

Fig.5: BBCH 10 Start of leaf development

Fig. 6: BBCH 11: first leaves developed

Fig. 7: Evergreen plant

3. Results

3.1 Efficacy

When evaluating the experiment, overwhelming consideration was given to plant safety. Nevertheless, the effect on weeds was noticeable. In particular, on pot surfaces treated with the Vorox F herbicide, less germination of impatiens and groundsel was observed (see Figures 15 and 16).

3.2 Safety

Plant safety was observed until 29 May 2014. A summary of the results is shown in Table 2 at the end of the report.

Overall, the herbicide Spectrum, with its active ingredient dimethenamid-P, was clearly more safe than Vorox F. According to the product information, the active substance, dimethenamid-P, is absorbed by young weed plants through the roots and the lower part of the shoot. It is said to act mainly on the soil and to have only slight leaf activity.

In spite of the low leaf activity and watering, damage in the form of necrosis was observed in some plants which were well developed at the time of treatment. These included, *Deutzia gracilis* and *Spiraea* ‘Snowmound‘. The evergreen *Pyracantha* ‘Orange Glow‘ also showed slight leaf damage at the beginning. In other cases, the Spectrum herbicide led to a slight delay in shoot emergence, which disappeared by the end of the observation period.

Fig. 8: *Potentilla* ‘Goldfinger‘ on 10 April 2014 (two weeks after treatment). The two left hand rows are treated with 1.2 l/ha Spectrum and on the right of them is the control. No differences were observed.

Fig. 9: *Deutzia gracilis* on 10 April 2014 (two weeks after treatment). The two right hand rows are treated with 1.2 l/ha Spectrum and on the left of them is the control. In spite of watering, severe burning occurred in the already developed leaves.

In addition to the good effect on soil, Vorox F is well known for its strong action on leaves. Sunlight intensifies the action. In this experiment, Vorox F caused more severe necrosis in already open buds or developed leaves. Even evergreen leaves of *Pyracantha* showed severe damage in the form of necrosis in spite of watering with 5 l water per m^2.

Fig. 10-13: At the time of assessment on 10 April 2014 (two weeks after treatment) some test plants showed damage in the form of necrosis as a result of treatment with Vorox F. Plants in an advanced stage of development, such as *Deutzia gracilis* and the evergreen, *Pyracantha,* showed severe damage at the time of treatment. *Salix aurita* and *Prunus mahaleb* only exhibited necrosis at the leaf tips.

Some of the plants reacted by a delay in shoot emergence to treatment with Vorox F. The *Salix* species in particular and the plants already well developed at the time of treatment (see Table 2) exhibited such damage. Any initial delay in shoot emergence of *Rosaceae* disappeared again.

Potentilla 'Goldfinger' exhibited a particular feature. Plants of this species were already relatively well developed at the start of the experiment. Nevertheless, no damage was observed at any assessment. If already developed leaves were damaged, such damage was quickly compensated for.

Fig. 14: At the time of assessment on 9 May 2014, delayed shoot emergence was detected in all the *Salix* plants treated (with the exception of *S. Rosmarinifolia* with Spectrum). (Back row untreated).
Fig. 15: At the time of assessment on 29 May 2014 the slight delayed shoot emergence of *Salix caprea* and *S. aurita* as a result of the Spectrum herbicide (centre row) had disappeared. The willows treated with Vorox F (front row) still exhibited shorter shoots than the untreated plants (back row).

Fig. 15: At the time of assessment on 29 May 2014 there was still some damage in the form of size differences caused by Spectrum (middle row) and Vorox F (bottom row). In the pots of the untreated control (top row) weeds area already growing. From left to right: *Cornus* ‘Spaethii‘, *Spiraea* ‘Snowmound‘, *Deutzia gracilis*, *Pyracantha* ‘Orange Glow‘, *Spiraea* ‘Little Princess‘.

Fig. 16: At the time of assessment on 9 May 2014, delayed shoot emergence of *Rosaceae* caused by Vorox F (front row) has ceased. In this test, treatment with the Spectrum herbicide (middle row) caused no damage to *Rosaceae*. In the back grow are the untreated plants. Flowering weeds are already growing in some of these pots.

Fig. 17: At the time of assessment on 29 May 2014 there are no (more) visual differences between the treated and untreated shrubs. Back grow: untreated control; middle row: treated with Spectrum and front row: treated with Vorox F. From left to right: *Philadelphus coronarius*, *Euonymus alatus*, two types of *Lonicera, Ribes* ‘King Edward VII‘ and *Weigela* ‘Bristol Ruby‘

The following table gives a summary of plant safety revealed in this experiment. The BBCH column lists the stage of development of the test plants at the time of treatment (see Figures 2-7).

In the table, the green shaded area fields mean that no damage to the respective test plant was observed at any of the assessments as a result of the corresponding herbicide applied during the experiment.
The yellow shaded areas represent those combinations of herbicide and test plant, where initially a slight delay in shoot emergence occurred. This damage, however, disappeared during the observation period.
Red shaded areas on the other hand, indicate considerable damage caused by the respective herbicide, which would not be tolerated in practice. The abbreviations show how damage was manifested in the plants (A = delay in shoot emergence, V = necrosis).

Table 2: Summary of the stage of development at the time of treatment and the safety, observed up to 29 May 2014.

Plant	**BBCH**	**Spectrum 1.2 l/ha**	**Vorox F 200 g/ha**
Chaenomeles japonica	09		A
Cornus alba 'Spaethii'	01		A
Deutzia gracilis	11	A V	A V
Euonymus alatus	10		A
Lonicera korolkowii zabelii	01		
Lonicera ledebourii	03		
Philadelphus coronarius	01	A	A
Potentilla fruticosa 'Goldfinger'	11		
Prunus mahaleb	10		A
Pyracantha 'Orange Glow'	03	A	A V
Ribes 'King Edward VII'	09		A
Rosa canina	09		A
Rosa multiflora	09		A
Rosa rugosa	09		A
Rosa rugosa 'Alba'	09		A
Salix aurita	03	A	A
Salix caprea	03	A	A
Salix rosmarinifolia	01		A
Spiraea 'Little Princess'	11	A	A V
Spiraea nipponica 'Snowmound'	11	A V	A V
Weigela 'Bristol Ruby'	01	A	A

A = Delay in shoot emergence, V = necrosis

BBCH 01: Start of bud swelling

BBCH 03: End of bud swelling

BBCH 09: Bud tip open

BBCH 10: Start of leaf development

BBCH 11: first leaves developed

<u>4. Summary</u>

In order to test the safety of the herbicides, overhead applications of Vorox F at a rate of 200 g/ha and Spectrum applied at 1.2 l/ha were made to 21 container-grown species and varieties of deciduous subjects. Application took place after potting and once the substrate had settled. Some of the plants had already started shooting. Directly after treatment, the treatments were irrigated in at a rate of 5 l per m^2.

During the experiment, damage in the form of necrosis or a delay in shoot emergence occurred, particularly as a result of Vorox F. Evergreens and several of the *Salix* species showed sensitive reactions.

Spectrum proved to be safer. In this case, damage usually occurred in the form of delayed shoot emergence and in most cases disappeared quickly.

It may be possible to consider treatment of freshly potted plants with Spectrum prior to shoot emergence. The results of other experiments show that the action of Spectrum is of shorter duration than that of Vorox F. Moreover, Vorox F has a longer action against mosses and possibly even against the germination of subsequently air-borne willow seeds.

Treatments with Vorox F in the case of deciduous trees may lead to serious damage and should only be carried out where its tolerance is known or following own experimental application.

For all herbicide treatments applied overhead after potting, the rule is that plants are more tolerant the less developed they are. Phytotoxicity and damage can also be reduced by irrigating after application.

Phytotoxicity assessment of soil applied herbicides
(Britta Zielke)

1. Experiment aim

The soil herbicide, Terano (metasulam), combined with the herbicide Stomp Aqua has for years formed part of the standard treatment in the cultivation of deciduous trees. As part of the search for an alternative to Terano (VuB annual report 2013, p. 24 et seq.) a phytotoxicity assessment was carried out on various deciduous trees. Herbicides and herbicide combinations, which proved to be effective in previous experiments for the control of weed species found in production, were tested with a number of trees and shrubs.
Moreover, in this assessment, the herbicide product Milestone was tested for its suitability for use with woody plants and shrubs. Propyzamide, a constituent ingredient of Milestone, is the active substance in Kerb Flo. The second active substance, aminopyralid, on the other hand, is contained in the herbicide Simplex, which in the past got onto tree production areas within horse manure and caused damage to the woody plants and shrubs. The test was conducted on the experimental area of the Testing and Advisory Council.

2. Experiment structure

Shortly before shoot emergence, 19 different woody plants and shrubs, which had been lined out in the spring of 2013 in plots replicated three times, were treated with the herbicide treatments. Application took place on 10 March 2014 in sunny weather at 15°C with the plot sprayer and in a water volume rate of 512 l/ha.

The plants were observed up until the end of May. Attention was paid to delayed shoot emergence, bud, bark and leaf damage.

Fig. 1: Which soil herbicides can be used to treat a mixed planting prior to shoot emergence?

The treatments listed in the following table were examined:

Table 1: Test treatments

Test agents	Quantity/ha	Active ingredient	Licence	Notes
Control				
Artist + Stomp Aqua	2 kg/ha + 3.5 l/ha	Metribuzin 175 g/kg Flufenacet 240 g/kg Pendimethalin 455 g/l	Potatoes, asparagus Art. 51 ZG	N, Xn, B4 N, Xn, B4
Milestone	1.5 l/ha	Aminopyralid 5.3 g/l Propyzamide 500 g/l	Winter rape	N, Xn, B4
Proman	3 l/ha	Metobromuron 500 g/l	Art. 53 Lambs lettuce	N, Xn
Spectrum + Stomp Aqua + Sencor Liquid	1.2 l/ha + 3.5 l/ha + 0.3 l/ha	Dimethenamid-P 720 g/l Pendimethalin 455 g/l Metribuzin 600 g/l	Art. 51 ZP Art. 51 ZG Section 22 (2) B, St	N, Xn, B4 N, Xn, B4 N, B4
Terano + Stomp Aqua	1 kg/ha + 3 l/ha	Metosulam 25 g/kg Flufenacet 600 g/kg Pendimethalin 455 g/l	Art. 51 ZG Art. 51 ZG	N, Xn, B3 N, Xn, B4
Vorox F	300 g/ha	Flumioxazin 500 g/kg	ZG	N, T, B4 NG 405

3. Results

Roughly four weeks after the start of the experiment, most of the woody plants and shrubs had started shooting. Delayed shoot emergence was observed in some species.

This was particularly the case following treatment with Vorox F. This delay was very mild in *Quercus*, *Rosa*, *Alnus*, *Ligustrum* and *Spiraea*. The delay to *Malus communis*, *Cornus sanguinea* and *Philadelphus* was more marked.

Figs. 2-3: A bed with three rows (at the back *Spiraea*, in the middle *Philadelphus* and at the front *Ligustrum*) was treated with herbicides across the direction of planting on 10 March 2014. Four weeks later, phytotoxicity differences were observed. Left: treated with Artist + Stomp Aqua: normal shoot

emergence for *Philadelphus* (middle row). Right: treated with Vorox F: delayed shoot emergence for *Philadelphus* (middle row).

Malus communis showed slight delays in shoot emergence even after the application of other soil herbicide treatments, eg Terano, Artist or Spectrum + Sencor Liquid, each case in combination with Stomp Aqua.

Slight delays in shoot emergence would usually not be noticed at all without the untreated control; the delays frequently disappeared quickly and are an acceptable consequence of achieving weed control.

A plant assessment two months after treatment was used to create the classification in the phytotoxicity table on the following page. In most cases, initial growth differences evened out. The differences in *Philadelphus* could still be slightly detected. On the other hand, the differences in *Cornus* and *Malus,* triggered by the herbicide Vorox F, were still clear to see. In practice, damage of this kind would not be accepted.

Figs. 4-5: Signs of dying in *Cornus* and still strong delayed growth in *Malus communis* on 9 May 2014, two months after treatment with Vorox F (300 g/ha).

The table also shows that the new herbicide, Milestone, is not tolerated by many woody plants and shrubs. The active substance, aminopyralid, even in the low dose of 8 g/ha in this experiment, led to widespread damage in woody plants and shrubs. Leaf and needle deformation was observed, for example, in *Colutea*, *Rosa*, *Spiraea* and in almost all the tested conifers (see Figs. 6-7). Conifers in particular, were sensitive to the herbicide Milestone. Deformations could still be observed at the end of May.

Table 2: Summary of herbicide safety

	Artist + Stomp Aqua	Proman	Spectrum + Stomp A + Sencor L.	Milestone	Vorox F	Terano + Stomp A
Acer platanoides						
Alnus glutinosa						
Colutea arborescens						
Cornus sanguinea						
Fagus sylvatica						
Ligustrum vulgare						
Malus communis						
Philadelphus 'Virginal'						
Quercus robur						
Rosa canina						
Spiraea bil. Triumphans						
Tilia cordata						
Abies nordmanniana						
Juniperus communis						
Larix leptolepis						
Picea abies						
Pinus sylvestris						
Taxus baccata						
Thuja occidentalis						

Green = safe prior to shoot emergence, yellow = damage possible, red = unacceptable damage

Figs. 6-7: On 9.May 2014, two months after treatment with the herbicide Milestone, deformation of woody plants and shrubs could still be observed.

<u>4. Summary</u>

In order to test the safety of five different soil applied herbicides or soil herbicide combinations, an experiment was set up on 19 species of woody plants and shrubs and treatments were applied prior to shoot emergence. The herbicide Milestone proved to be unsuitable for treating woody plants and shrubs as it caused damage in many plots.

Almost as safe as the standard combination of Terano + Stomp Aqua, on the other hand, were Artist + Stomp Aqua, as well as Spectrum + Stomp Aqua + Sencor Liquid. *Cornus* was the exception. This species was very sensitive to all the herbicide combinations in the experiment apart from the Terano + Stomp Aqua herbicide combination and the herbicide Proman.

Up to and including the spring season of 2016 tree nurseries can still use up existing stocks of Terano. Once the supplies have been used up, a combination of Spectrum and Stomp Aqua can be considered as an alternative for deciduous trees. For efficacy of longer duration, a small quantity of Sencor liquid can be added, however, this increases the risk of damage to sensitive woody plants and shrubs, such as *Cornus.*

In lined-out conifers or avenue trees, the highly effective Vorox F herbicide can be used.

Nitrogen content in tree nursery soils – guide values according to the Fertiliser Regulations, section 3, 2014

(Hendrik Averdieck)

The German Fertiliser Regulations are currently being revised and the first draft to amend them is available. For the time being, however, the provisions contained in version of the Regulations from 24 February 2012 will continue to be applicable. Accordingly, before applying more than 50 kg/ha nitrogen (total nitrogen) and more than 30 kg/ha phosphate (P_2O_5) the nutrient quantities available for the plants in the soil must be determined.

For nitrogen, the quantity of nitrogen available in the soil must be determined at least once a year and phosphate requires soil analyses at least every 6 years.
In the case of nitrogen, the legislation does <u>not</u> however demand that the nurseries conduct their own soil analysis for nitrogen in all areas but instead, values from representative sites determined by a consultant can be adopted for the nursery's own areas.

In 2014, 40 tree nursery areas, divided into the main cultivation groups, were again tested for N_{min} content in mid-February.
The results were made available to the nurseries through circular letters and publications. The Schleswig-Holstein Chamber of Agriculture, and Horticultural Department, will bear the costs of these tests.

The results of the N_{min} tests listed in the table can be used as guide values according to the Fertiliser Regulation. Where nurseries do not conduct their own nitrogen tests of the areas, then the anticipated values of nitrogen fertiliser quantity required, can be deduced depending upon cultivation and soil type. Using this procedure ensures that the plants are supplied with the necessary quantity of nitrogen, depending upon requirements, without using excessive amounts.

In addition, during the course of 2014, the tree nurseries in Schleswig-Holstein again conducted their own N_{min} tests on 220 sites.

N_{min} – guide values for 2014		
Cultivation	**Nature of soil**	NO_3-N +NH_4-N [kg/ha] (0-60 cm soil depth)
Open areas for cuttings, rose and fruit tree rootstocks	Loamy sand and sandy loam	20
Deciduous tree seedlings and nursery beds	Loamy sand and sandy loam	13
Conifer seedlings and nursery beds	Loamy sand and sandy loam	6
Roses - grafts	Loamy sand and sandy loam	16
Shrubs, young trees and hedge plants	Loamy sand and sandy loam	20
Individual and fruit trees/bushes	Loamy sand and sandy loam	19
Conifers	Loamy sand and sandy loam	10
Evergreen woody plants/shrubs	Loamy sand and sandy loam	9
Avenue trees	Loamy sand and sandy loam	18
Christmas tree cultivations	Loamy sand and sandy loam	9

The values were, on average, were roughly 5 kg nitrogen/ha higher than in 2013.

This table serves as evidence of knowledge of the nitrogen content in the soil for your cultivations. In the event of an inspection, it must be possible to present it in accordance with the duty of each individual nursery to keep records, if there are no own N_{min} tests of the areas available.

Experiment using part-coated Field-Cote CRF products on cutting beds under film

(Hendrik Averdieck)

1. Aim and structure of the experiment

Initial experiments with part-coated long-acting fertilisers on cutting beds under film had already been carried out in 2013 (see annual report 2013, p. 45-52). Normally, a stabilised mineral fertiliser such as Entec Perfekt or NovaTec Classic is used to fertilise cutting beds prior to laying down the film. The aim of the experiment was to examine whether an improved and longer lasting fertiliser action could be achieved by using part-coated Field-Cote CRF products with 4 or 6 month release pattern. In 2013 the growth results with the fertiliser products examined had been fairly equal for both tree species (*Ribes alpinum*, *Ligustrum vulgare* ‘Atrovirens‘). The quality of plants was not significantly improved by using the part coated products. The presumed cause was that the amount of water, which penetrated the soil between the rows of cuttings, may have been inadequate to guarantee a sufficient release of nutrients from the coated products. As the precipitation could only penetrate the earth through the rows of holes for the cuttings, the soil between the rows was possibly too dry, the more so since the fertilisers had been scattered directly onto the surface of the beds and were therefore directly underneath the film.

During the 2014 test year therefore, the fertilisers were to be worked in using a rotary hoe, before placing the film over the beds. This way, the fertiliser grains should penetrate the root area of the cutting, should make better contact with moisture in the soil and in this way possibly improve the effectiveness of the products.

The experiment was set up on two different nurseries with cuttings of *Platanus hispanica* and *Ligustrum vulgare* ‘Atrovirens‘ (Tables 1 and 2).

Table 1: Summary of fertiliser treatments for *Platanus hispanica* cuttings

	Type of fertiliser	Formula	N quantity (kg/ha)	Nursery
1.	Field-Cote CRF (4M)	18-8-12-7	60 kg/ha N	Ulf Glismann tree nursery, Bullenkuhlen
2.	Field-Cote CRF (6M)	18-8-12-7	60 kg/ha N	
3.	NovaTec Classic	12-8-16-3	60 kg/ha N	

Table 2: Summary of fertiliser treatments for *Ligustrum vulg*. ‘Atrovirens‘ cuttings

	Type of fertiliser	Formula	N quantity (kg/ha)	Nursery
1.	Field-Cote CRF (4M)	18-8-12-7	80 kg/ha N	Breckwoldt tree nurseries, Ellerbek

2.	Field-Cote CRF (6M)	18-8-12-7	80 kg/ha N	
3.	NovaTec Classic	12-8-16-3	80 kg/ha N	

The *Platanus hispanica* cuttings was planted on 7 March 2014 and the *Ligustrum* cuttings on 24 April.

Figs. 1 and 2: Ready prepared and fertilised beds for *Platanus hispanica* (left) and *Ligustrum vulgare* ‘Atrovirens‘ (right) before hoeing and covering with film

2. Results

2.1. Weather conditions in 2014

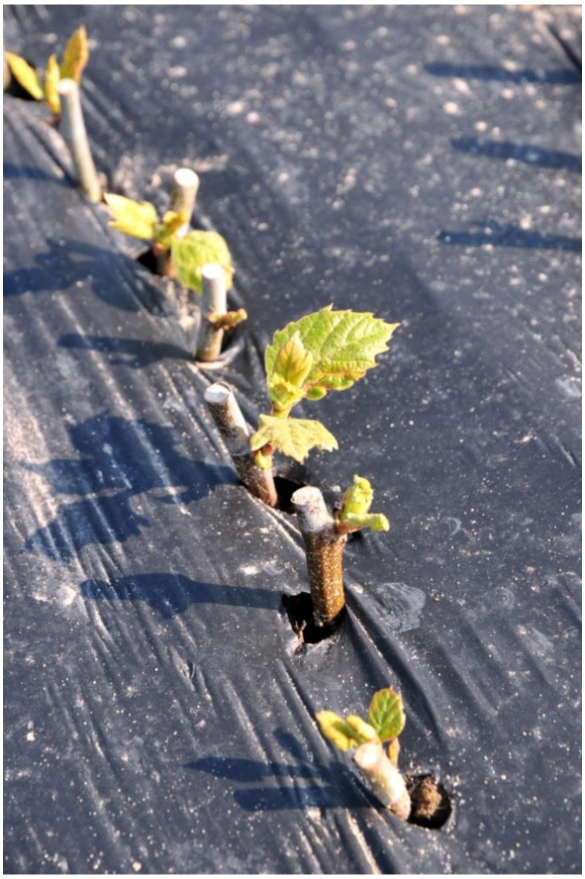
The weather conditions during the test year are shown in the weather data section of the report. The weather in North Germany was characterised by a distinctly warmer first six months compared with 2013 and also with the mean over many years. Both April and July stood out because of the considerably higher average temperatures. On several occasions, temperatures of 30-33°C occurred in July. As a result, the conditions for nutrient release of the part coated products worked into the soil, were also good.

The months of April and May had significantly more precipitation compared with the mean over many years. As a result, sufficient precipitation also penetrated the holes in the film covering into the soil and ensured good release conditions for the fertiliser granules distributed in the top layer of the soil. In May and July in particular, heavy rain occurred on several occasions, which likewise resulted in the beds being well moistened, in spite of the film covering. The months of June and September on the other hand, were very dry.

2.2. Growth results with *Platanus hispanica*

The plane tree cuttings were planted on 7 March 2014. The cuttings started to shoot in mid-April (Figures 3 and 4). Growth over the following weeks was strong and even in all plots. No increased failures were recorded in any of the plots. Differences in growth between the fertilised plots were not visually apparent during the months of growth and up to the end of the growing season (Figures 5-7).

The plants were dug up and assessed on 20 November 2014. As part of the assessment, the height of the plant (Figure 8) was measured and they were sorted into size grades of 30-50 cm, 50-80 cm and 80-125 cm (Figure 9). Particularly straight plants, which were not bent or kinked in the stem and which were > 80 cm tall, were sorted into a further grade. These plants are sold by the nursery as the starting material for avenue tree cultivation (Figure 10).



Figs. 3 and 4: Test bed with plane tree cuttings inserted through the film. After they have taken root, the plants begin to shoot (date: 25 April 2014)

Fig. 5:
Growth in a plot with Field-Cote CRF 4M on 21 July 2014

Fig. 6:
Growth in a plot with Field-Cote CRF 6M

Fig. 7:
Plane tree cuttings fertilised with NovaTec Classic

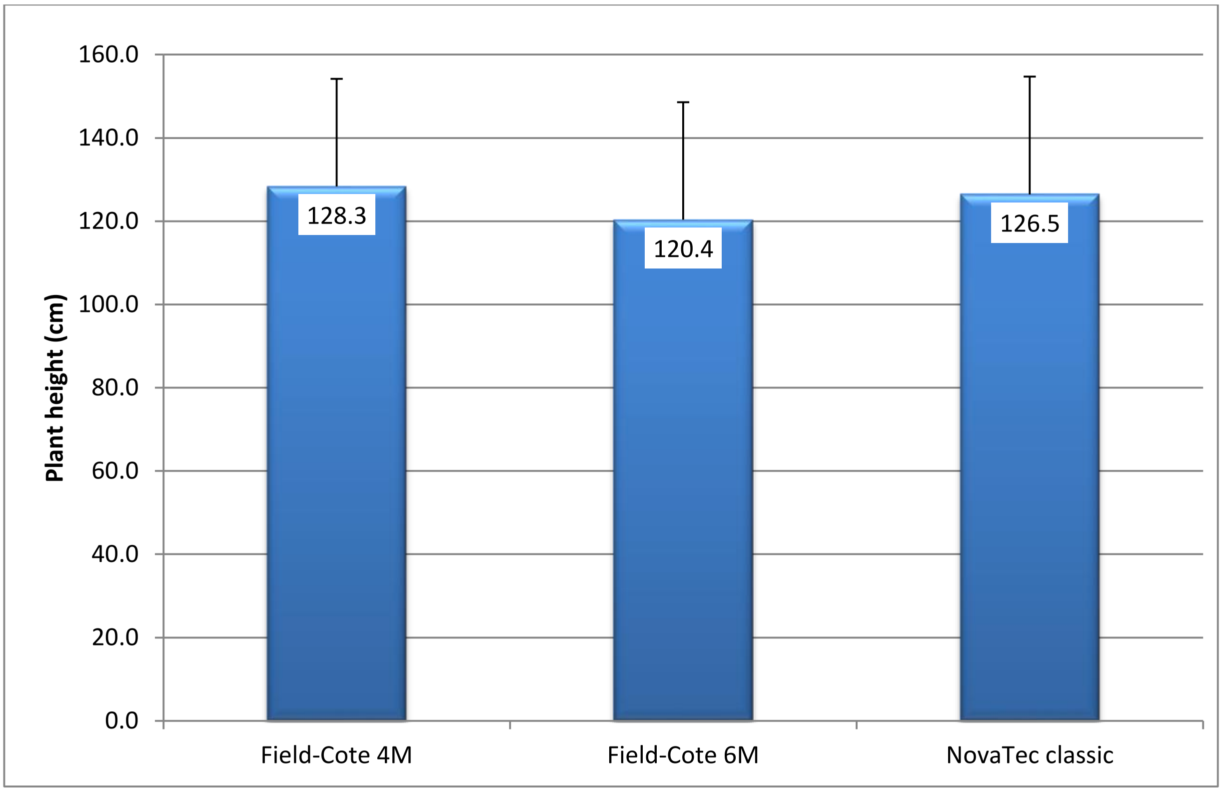


Fig. 8: Average plant height of *Platanus hispanica* plants on 20 November 2014.
The error bars show the standard deviation amongst the test variants

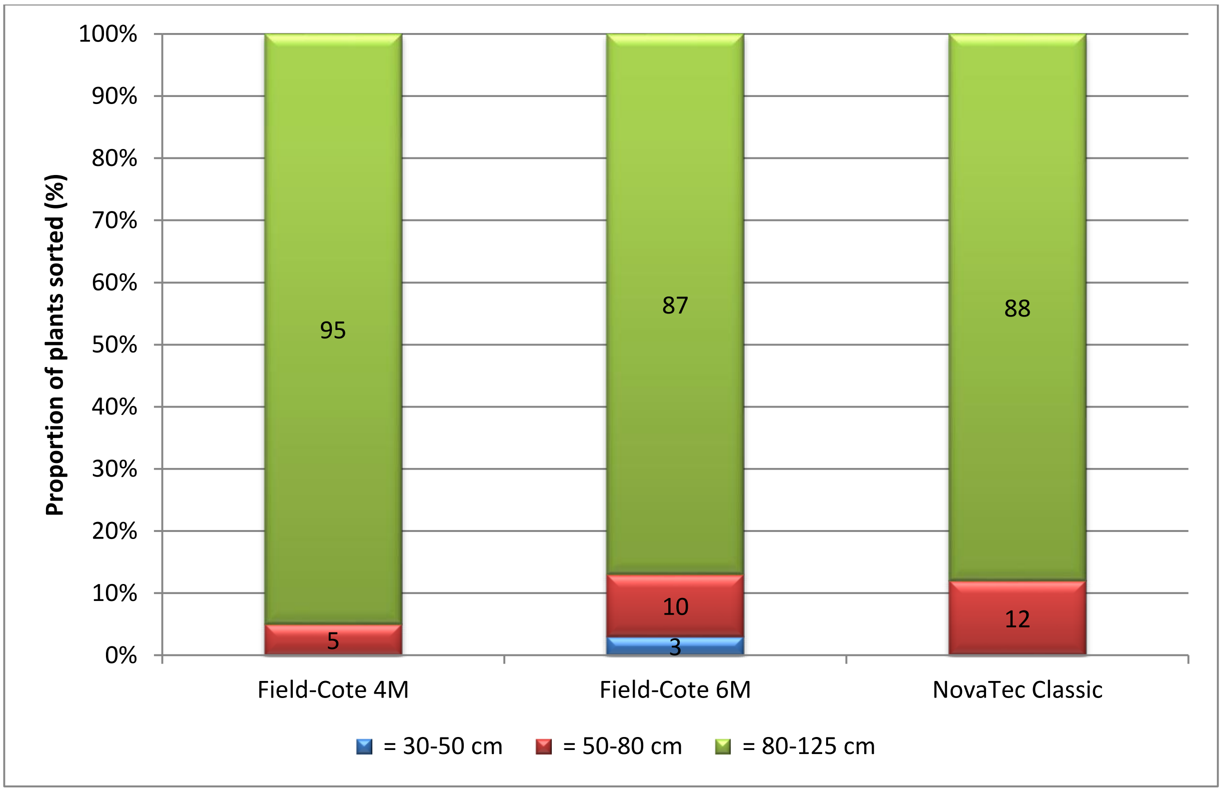
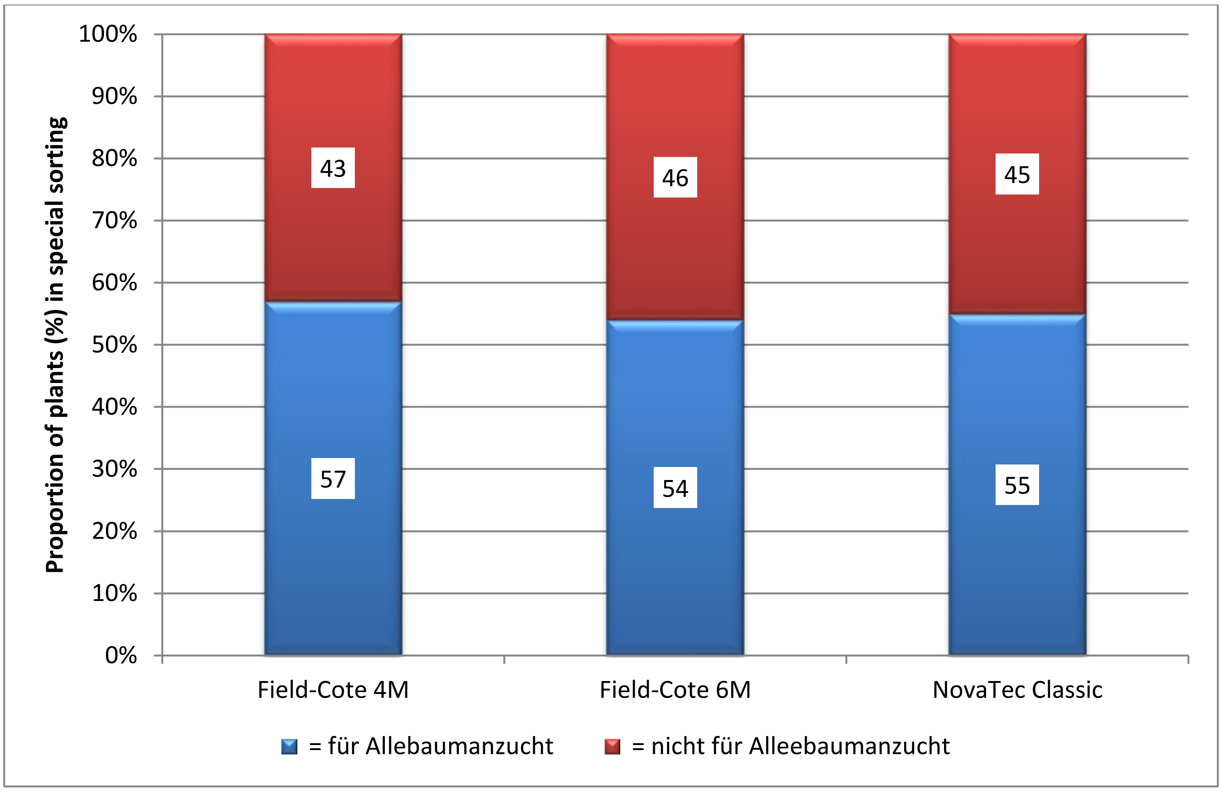


Fig. 9: Proportion of plants (percentage) of each treatment in each size grade



[blue – for avenue tree cultivation | red – not for avenue tree cultivation]

Fig. 10: Proportion of plants (percentage) of each treatment used for avenue tree cultivation

The plants in the plots supplied with Field-Cote CRF 4M were slightly larger overall and therefore the best at grading. 95% of the plants were sorted into the size grade 80-125 cm. 57% of the plants met the requirements for continued cultivation as avenue trees. The second best result was achieved in the plots treated with NovaTec Classic. The grading result, of 88% of the plants in the 80-125 cm grade and 55% for avenue tree cultivation, was only slightly worse.

The plants in the plots supplied with Field-Cote CRF 6M were slightly smaller and weaker.

2.3. Growth results with *Ligustrum vulgare* ‘Atrovirens‘

Following fertiliser application to the prepared bed, the bed was hoed and then covered with film (Figure 11). The privet cuttings were then planted.

The growth result for the privet cuttings was very good this year and the stock developed evenly and strongly. No differences were observed between the fertiliser plots during the course of the growing season. Figures 12-14 show, in each case, plant development in individual plots of each fertiliser treatment on 10 July 2014.

Fig. 11: Covering the fertilised and hoed bed with biodegradable film

Fig. 12: Privet plants in a plot treated with Field-Cote CRF 4M (18-8-12-7)

Fig. 13: Privet plants in a plot treated with Field-Cote CRF 6M (18-8-12-7)

Fig. 14: Privet plants in a plot treated with NovaTec Classic (12-8-16-3)

The privet plants were lifted and assessed on 27 November 2014. The assessment included the parameters of plant height (Figure 15) and shoot number (Figure 16). The plants were also sorted into the various size grades (Figure 17).

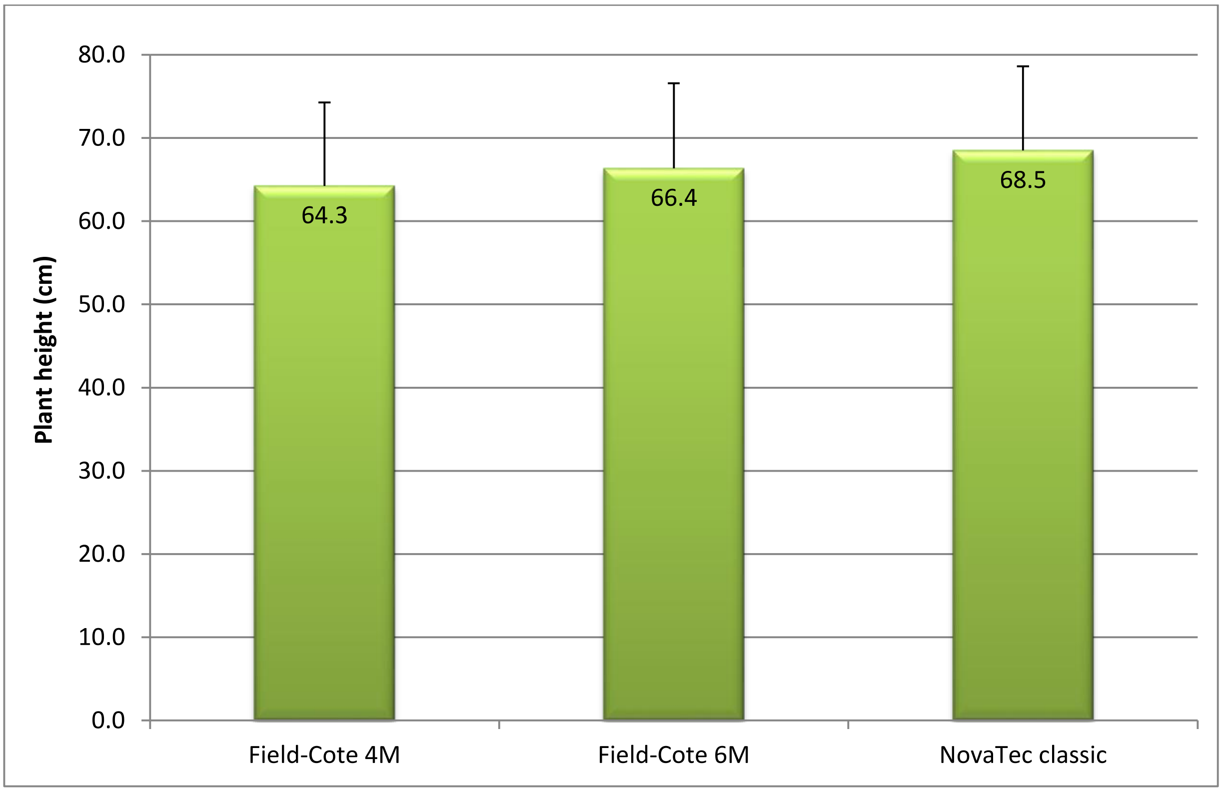


Fig. 15: Mean plant height for *Ligustrum vulgare* 'Atrovirens' on 27 November 2014.
The error bars represent the standard deviation amongst the treatments

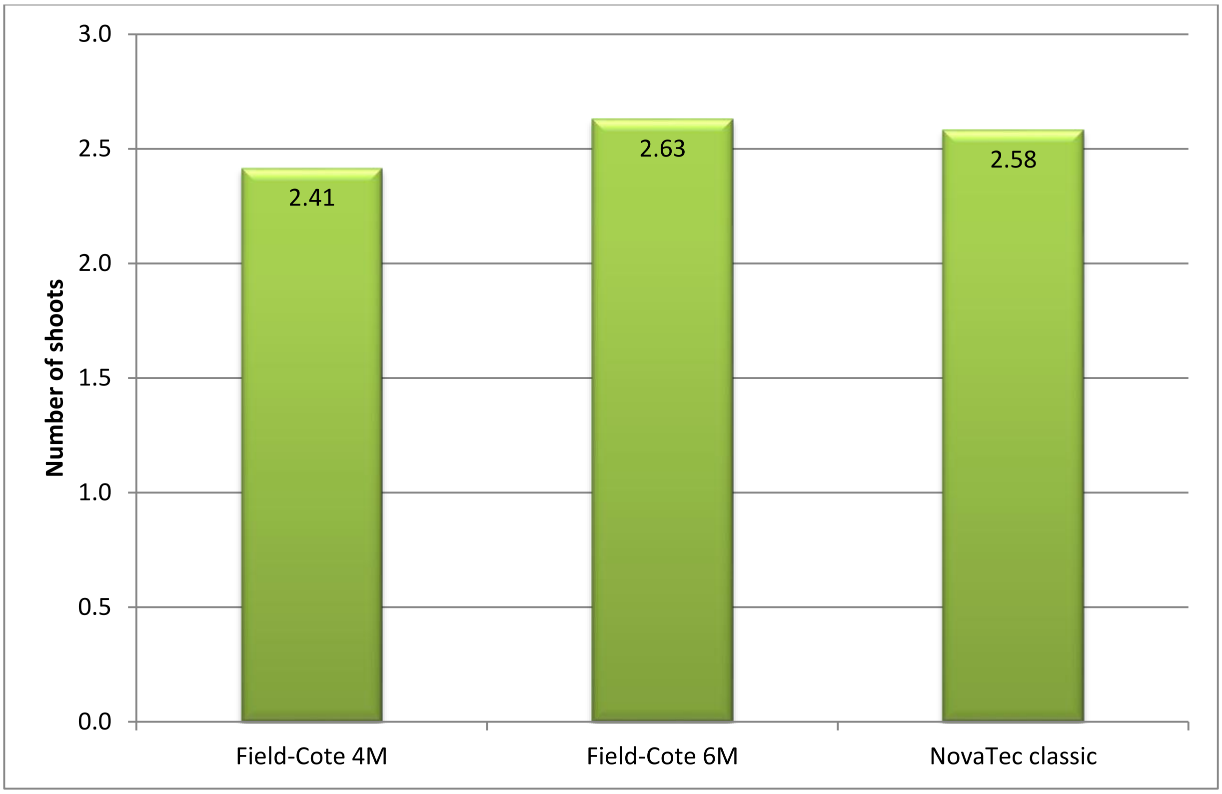


Fig. 16: Mean number of shoots on the privet plants at the end of the growing season

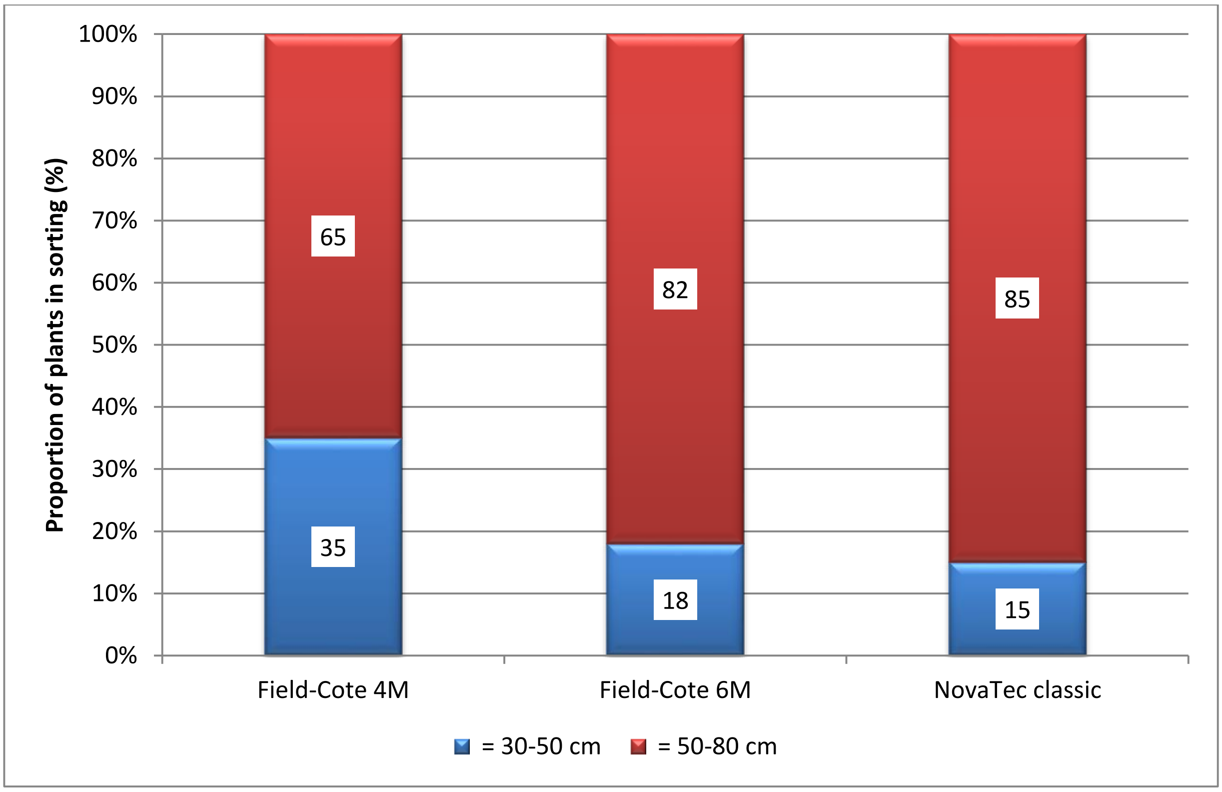


Fig. 17: Proportion of plants (percentage) of each treatment in each size grade

The privet plants in the plots treated with Field-Cote CRF 6M and NovaTec Classic were almost the same. In terms of plant size, shoot number and grading, there were hardly any differences. On the other hand, the plants supplied with Field-Cote CRF 4M were somewhat smaller, which was also apparent at grade out.

2.4. Results of N_{min} tests in autumn

In the autumn the nitrogen content of the soil was measured for the plane trees (N_{min} tests). Sampling was carried out separately at soil depths of 0-30 cm and 30-60 cm. In the plots fertilised with part coated Field-Cote products, higher nitrogen contents were measured compared with the NovaTec Classic plots. Figure 18 shows the nitrogen levels measured in the soil.

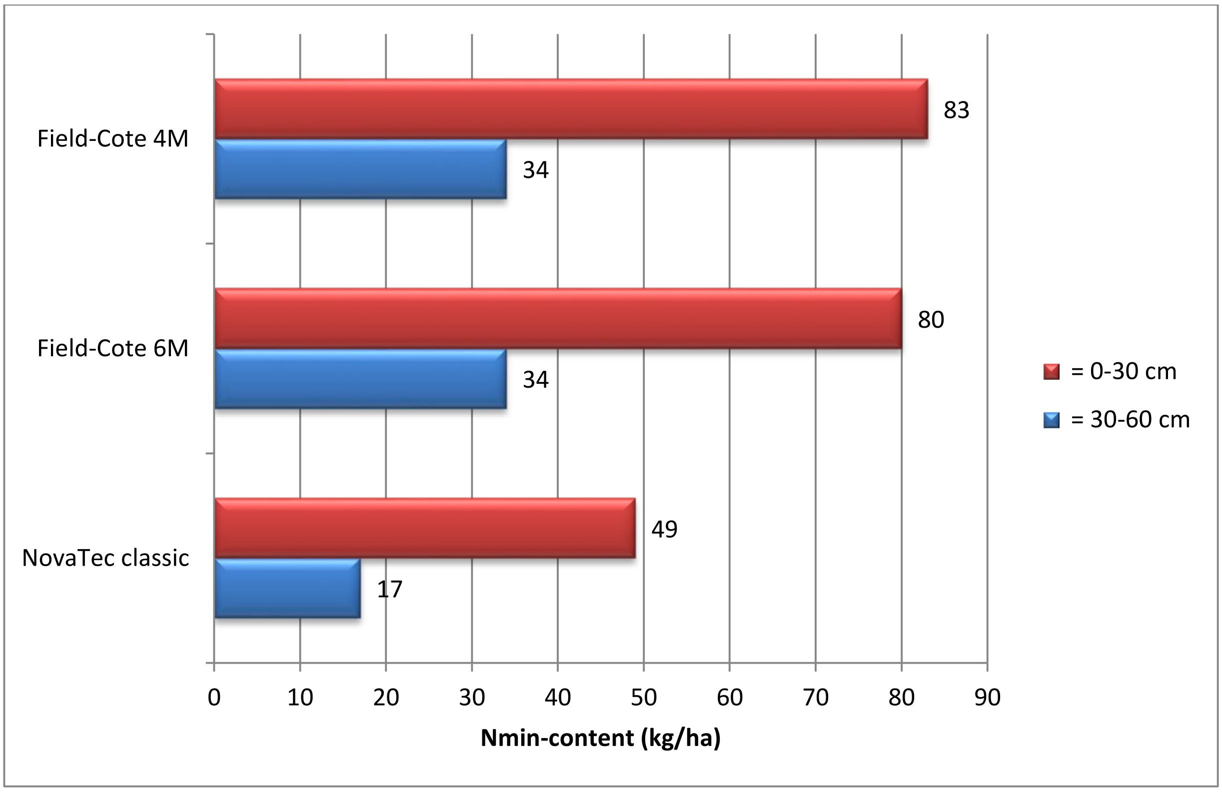


Fig.18: Nitrogen levels (NO_3^- + NH_4^+-N) in the soil for *Platanus hispanica* on 30 October 2014

In the test area used to grow the plane trees, higher nitrogen levels were found for the part coated products, both in the top soil and in the 30-60 cm soil layer. In all, 114-117 kg/ha N was found in the 0-60 cm sampled depth. In the NovaTec Classic plots, a total of 66 kg/ha N was measured.

3. Summary

For the second year in succession, experiments were carried out on the part-coated products, Field-Cote CRF 4M and Field-Cote CRF 6M in comparison with NovaTec Classic on cutting beds covered with a film cover. The difference compared with the first year was that the fertiliser was worked into the soil using a rotary hoe prior to covering with film, and hence was distributed throughout the rooting area and did not rest on the soil surface.

The experiments were carried out using cuttings of *Platanus hispanica* and *Ligustrum vulgare* ‘Atrovirens‘. The differences in growth between the fertiliser treatments was also slight this year. Amongst the plane trees, the plants in the plots with Field-Cote CRF 4M showed slightly stronger growth and had a better grade out. However, the difference compared with the results of NovaTec Classic was slight.

In the plots treated with NovaTec Classic, the fertiliser was more effectively translated into growth, because here, at the end of October, the nitrogen content of the soil, totalling 66 kg/ha N in the 0-60 cm soil layer, was distinctly less than in the Field-Cote plots, at 114-117 kg/ha N.

For the privet plants, the growth differences were likewise small. The strongest plants and best grade out were, however, found in the NovaTec Classic plots. The plants treated with Field-Cote CRF 6M were of almost equivalent size. The plants in the Field-Cote CRF 4M plots were slightly smaller and the final grade out was not as good.

The idea of being able to better supply nitrogen using part coated products applied to cutting beds under film cover, which cannot be re-fertilised during the growing season, has not proved itself in the two experiments. By feeding with stabilised nitrogen fertilisers, such as NovaTec, Classic plants of equal quality could be achieved, whilst at the same time leaving a smaller nitrogen residue in the soil.

The higher price of the part coated products does, therefore, not yet yield a return for this application.

As a result of less nitrogen leaching under film and simultaneously increased nitrogen mineralisation as a result of greater soil warming, the amount of fertiliser used can presumably be reduced overall, without having to worry about poorer growth results. The relatively uniform growth results and simultaneously increased N_{min} contents on the areas in autumn suggest this conclusion.

Experiment to improve the colour of conifers in autumn

(Hendrik Averdieck)

1. Aim and structure of the experiment

Severe yellowing is often observed amongst conifers during the autumn and winter months. This predominantly occurs in lighter sandy soil. Pines are most frequently affected (Figures 1-2). Fertilisers containing potassium and magnesium are most often applied in order to achieve a more intense green colouration of the plants.The effect of these measures, however, is frequently not satisfactory.

Figs. 1 and 2: Yellowing of pine stocks during the winter months

The aim of the experiment was to examine the best ways of preventing yellowing using a range of fertilisers and thereby achieve good foliage colour.

The experiment was carried out on beds of *Abies nordmanniana*, *Picea sitchensis*, *Pinus strobus* and *Pinus mugo*. The following fertiliser treatments were applied (Table 1):

Table 1: Treatment list

	Product	Composition	Quantity used
1.	Unfertilised control	---	---
2.	Patentkali	30% K_2O, 10% MgO, 17% S	500 kg/ha
3.	ESTA Kieserit granules	25% MgO, 20% S	500 kg/ha
4.	Bittersalz (magnesium sulphate)	16% MgO, 13% S	800 kg/ha
5.	CalMag (coated fertiliser)	9-0-0 + 16% CaO + 9% MgO	500 kg/ha
6.	Ferrogranul 20	20% ferrous-II-sulphate	250 kg/ha
7.	Ferro Top	6-0-12-6 + 18% S + 8% Fe	500 kg/ha
8.	Sferosol	87% S	500 kg/ha
9.	Blaukorn Classic	12-8-16-3	350 kg/ha
10.	Agromaster 2-3M (part coated fertiliser)	19-5-20-4	250 kg/ha

Apart from the listed magnesium and potassium fertilisers, ESTA Kieserit, Bittersalz (magnesium sulphate) and Patentkali, a coated calcium-magnesium fertiliser (CalMag) with a portion of nitrogen, was applied following experiments on container-grown woody plants and shrubs. Because of the limited available quantity, this fertiliser was only applied to *Abies nordmanniana* and *Pinus strobus*.

In order to test the effect of iron, the pure ferrous fertiliser, Ferrogranul 20, and iron- containing complete fertiliser, Ferro Top, were used. Apart from an 8% iron content, Ferro Top also contains nitrogen (6%), potassium (12%) and magnesium (6%). Any yellow colouration caused by a lack of sulphur was examined by the use of the pure sulphur fertiliser, Sferosol, which achieves improved trace nutrient availability by acidifying the top layer of soil. Furthermore, two nitrogen-containing complete fertilisers were used. Blaukorn classic is a quick-acting mineral fertiliser. Agromaster 2-3M on the other hand, is a part-coated product where 43% of the nitrogen content is coated and the nitrogen is released over a period of approximately 3 months. The lined out Nordmann firs were treated with fertiliser on 29 August and the remaining conifers on 29 September 2013.

2. <u>Results</u>

No differences in needle colour were apparent in the case of *Abies nordmanniana* during the course of the winter; the plants remained uniformly dark green throughout the winter. Only very slight yellowing colour differences occurred between treatments in the case of *Picea sitchensis*. Distinct differences in the colour of the plants, however, developed in the case of *Pinus strobus* and *Pinus mugo* during the course of the winter. Figures 3 and 4 show a control plot and a plot of *Pinus strobus* fertilised with Ferro Top on 21 January.

Figs. 3 and 4: Comparison of two plots showing a very different green colouring: unfertilised control plot (left) and plot fertilised with Ferro Top (right)

In March 2014, the differences in colour of the individual plots were assessed and graded from 1 (yellowish-green/light green) to 4 (blue green/olive green) in order to obtain as detailed a record as possible (Figure 5). A mean value was obtained from three replicates of each treatment.

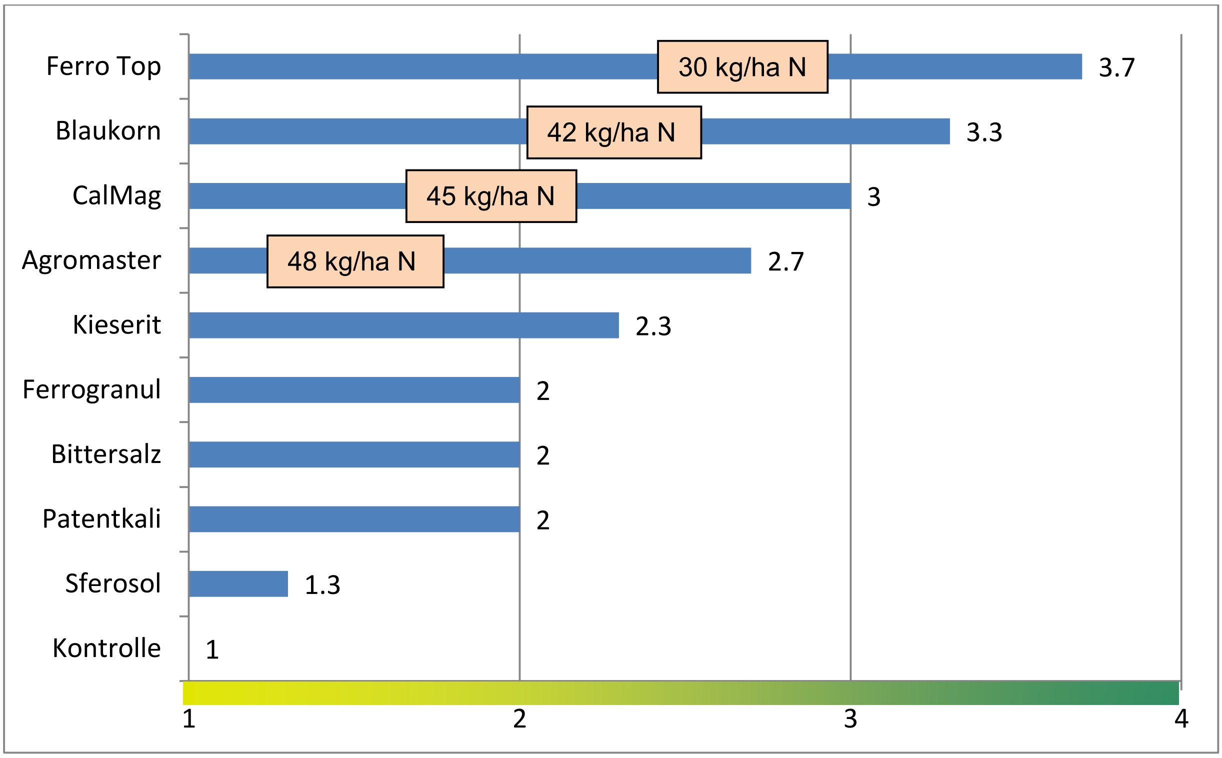


Fig. 5: Degree of green colouration in *Pinus strobus* on 21 March 2014 (1 = yellowish-green, 4 = blue-green). For products containing nitrogen, the N-dose applied is indicated

The sulphur fertiliser had hardly any effect; the plants remained similarly yellowish green as in the unfertilised control. The plants in the plots treated with potassium (Patentkali), magnesium (Bittersalz, ESTA Kieserit) and iron (Ferrogranul 20) were only slightly greener. Clearly better results were obtained if fertilisers with a nitrogen content were used. This was the case with the Agromaster 2-3M, CalMag, Blaukorn classic and Ferro Top products. It was not the level of the nitrogen administered with these products that was decisive, but basically just the presence of nitrogen in a balanced ratio with the other nutrients. The best result was obtained with the Ferro Top fertiliser. Apart from administering 30 kg/ha nitrogen; potassium, magnesium, iron and sulphur were also provided with this product. The result with Blaukorn Classic was slightly worse.

The results obtained for *Pinus mugo* were comparable but the colour differences were slightly less marked (Figure 6). Even with this species, the best result was obtained with the nitrogen and iron-containing complete fertiliser, Ferro Top. The Agromaster 2-3M and Blaukorn Classic products likewise produced good colouration. The CalMag fertiliser was not used for this pine species.

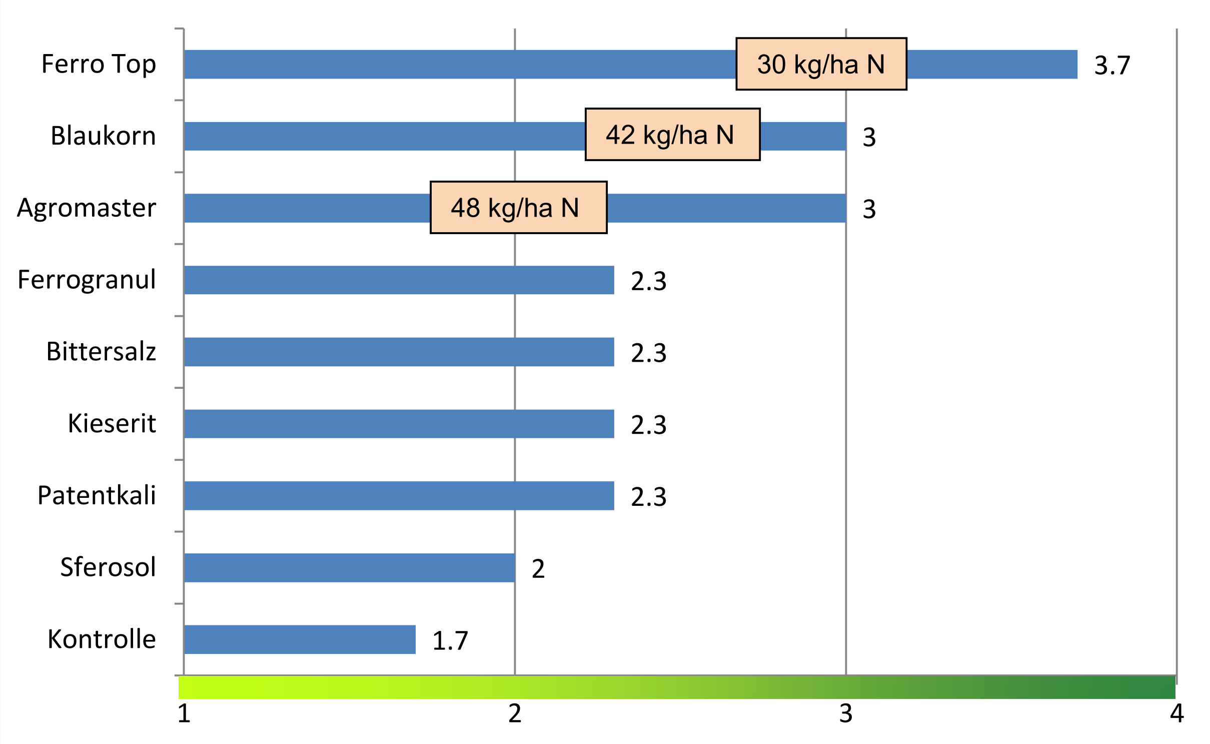


Fig. 6: Degree of green colouring in *Pinus mugo* on 21 March 2014 (1 = light green, 4 = olive green). For products containing nitrogen, the N-dose applied is indicated

3. Summary

In the winter of 2013/2014 an experiment to assess foliage colouration in several lined out conifer beds was carried out. The best fertiliser strategy for preventing yellowing during the winter months was assessed. In addition to the potassium and magnesium fertilisers, (Patentkali, ESTA Kieserit and Bittersalz), usually used in commerce, a sulphur fertiliser (Sferosol), an iron fertiliser (Ferrogranul 20) and various nitrogen-containing products were also examined. All the nitrogen-containing fertiliser products brought about a distinctly better colouration than the products without nitrogen. The best results were obtained with the iron-containing product, Ferro Top. The quick-acting mineral fertiliser, Blaukorn Classic and the part-coated Agromaster 2-3M product also had a very good effect.

The level of nitrogen administered in the case of this autumn fertiliser programme should be within the range 30-45 kg/ha N. Thus, for mature woody plants and shrubs there is no need to worry about any reduction in winter hardiness.

The statutory provisions must be observed:

- According to the Fertiliser Regulations currently applicable, the spreading of fertiliser with more than 1.5% N_{ges}-content dry weight is forbidden during the period from **1 November-31 January** (apart from solid manure).
- In water conservation areas in Schleswig-Holstein it is forbidden to apply nitrogen-containing fertiliser during the period **15 September-31 January**.

Experiments using the new Multicote High-N products in container cultivation

(Hendrik Averdieck)

1. Aim and structure of the experiment

In 2014, several experiments were set up using the controlled release fertiliser, Multicote High N 17-11-11 in nursery tree production. The 6M type and a combination of 6M + 8M types were used. The Osmocote Pro 5-6M and Nutricote T100 were used as comparisons. The experiments were set up using three species of woody plants and shrubs on two tree nurseries. Table 1 shows the treatment list. Table 2 provides a summary of the subject plants, the potting times and the test sites.

Table 1: Treatment list

	Product	Manufacturer's declaration	Quantity used
1.	Osmocote Pro 5-6M	17-11-10-2	4.0 kg/m^3
2.	Nutricote T100	15-09-10-2	4.0 kg/m^3
3.	Multicote High N 6M	17-11-11-2	4.0 kg/m^3
4.	Multicote High N 6M + Multicote High N 8M	17-11-11-2 17-11-11-2	2.5 kg/m^3 + 1.5 kg/m^3

Table 2: Subject plants and potting times

	Potting time	Pot size	Facility
Weigela 'Lucifer'	27/05/2014	3-litre pot	BKN Strobel, Holm
Juniperus squamata 'Blue Star'	27/05/2014	2-litre pot	BKN Strobel, Holm
Lonicera pileata	25/06/2014	1-litre pot	Heydorn Baumschulen, Bevern

In the case of experiment with *Weigela* and *Juniperus*, 80 plants were potted per fertiliser treatment and 20 of each were distributed over four replicates.

The ground cover plant, *Lonicera pileata,* was potted using 240 plants per fertiliser treatment, distributed over four replicates of 60 plants.

The substrate used was the medium-coarse white peat substrate, type MR M-7147 from Stender AG containing 75% sod peat, 25% wood fibre and having a pH value of 5.5. With all the treatments, the fertiliser was mixed into the substrate by hand.

2. Results

2.1. Pattern of nutrient release in the laboratory leaching-out test

Parallel to the practical tests, the release patterns of the Multicote High N 6M, Osmocote Pro 5-6M and Nutricote T100 products were examined in a laboratory experiment at room temperature. For this experiment, the fertilisers were placed in beakers in distilled water. At regular intervals, the conductivity (EC value) was measured in the beakers in mS/cm. The water was regularly changed so that the salt solution did not become saturated. Figure 1 shows the release of the products per unit of time measured as conductivity. The conductivity was cumulatively updated in the graph. Initially, the Multicote High N 6M showed a stronger release than the other two products. As the experiment progressed, the curve then flattened out somewhat. After approximately 100 days in the laboratory, the Osmocote Pro 5-6M overtook the Multicote High N 6M with respect to the release rate. During the period from 15-45 days after the start of the experiment at room temperature, the Nutricote T100 showed a stronger release rate than the comparative products.

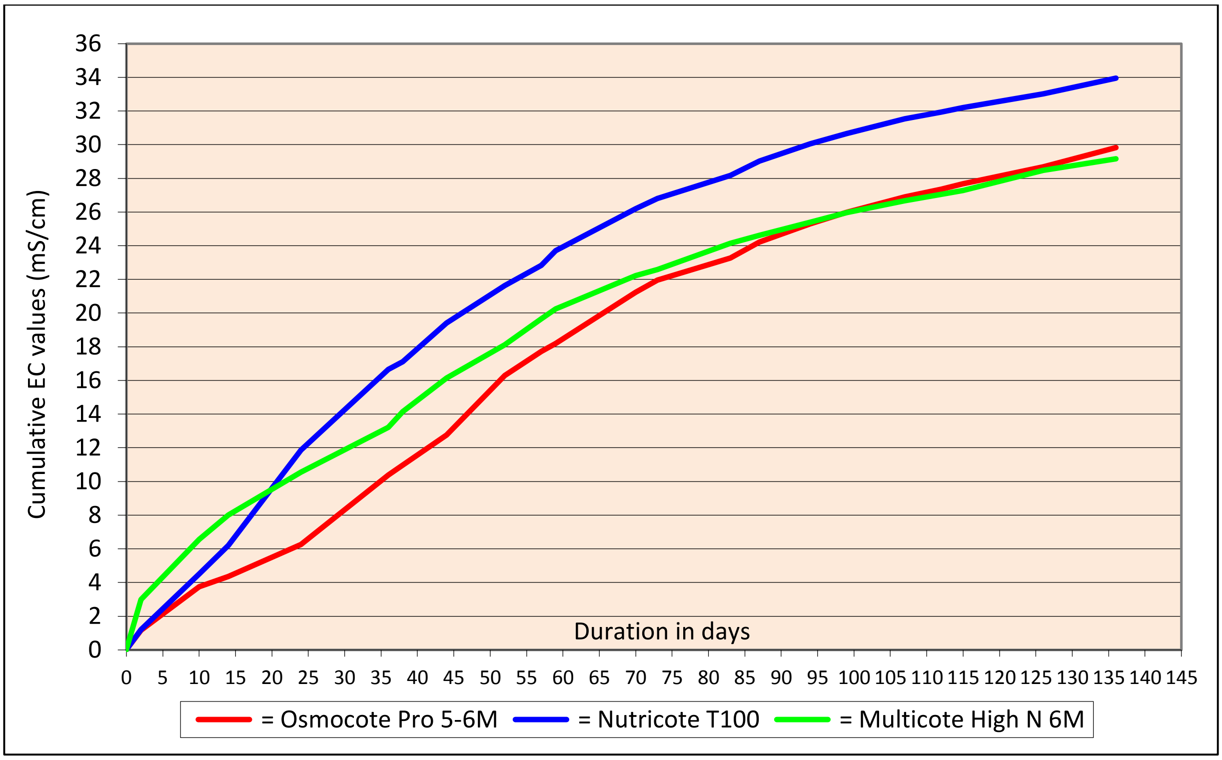


Fig. 1: Release curves of the three products in the laboratory

2.2. Growth of *Weigela* 'Lucifer'

The *Weigela* were potted on 27 May 2014 and placed in production trays on a covered production area (Figure 2). During the coming weeks, the plants established very well and exhibited very even growth. There were no plant failures.

Fig. 2:
View of the *Weigela* 'Lucifer' following potting on 27 May 2014. The pot surface was covered with a layer of mulch from screening material (conifer chaff) to prevent weeds from growing

The final assessment of the *Weigela* took place at the end of October on 20 October 2014 (Figure 3). Plant growth in the Osmocote Pro 5-6M and Nutricote T100 plots was comparatively good. Somewhat smaller but still of good quality were the plants supplied with Multicote High N 6M. The plants given a combination of 6M and 8M were smaller still.

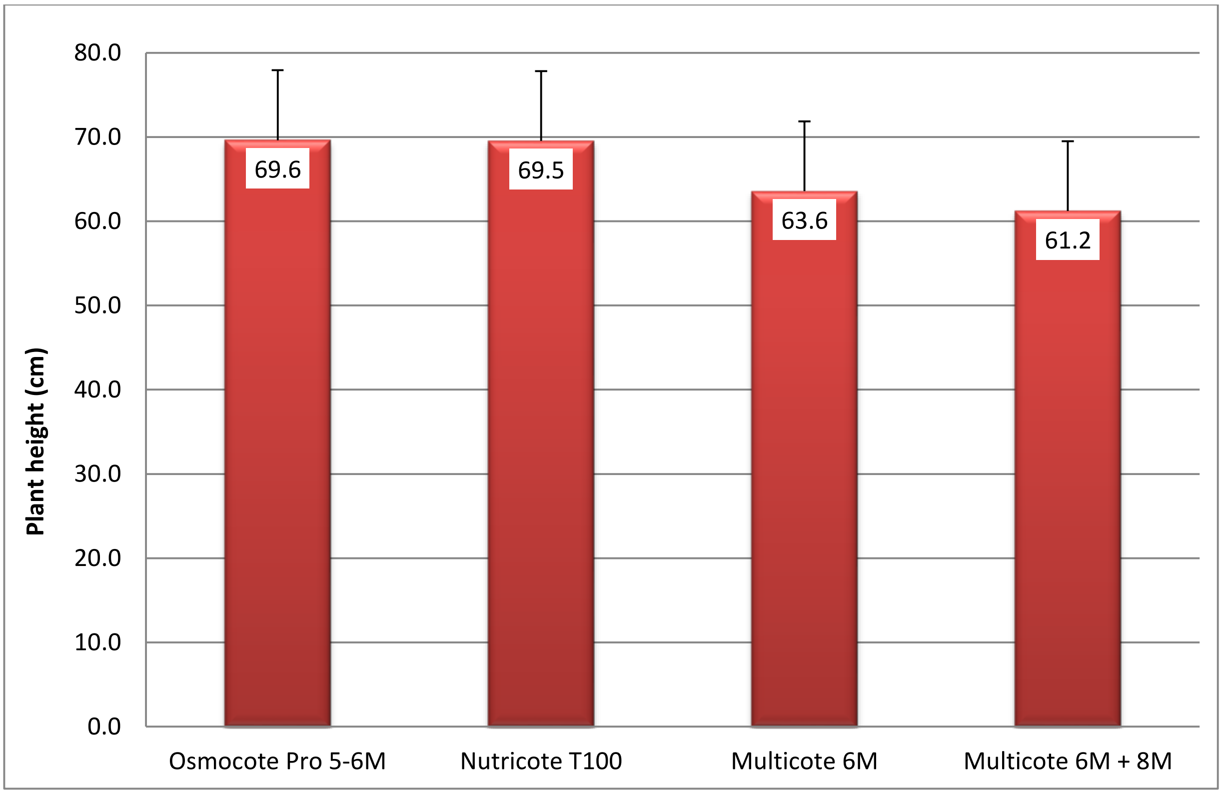


Fig. 3: Mean plant height of *Weigela* 'Lucifer' on 20/10/2014
The error bars show the standard deviation between the treatments.

During grading into the various size categories (30-40 cm and 40-60 cm) it was found that 100% of the plants fell into the 40-60 cm category following application of the Osmocote Pro 5-6M, Nutricote T100 and Multicote High N 6M fertilisers. Where Multicote High N 6M was combined with 8M, 4% fell into the smaller category of 30-40 cm.

Figs. 4 and 5: Typical plants treated with Osmocote Pro 5-6M (left) and Nutricote T100 (right)

Figs. 6 and 7: Typical plants treated with Multicote High N 6M (left) and the combination of Multicote High N 6M and 8M (right)

2.3. <u>Growth of *Juniperus squamata* 'Blue Star'</u>

Just like the *Weigela*, the *Juniperus* plants were potted on 27 May 2014 and placed in production trays on a covered production area. During the following weeks the plants showed very uniform growth in all plots with no failures (Figure 8). Although *Juniperus* 'Blue Star' requires a lot of nutrients, only slight differences in growth occurred during the growing season between the treatments. The plants in the Osmocote Pro 5-6M and Nutricote T100 plots were marginally larger and the needle colouring appeared slightly darker.

Fig. 8:
View of the test facility with *Juniperus squamata* 'Blue Star' on 1 July 2014

A final measurement of the plants took place on 20 October 2014. The plant height and maximum width were measured for each plant. Figure 9 shows the results for plant height.

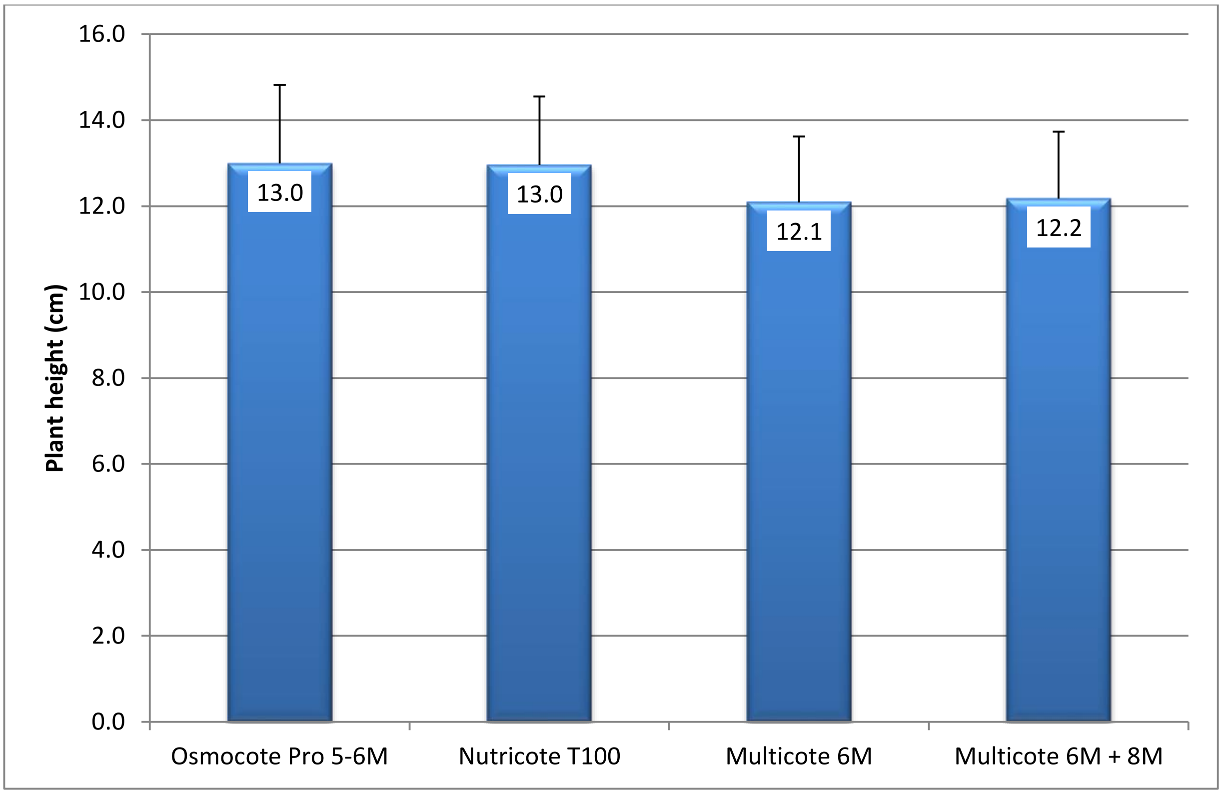


Fig. 9: Plant height for *Juniperus squamata* 'Blue Star' on 20 October 2014

The plants in the plots supplied with Osmocote Pro 5-6M and Nutricote T100 showed a slight height advantage. However, this hardly led to any benefit when grading the plants according to size categories. For the Osmocote Pro 5-6M fertiliser treatment, 5% of the plants were graded in the taller 15-20 cm category whilst all the others fell into the 10-15 cm category.

With the Nutricote T100 treatment, only 1% of the plants were allocated to the taller grade of 15-20 cm. 100% of the plants in both Multicote-treatments fell into the 10-15 cm category. There were no differences with respect to plant width. Figures 10-13 show typical plants of each fertiliser treatment.

Fig. 10-13: Typical *Juniperus* plants of each fertiliser variant on 20 October 2014

2.4. Growth of *Lonicera pileata*

The ground cover species *Lonicera pileata* were potted on 25 June 2014 and immediately faced the hot season of July. In spite of the hot weather conditions and a supply of 4.0 kg/m^3 of controlled release fertiliser, there was no damage caused by flash nutrient release in any of the fertiliser treatments.

Fig. 14: View of the freshly potted test beds with *Lonicera pileata*

Fig. 15: State of growth of the ground cover plants on 4 August 2014

The plants developed quite uniformly in all the treatments. The final assessment took place on 6 October 2014. The shoots of each plant were held together and the maximum length measured. Grading into the size categories 20-30 cm and 30-40 cm also took place and the predominant foliage colour was also recorded for each fertiliser treatment.

With respect to the shoot lengths achieved, the plants were approximately of equal length regardless of treatment (Figure 16). Plants treated with Multicote High N 6M showed a slight advantage, which was also noted at grading into the size categories (Figure 17).

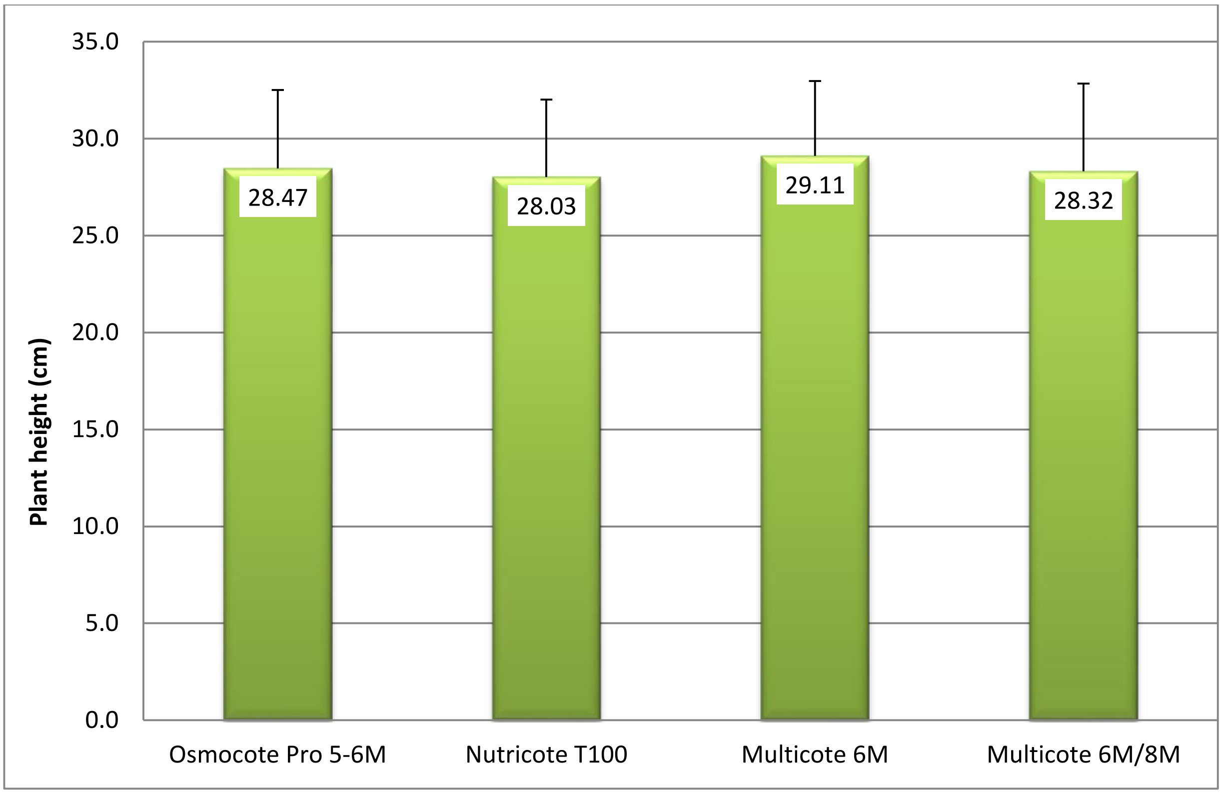


Fig. 16: Mean shoot length of *Lonicera* plants on 6 October 2014.
The error bars represent the standard deviation within the test variants.

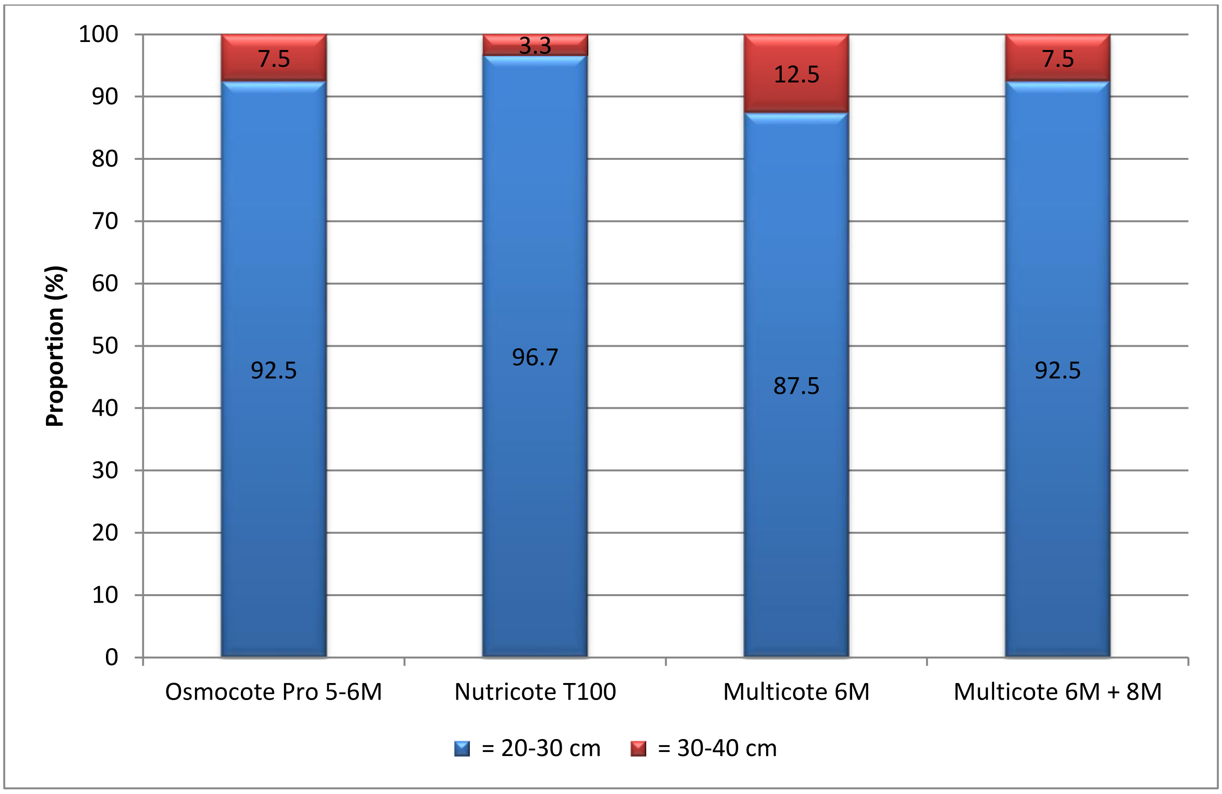
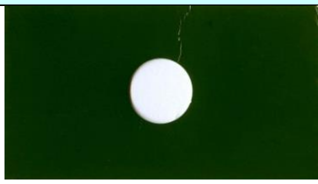
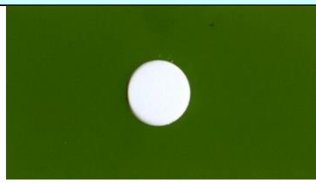
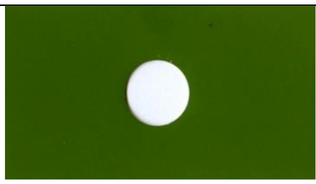
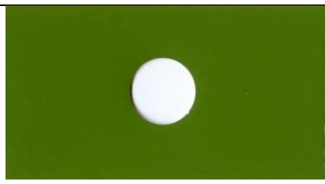
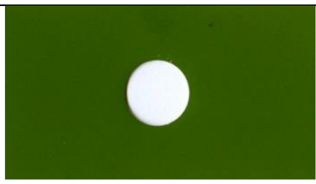
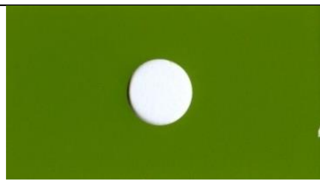
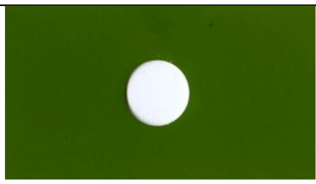
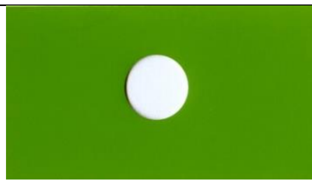


Fig. 17: Proportion (percentage) of plants in the 20-30 cm and 30-40 cm size categories

The Multicote treatments were, however, marked by a slightly lighter leaf colouration (Table 3).

Table 3: Leaf colouration of each treatment on 6 October 2014 according to the RHS Colour Chart

	Treatment	Colour No.	Predominant colour shades	
1.)	Osmocote Pro 5-6M	147 A – 146 A		
2.)	Nutricote T100	146 A - 147 B		
3.)	Multicote High N 6M	146 A – 146 B		
4.)	Multicote High N 6M + 8M	146 A - 144 A		

Figures 18-21 show typical plants for each fertiliser treatment at the time of final assessment.

Fig. 18:
Typical plants of *Lonicera pileata* from plots treated with Osmocote Pro 5-6M. These plants had the darkest leaf colouring

Fig. 19:
Typical plants from the Nutricote T100 plots

Fig. 20:
The plants from the plots treated with Multicote High N 6M all grew well but their leaf colouring was somewhat lighter

Fig. 21:
Likewise good growth, but slightly lighter leaves in the plots treated with Multicote High N 6M + 8M

3. Summary

Experiments were carried out in 2014 in order to test the efficacy of Multicote fertilisers. The Multicote High N 6M fertiliser was used either alone or together with Multicote High N 8M. Osmocote Pro 5-6M and Nutricote T100 were chosen to be the control (comparison) as these were highly important for the Pinneberg tree nurseries.

The experiment was undertaken using *Weigela* ‘Lucifer‘, *Juniperus squamata* ‘Blue Star‘ and the ground cover species *Lonicera pileata*. In the case of *Weigela*, the plants supplied with Osmocote Pro and Nutricote T100 showed the strongest growth. The plants fertilised with Multicote High N 6M were slightly smaller. However, all the plants ended up in the largest 40-60 cm category. The plants given a combination of 6M and 8M remained smaller.

The growth of *Juniperus squamata* 'Blue Star' was practically the same for all the treatments. The growth of the ground cover plants was also fairly uniform for all four treatments, with a slight benefit noted in response to the Multicote High N 6M fertiliser treatment. The leaf colouration was slightly lighter on the plants in the three Multicote treatments compared with the standard fertilisers, Osmocote Pro and Nutricote T100.

Comparison of controlled release fertilisers, Plantacote Pluss 6M and Osmocote Pro 5-6M

(Hendrik Averdieck)

1. Aim and structure of experiment

Two shrub species were selected in 2014 in order to compare the Plantacote Pluss 6M (14-09-15-2) and Osmocote Pro 5-6M (17-11-10-2) products with each other. The fertiliser quantities for each product were calculated in such a way that the plants received the same nitrogen quantity (750 mg/litre) for the fertiliser treatments. As a result of keeping the nitrogen quantity the same, different quantities of fertiliser were actually mixed into the substrate (Table 1). This resulted in differences in the supply of other elements, particularly potassium, and this should be considered when interpreting the results.

The woody shrubs, *Photinia fraseri* 'Little Red Robin' and *Lonicera pileata* were chosen as the test subjects. Both plants have a long growing period that is sustained right until late summer. Table 1 summarises the treatments examined.

Table 1: Test Treatments

	Product	Manufacturer's declaration	N-quantity required in the substrate	Fertiliser quantity mixed in
1.	Plantacote Pluss 6M	14 – 09 – 15	750 mg/l N	5.4 g/l
2.	Osmocote Pro 5-6M	17 – 11 – 10	750 mg/l N	4.4 g/l

As a result of the extended sales season during the spring, potting on the nursery, and hence also potting of the test plants, took place comparatively late. The young *Photinia* plants (root balled) were potted into 3-litre containers on 13 June 2014 (Figure 1) and the *Lonicera* ground cover plants (rooted cuttings) were planted into 1-litre pots on 24 June 2014 (Figure 2).

Of the *Photinia* plants, 84 plants were potted for each treatment and these were divided up into 28 plants for each of three replicates. 216 ground cover plants were potted per fertiliser treatment, divided up into 72 plants for each of the three replicates.

Running parallel to the practical experiment, the release properties of the products used were also tested in a laboratory experiment at room temperature. For this test, 20 g of each fertiliser were weighed and placed in a 500 ml beaker, which was then topped up with 400 ml distilled water. Three beakers were used for each fertiliser and the mean value from the three replications was used. The conductivity (EC value) in mS/cm was measured in the beakers at regular intervals. Once a value of 5 mS/cm was reached, the water was changed so as to avoid any saturation of the saline solution. The conductivity was cumulatively updated in the release curves.

Fig. 1: View of the bed with the potted *Photinia fraseri* ‘Little Red Robin’ in 3-litre containers

Fig. 2: View of the bed with the potted *Lonicera pileata* in 1-litre pots

2. Results

2.1. Results with *Photinia fraseri* ‘Little Red Robin‘

Plant growth for both the fertiliser treatments was fairly uniform. During the month of July, there were no visual differences regarding growth between the plots (Figure 3). Even with respect to the red colouration of the leaves during budding, there were no differences between the fertiliser treatments.

The first measurement of plant height took place in August. The trend was for slight growth benefits for plants supplied with Plantacote Pluss. A second measurement took place two months later on 6 October 2014 (Figure 4). This measurement too showed a growth benefit for plants supplied with Plantacote Pluss. With regard to the average plant height, the difference was slight, but it did result in a difference in the grading results (Figure 5).

Fig. 3:
View of the test bed with *Photinia fraseri* ‘Little Red Robin‘ on 4 August 2014

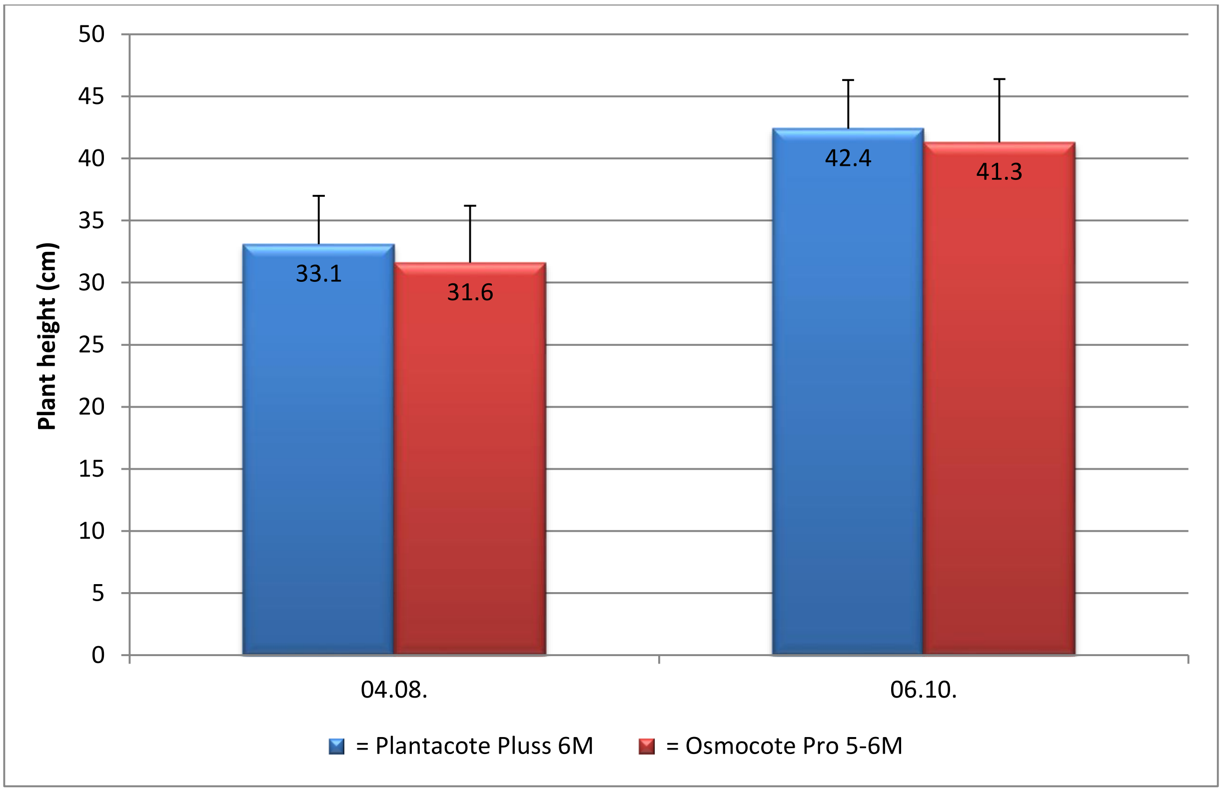


Fig. 4: Plant height of *Photinia fraseri* 'Little Red Robin' on 4 August and 6 October

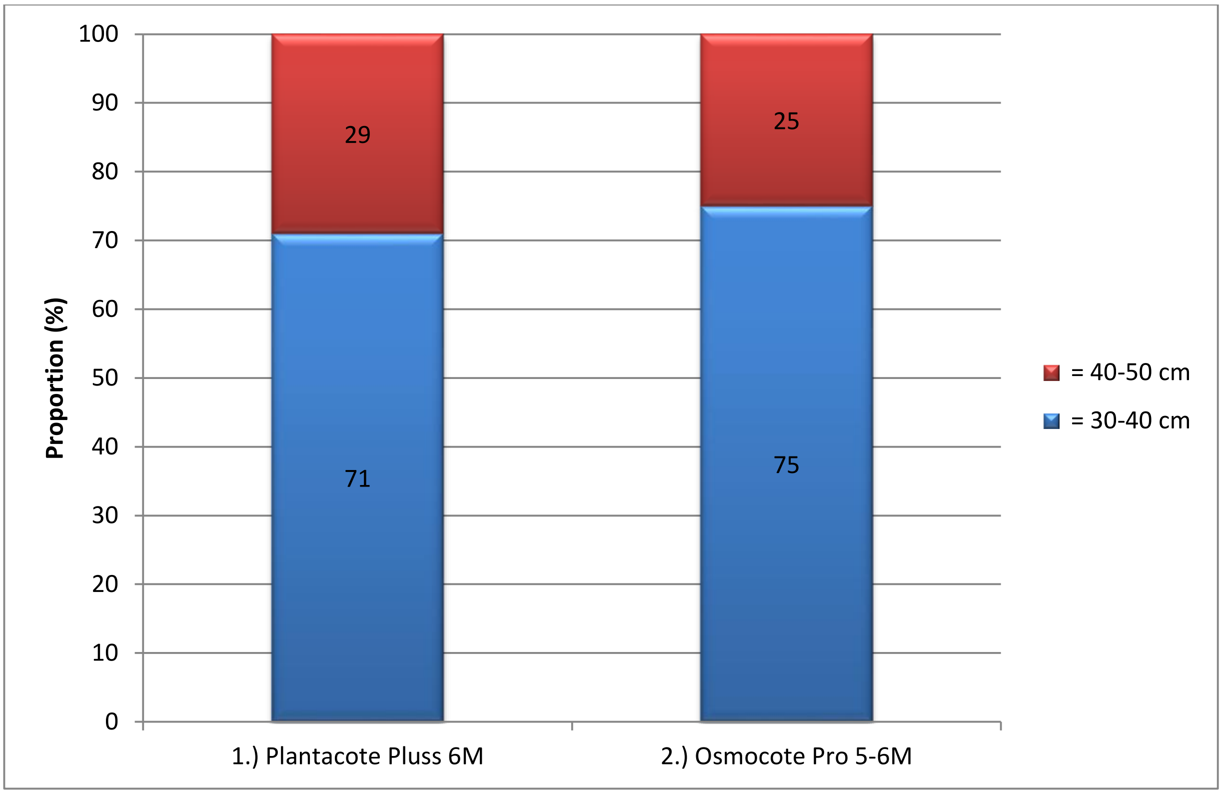


Fig. 5: Proportion (percentage) of test plants graded in the 30-40 cm and 40-50 cm size categories

The slight differences in growth were reflected to a limited extent, in the grading result. In the Plantacote Pluss plots, 29% of the plants were allocated to the 40-50 cm size category and the remaining 71% to the 30-40 cm category. In the Osmocote Pro plots, 25% were in the taller category of 40-50 cm with 75% graded into the smaller 20-30 cm category. Figures 6 and 7 show typical plants from the two treatments on 6 October 2014.

Fig. 6: Typical *Photinia* plants from the plots treated with Plantacote Pluss 6M

Fig. 7: Typical *Photinia* plants fertilised with Osmocote Pro 5-6M

2.2. <u>Results with *Lonicera pileata*</u>

Growth of the ground cover plants was initially fairly uniform. Although 10-14 days following potting the prevailing air temperatures were already around 30°C, there were no plant failures for none of the two products. During the mid-August to mid-September period, it was possible to see slight differences. The *Lonicera* plants supplied with Plantacote Pluss showed slightly better growth. The final assessment took place on 6 October 2014. The shoots from each plant were gathered together and the maximum length measured.

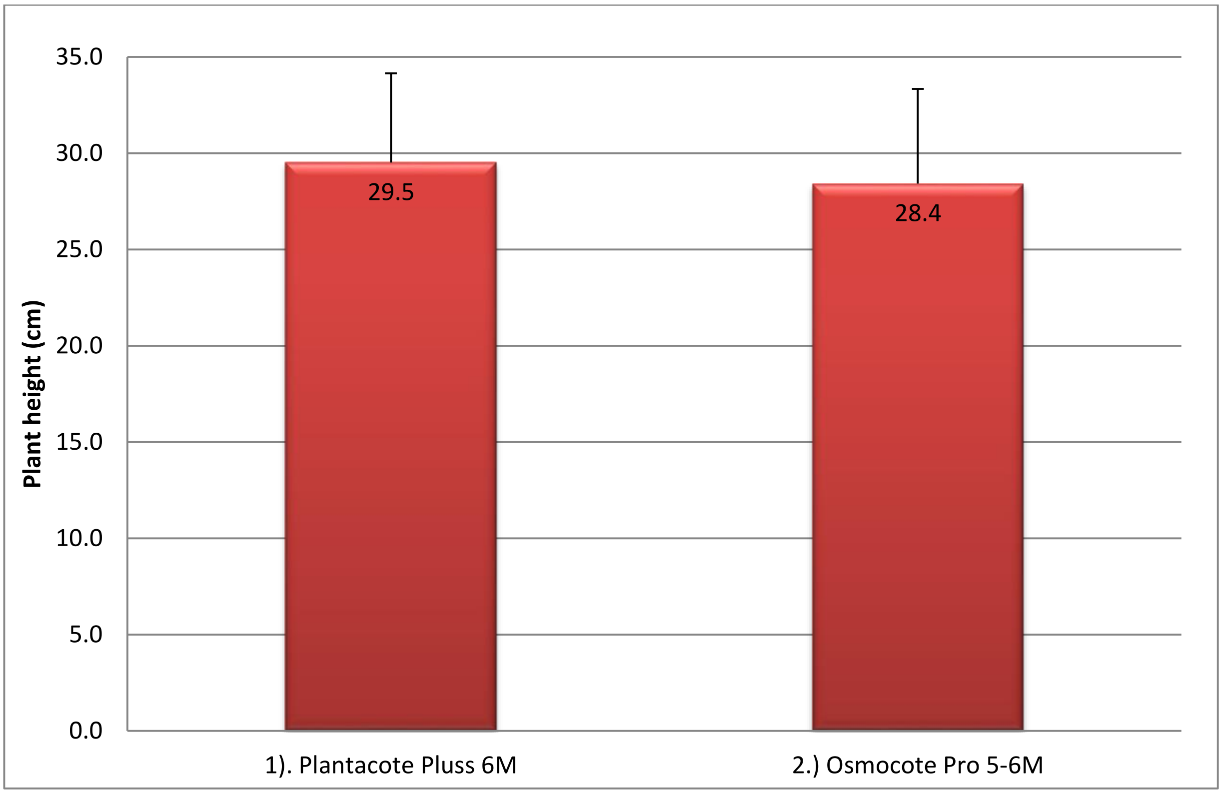


Fig. 8: Mean shoot length of the *Lonicera* plants on 6 October 2014

The differences in growth between the plants were not extensive and the slightly larger plants continued to be those from plots supplied with Plantacote Pluss 6M (Figure 8). As a result of the slightly stronger growth amongst the plants treated with Plantacote Pluss these plants had a better grade-out (Figure 9). 14% of the plants fell within the 30-40 cm category and 86% in the 20-30 cm category. For the plants in the Osmocote Pro plots, 8% fell within the 30-40 cm category and 92% in the 20-30 cm category.

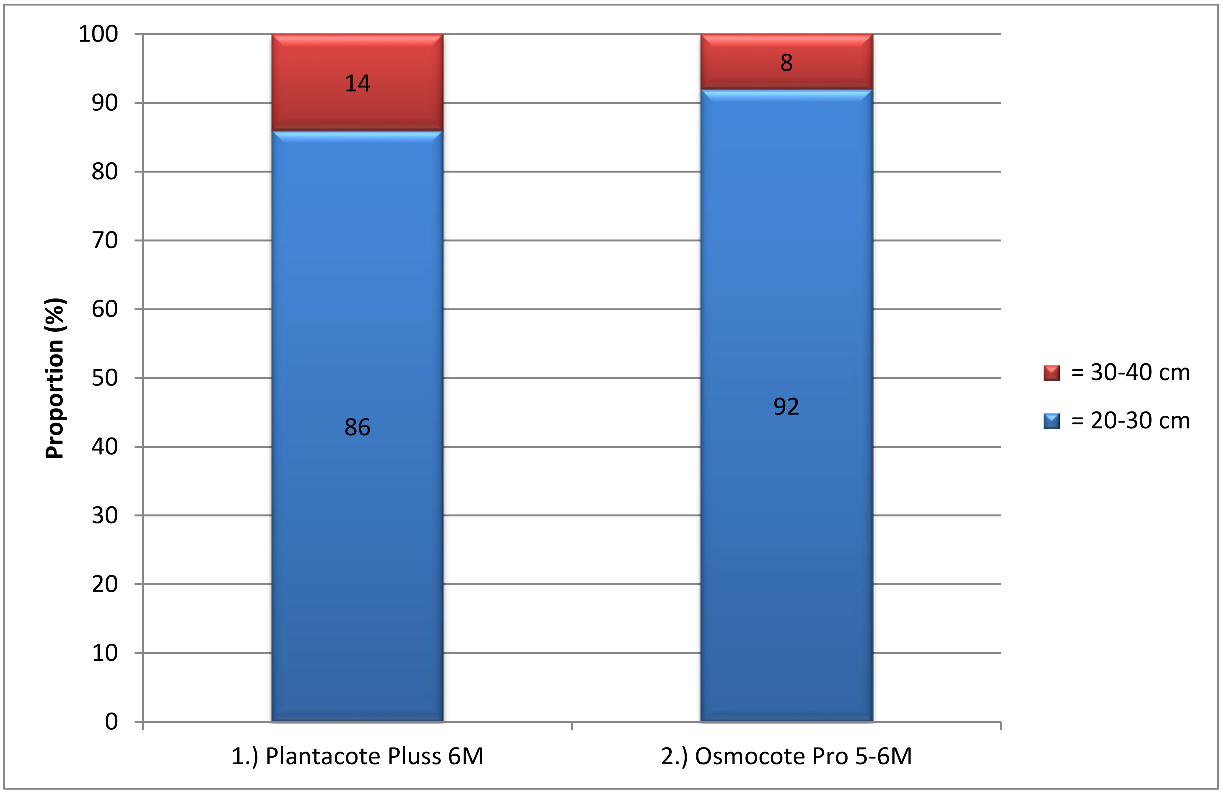


Fig. 9: Proportion (percentage) of test plants in the 20-30 cm and 30-40 cm categories

Differences in leaf colouration could not be determined between the fertiliser treatments. When determining the leaf colour against the RHS Colour Charts (The Royal Horticultural Society, London), the leaf colour of both treatments was in the range of 147 A-146 A (Figure 10).

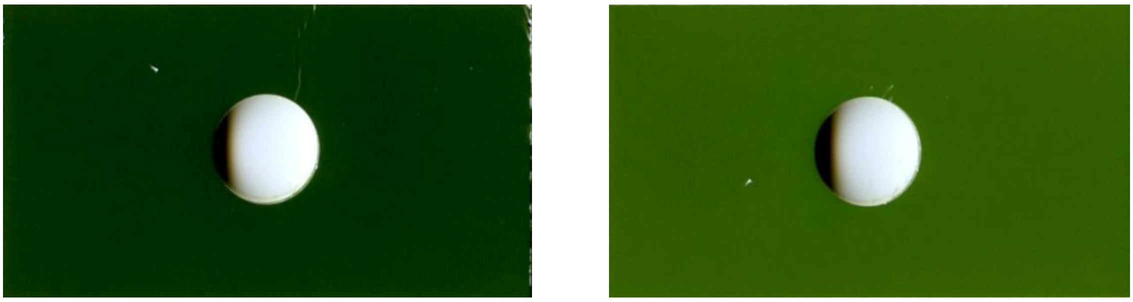


Fig. 10: Predominant range of the leaf colour of *Lonicera pileata* for all treatments on 6 October 2014 (according to the RHS Colour Charts)

Figures 11-12 each show typical plants from the experimental plots.

Fig. 11: Typical plants from the Plantacote Pluss plots at the beginning of October

Fig. 12: Typical plants from the Osmocote Pro 5-6M plots at the beginning of October

2.4. <u>Nutrient release pattern in the laboratory leaching-out test</u>

The release test in the laboratory was carried out over a period of approximately 4.5 months at room temperature (Figure 13). From the curves it can be seen that Plantacote Pluss showed stronger initial release than Osmocote Pro.

After a period of roughly 70 days, the Plantacote Pluss fertiliser curve started to flatten out.

Following an initial lower release, the Osmocote Pro released more nutrients and its curve flattened less obviously compared with the Plantacote product.

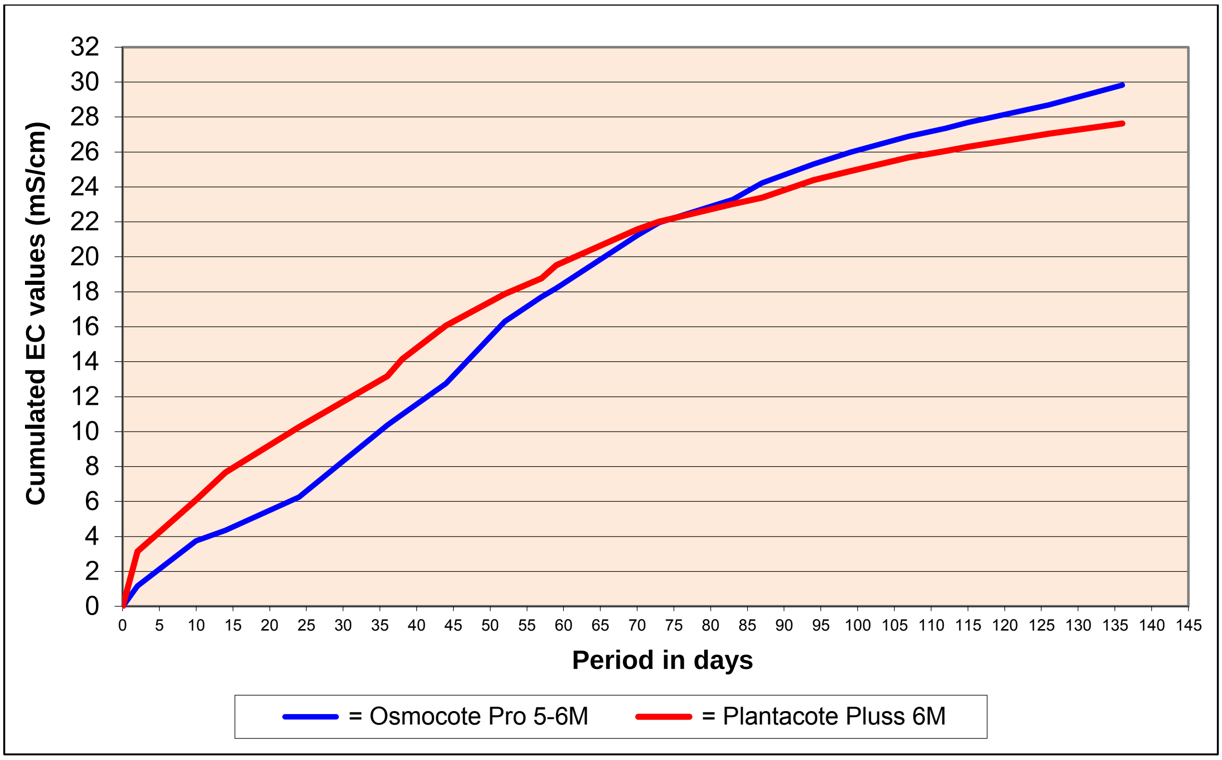


Fig. 13: Release curves of the controlled release fertilisers used in the experiment in the laboratory leaching out test

3. <u>Summary</u>

The efficacy of the products, Plantacote Pluss 6M (14-09-15-2) and Osmocote Pro 5-6M (17-11-10-2) was compared in the production of two shrub species.

The test plants were young *Photinia fraseri* 'Little Red Robin' plants which were potted in 3-litre containers and rooted cuttings of *Lonicera pileata*, which were potted in 1-litre pots. As a result of a long dispatch time, potting of the test plants on the nursery occurred relatively late, on 13 and 24 June 2014. At the same time, a leaching out test on the products used was set up in the laboratory, so that the release properties of the products could be better assessed.

As a result of the hot weather in July, there was strong nutrient release of the controlled release fertilisers a short time after potting. However, this did not cause plant failures but both test plants converted the available nutrients in both fertiliser treatments into vigorous growth. At the end of the growing season, the plants of both species treated with Plantacote Pluss 6M tended to show better growth. The difference in relation to the comparative product, Osmocote Pro 5-6M, was however, small. What should be noted is that both fertilisers were matched to the same amount of nitrogen in the substrate. Because of the high nitrogen content of the Osmocote Pro, there was 1 kg/m^3 less Osmocote Pro in the substrate. As a result the amount of potassium in the Osmocote Pro plots was likewise distinctly lower than in the Plantacote Pluss plots.

Use of products to improve plant resistance to frost

(Hendrik Averdieck)

1. Aim and structure of experiment

Depending on the type of woody plant or shrub and the prevailing weather conditions in late winter/early spring, many woody plants and shrubs can be expected to shoot roughly in mid-April. In May, many deciduous trees and conifers, including, for example, *Abies nordmanniana*, are in full growth and accordingly have very soft shoots and fresh soft leaves or needles. If severe late frosts occur during this critical time, then considerable plant damage can be expected (Figures1 and 2).

Fig. 1: Severely damaged crop of copper beech caused by a late frost on 4 May

Fig. 2: Frost damage to fresh Douglas fir shoots

It is only practicable and economical to cover more valuable species and smaller branches and foliage with netting or a winter protection blanket. For a much larger percentage of tree species, frost-protection irrigation is carried out during the critical shooting phase. However, on large tree nurseries, not all cultivated areas are protected this way. In densely populated regions, frost protection irrigation is also meeting with increasing resistance from local residents because of the night-time noise from the diesel generating units and the rattling noises from the irrigators disrupting sleep.

A much simpler and cheaper way, would be to treat plants at risk with products which increase frost resistance. In practical tests, three products were examined, which should or might have an appropriate effect (Table 1).

Table 1: Test treatments

	Product	Quantity used	Manufacturer/sales
1.	CropAid NPA	0.5% at 666 l/ha	CropAid Ltd., England
2.	Compo Frost Protect	0.5% at 666 l/ha	Compo Expert
3.	Multi-K-Mg (12-0-42-2)	0.5% at 666 l/ha	Wilhelm Haug GmbH
4.	Untreated control	---	---

According to the manufacturer's data, CropAid NPA is a natural frost protection agent for plants, which is intended to improve the tolerance of plants to cold, frost and heat. Spraying the product is intended to encourage the plants to produce special proteins and amino acids, which encourage frost protection. The product is produced from special minerals and bacterial components of the *Thiobacillus* strains.

Compo Frost Protect, which is currently distributed in England by Compo Expert, is likewise intended to protect sensitive plant parts against frost damage. It consists of various cold protecting substances, the natural anti-stress compound, α-DL-tocopherol and a 2% boron component.

Multi-K-Mg is a spray nutrient salt with a very high potassium content of 42%. Potassium is also attributed with an action that increases tolerance to cold, which is based on lowering the freezing point of the cell vacuoles.

All the products were applied using a plot spray on 30 April 2015, roughly two days (approximately 50 hours) before a forecast late frost. The concentration of all products was in line with the manufacturer's instructions of 0.5%. The quantity of water sprayed was 666 l/ha.

The preparations were sprayed on seven different tree/shrub cultures: 1 and 2-year old seedlings of *Fagus sylvatica*, 1-year old seedlings of *Quercus robur* and *Quercus petraea*, freshly emerged rose grafts (Nostalgia variety) and on 2-year old lined out Douglas fir seedlings and 4-year old Noble firs.

2. Results

Figures 3-8 show the state of development of the cultures at the time the products were sprayed on 30 April 2014 before the late frosts occurred.


Figs. 3 and 4: Stage of shoot emergence of the 1-year-old (left) and 2-year-old copper beech seedlings (right) on 30 April 2014


Figs. 5 and 6: Foliage development of 1-year-old pedunculate oak (left) und sessile oaks (right)


Figs 7 and 8: Fresh shoots on the 2-year-old lined-out Douglas firs (left) and rose grafts (right)

During the night of the 2 to 3 May 2014, frosts of -1.5 to -4.0°C, depending on the region, caused damage to plants on many tree nurseries. On the 5 and again on 13 May, the species which had been treated in advance were graded with respect to frost damage.

The most severe damage occurred in the copper beeches 2/0. It was less severe in the Douglas firs and Noble firs.

The following figures show the damage done to these species in individual test plots.

Figs. 9 and 10: Severe damage to copper beech 2/0 in the control (left) and in the plots treated with CropAid NPA (right)

Figs. 11 and 12: Comparable damage in the plots treated with Compo Frost Protect (left) and Multi-K-Mg (right)

Figs. 13 and 14: Slight damage to the shoots of the Douglas firs in the control (left) and in the plants treated with CropAid NPA (right)

Figs. 15 and 16: No differences compared with the plants treated with Compo Frost Protect (left) and Multi-K-Mg. Photos: 5 May 2014


Fig. 17 and 18: Frozen shoots of the Noble firs in the untreated control (left) and the plants treated with CropAid NPA (right). Photos: 13 May 2014

Figs. 19 and 20: Damage in the plots with Compo Frost Protect (left) and with Multi-K-Mg

There was slight damage amongst the one-year old pedunculate oak seedlings (Figure 21) whilst there was no damage to the sessile oaks in the direct vicinity. The damage to the 1-year old copper beech seedlings was noticeably less than that in the copper beeches 2/0 (Figure 22). Even in these species, the frost protection products had no effect compared with the untreated control.

There was absolutely no frost damage to the rose grafts.

Fig. 21: Light foliage damage in *Quercus petraea* 1/0 (photo: 13 May 2014.)

Fig. 22: Slight foliage and shoot damage to *Fagus sylvatica* 1/0

3. Summary

In 2014, experiments were set up to test the effect of various products to improve the frost resistance of trees/shrubs to late frosts. The products CropAid NPA, Compo Frost Protect and predominantly potassium-containing nutrient salt, Multi-K-Mg were used in a comparison with untreated control plots. All the products were used approximately two days before a forecast late frost at a concentration of 0.5% in tree species that had freshly emerged. The test plants were 1 and 2-year-old seedlings of *Fagus sylvatica*, 1-year-old seedlings of *Quercus robur* and *Quercus petraea*, rose grafts and 2-year-old lined-out Douglas firs, as well as 4-year old Noble firs.

The late frost occurred in the night from 2 to 3 May 2014 with regionally fluctuating temperatures of -1.5 to -4.0°C. The rose grafts and sessile oaks suffered no frost damage. In all the other species, there was frost damage to foliage and to the fresh shoots. The 2-year old copper beeches suffered severe shoot damage.

In a single species a lessening of the frost damage as a result of the products used was recorded.

Study trip to the Netherlands

(Dr Heinrich Lösing, Horticultural Centre of the Schleswig-Holstein Chamber of Agriculture)

From 26 to 29 August 2014, 40 tree nursery staff from the Pinneberg cultivation area visited eleven tree nurseries, a marketing facility and the Plantarium trade fair in the Netherlands. However, first of all, a few general statistics about the country and tree nursery production, in each case compared with the Federal Republic of Germany.

	Netherlands	Germany
Total number of inhabitants	16,804 million	80,621 million
Total surface area	33,720 km²	348,540 km²
Density of the population/km²	498	231
No. of tree nurseries	3,486	2,241
Tree nursery production area	17,841 ha, incl. shrubs/bushes	21,753 ha

Quelle Netherlands: De Boomkwekerij 47, 2011, page 8, Areaal boomkwekerij licht gegroeid, Source data Germany: ZBG-trade report, January 2014

In the past ten years, tree nursery production in the Netherlands has been expanded from 13,150 ha in 2000 to 17,184 ha in 2014. The number of nurseries has further reduced from 4,747 in 2000 to 3,486 in 2014. Below is a short summary of the nurseries visited.

Hoof tree nursery, Zevenaar, www.bhoof.nl

On an area of approximately 5 ha, young plants are predominantly cultivated in 9 or 10.5 cm pots. Annual production was quoted at 2.5 million plants. A total of seven people were employed, including five Poles. 75% of sales are geared to eastern European markets. For this reason, many conifers are cultivated.

View of the tree cultures in open land

Father Bennie and son, Ralph Hoof

B & P Handelskwekerijen, Opheusden, www.bpboomkwekerijen.nl

In an area of 140 ha, four independent nurseries produce a broad assortment of trees. The nurseries co-operate on sales, so as to remain competitive in marketing. The group agrees on production. Particularly innovative in this operation is the so-called ‘channel cultivation’. For some years the trees/shrubs have not been cultivated in open soil but in a suspended channel with openings. The material corresponds to the so-called ‘spring ring pot’ or ‘air pot’.


Cultivation of young trees by channel cultivation


Clearly visible openings in the channel

The costs of producing the channel were set at approximately EUR 15 per linear metre. Manual winter grafting material is predominantly cultivated. Plants from grafts or seedlings grow better in the soil, according to sales manager Huismann. Approximately 15,000 plants are currently being cultivated by this system.

Batouwe tree nursery, Doodewaard, www.batouwe.com

The nursery produces cutting raised young trees on an area of 4 ha, in 9-cm pots and young trees for avenue trees in the Ercole slotted pots. Proprietor Henk Huibers founded the nursery 8 years ago.


Proprietor Henk Huibers


Cultivation of young trees in Ercole slotted pots.
(Sold by: H. Meyer, Rellingen)

Ebben tree nursery, Cuijk, www.ebben.nl

A very wide assortment of plants and avenue trees are cultivated on an area of 400 ha. Approximately 80 people are employed in the tree nursery and 20 in the office and in sales. For production, some of the cultivation work is farmed out to agricultural contractors. This practice is quite normal in the Netherlands, unlike Germany. The plants are predominantly sold in Western Europe. At roughly 40% the Netherlands has the largest market share.


Proprietor Toon Ebben at the presentation


Impressive reception rooms for customers

Quickhedge tree nursery, Boekel, www.quickhedge.com

On an area of 25 ha ready-for-planting hedging plants with standard heights of 80, 120 and 150 cm are exclusively produced.Cultivation takes place on open land using the latest machines. All cutting takes place automatically with the help of GPS-controlled Fendt-tractors with an accuracy of 2.5 cm.


Ready-to-plant *Fagus* hedging plants, prepared for dispatch in the summer


View of the cultivation areas on open land

ASRA Plant tree nursery, Meer, Belgium, www.asraplant.eu

The modern container operation is situated on the Belgian side of the border. Because the proprietor, Robert Huibregts, was briefly indisposed, the guided tour was conducted by Bert Miggelenbring (Javo company). The plants are marketed under the slogan ‘Sense of nature’, which is intended to appeal particularly to the human senses of touch, sight, taste, smell and hearing.

Transfer of plants from the cutting machine by forklift truck with fork

Lodders tree nursery, Wernhout, www.lodders.nl

The tree nursery has been very well known for many years throughout Europe as a special nursery for the marketing and production of woody plants/shrubs on open land and in containers. A large part of the cultivation takes place under contract in the Zundert region. This region is characterised by light sandy soils and mild winters and is therefore highly suited for seeding young trees/shrubs.

Cultivation of privet from cuttings, using PE film

Participants doing the rounds through the container section

C. Daamen tree nursery, Klein-Zundert, www.boomkwekerijdaamen.nl

As extra to the official programme, a short visit was paid in the evening to this nursery to view the world's first sorting machine for largish plants up to a total length of 2 m. Sorting can be done according to length and thickness. The machine was developed jointly with the Schrauwen company of Zundert.

The proprietor indicated an output of 1,400 plants per hour (3-year-old beech). According to Mr Daamen the average sorting rate per person is doubled. A price of EUR 185.000 (net) was quoted for the machine.

View of the sorting machines for trees up to 2 m

Drums for grading and counting plants

DeDouglas tree nursery, Wernhout, www.douglasboomkwekerij.nl

For many years, the tree nursery has specialised in the production of plugs. Annual production was put at 25 million units, of which 5 million plants were produced in an operation in Poland. Polystyrene plug trays are used for cultivation, because they guarantee a more even temperature in the substrate. This positive characteristic becomes clear, particularly at high temperatures in the summer and in the cold of winter. To prevent the plants from growing into the tray especially after it has been used several times, a so-called paper plug is now used. As a result, a better root development overall is achieved (see image).

Film house with seedlings of Douglas firs in polystyrene plug trays

Comparison between single polystyrene plug tray plant (left) and paper plug (right) with Douglas fir

De Rutven tree nursery, Wernhout, www.rutven.nl

The nursery was founded by the father with 5 ha in 1986 and now includes approximately 80 ha. Seven permanent staff are employed and during the peak season, a further eight people are taken on. The emphasis is on seed beds and lined out beds of deciduous and conifer trees. For successful, competitive production of seedlings, the use of soil disinfectants, such as basamid granules, is absolutely essential. According to the proprietor, the licensing and associated conditions for the use of basamid also cause problems.


Wide seed beds as standard, also for deciduous trees, covered with sand


Tour of the nursery, in the foreground *Acer palmatum* as main cultivation

Plantarium trade fair, Boskoop, www.plantarium.nl

For 32 years the trade fair has taken place at the trade centre in Boskoop-Hazerswoude with the emphasis on plants for the garden centre market. Approximately 300 exhibitors take part. Approximately 10,000 visitors are expected. An innovation competition is also held during the exhibition. This year, almost 100 new varieties were submitted. *Campsis* 'Summer Jazz Fire' was rated the best innovation.

Best exhibition stand as part of a competition by van Son & Koot


Campsis 'Summer Jazz Fire', awarded the top prize at the fair

G.C. Stolwijk & Co tree nursery, Boskoop, www.stolwijk.nl

The Stolwijk tree nursery was started in 1926 by the grandfather and right from the outset, concentrated mainly on trading, with some production. The assortment of trees cultivated has diminished drastically in the past decades. Of the many different species and varieties, only five actually still remain. These include *Ilex crenata* varieties as an alternative to *Buxus* which is currently the plant in most demand. The lack of load bearing capacity of the soil causes problems in Boskoop. All the buildings, including greenhouses and even parking spaces, have to be supported by piles. This incurs considerable cost.


Co-owner, Ronald Stolwijk, explaining his production and marketing concept


View of typical traditional Boskoop tree nursery landscape showing open land and ditches

Groen-Direkt, Boskoop, guided tour: Hans Cok, www.groen-direkt.nl

Groen-Direkt was founded 18 years ago as a marketing facility and for the past two years has been located on an area of 2 ha close to the Plantarium building. At the time of the visit, there were approximately 3,700 CC trolley layers with specimen plants on site. There are roughly 300 supplier nurseries from the Netherlands, Belgium and Germany. 40-50,000 CC trolley are moved each year by 10 employees. Every supplier has to pay a fee of 14.5%. This does not include transport of the plants.


Example of depth of assortment for *Hypericum* decorated with berries


Hans Cok (right) explaining the marketing concept

Kortmann Miniplant tree nursery, Boskoop, www.miniplant.nl

The Kortmann nursery was founded in 1915 and is now in its third generation. 3.5 million cuttings per year are rooted on an area of 1.5 ha, including the area for stock plants. Some of the cutting material is bought in. Five staff are employed plus additional seasonal workers.

Sales are directed predominantly to Western Europe (within a radius of 1000 km). According to the proprietor, 60-70% of the plants are pre-ordered.

Propagation of cuttings under flat tunnels with clear film

View of exemplary labelled and tended mother plant stocks

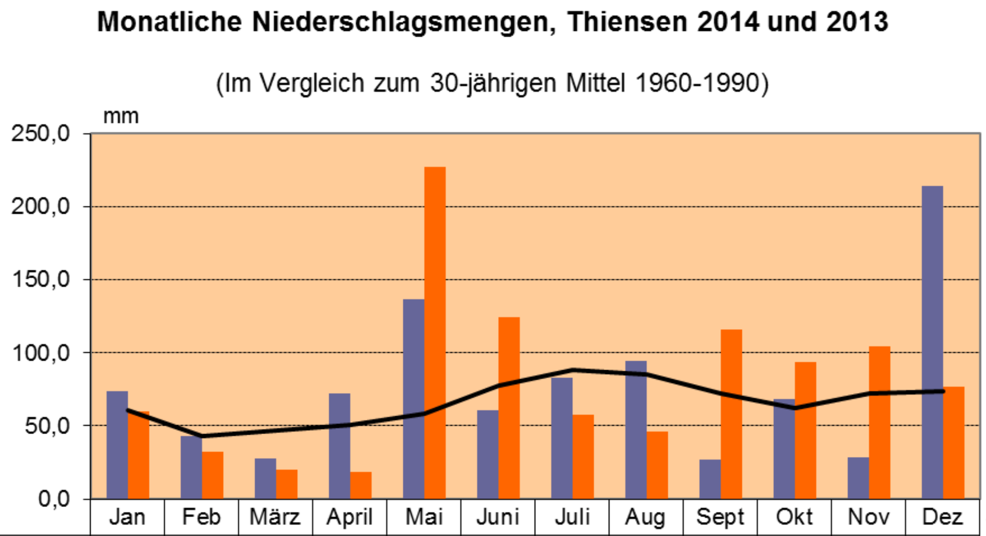
Kloosterhuis & Sohn tree nursery, Winschoten, www.kloosterhuis.com

The Kloosterhuis tree nursery produces a wide assortment of forest and hedging plants via seed and small fruits on an area of 80 ha. A further 100 ha. are available as alternating areas and are earmarked for tagetes flowers or agricultural cultivations. 12 members of staff are employed. The dispatch area was completely redesigned only a few years ago. The nursery uses the latest machinery and equipment. This also includes the tractor GPS control and the new multi-row harvester, which was developed and built together with Stingel in southern Germany and Bärtschi in Switzerland. A lot of grading work has been contracted out for years to a branch operation in Hungary. This avoided and is still avoiding the long-term problem of obtaining seasonal workers in the Netherlands.

Participants in the study trip to the Netherlands and the Kloosterhuis family

Data from the Thiensen weather station

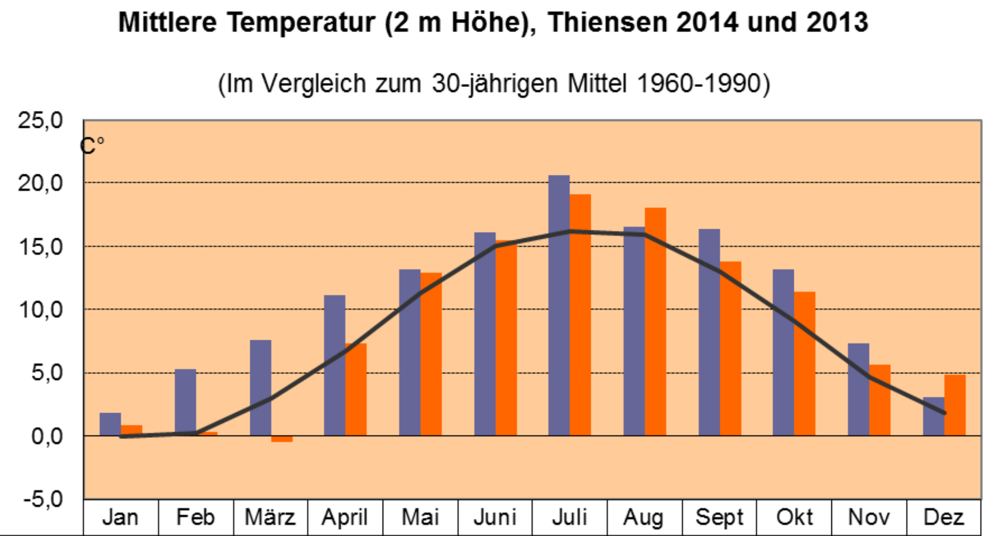
Comparison of the periods 2013 and 2014 with the 30-year average (1960-1990)



	Jan	Feb	März	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Dez	Summe
2014	73,6	43,0	27,8	72,0	136,4	60,8	82,6	94,4	26,8	68,2	28,8	213,6	928,0
2013	59,6	32,0	20,2	18,8	226,8	124,2	57,6	46,0	116,0	93,8	104,2	77,0	976,2
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

2014 2013 30-jähriges Mittel

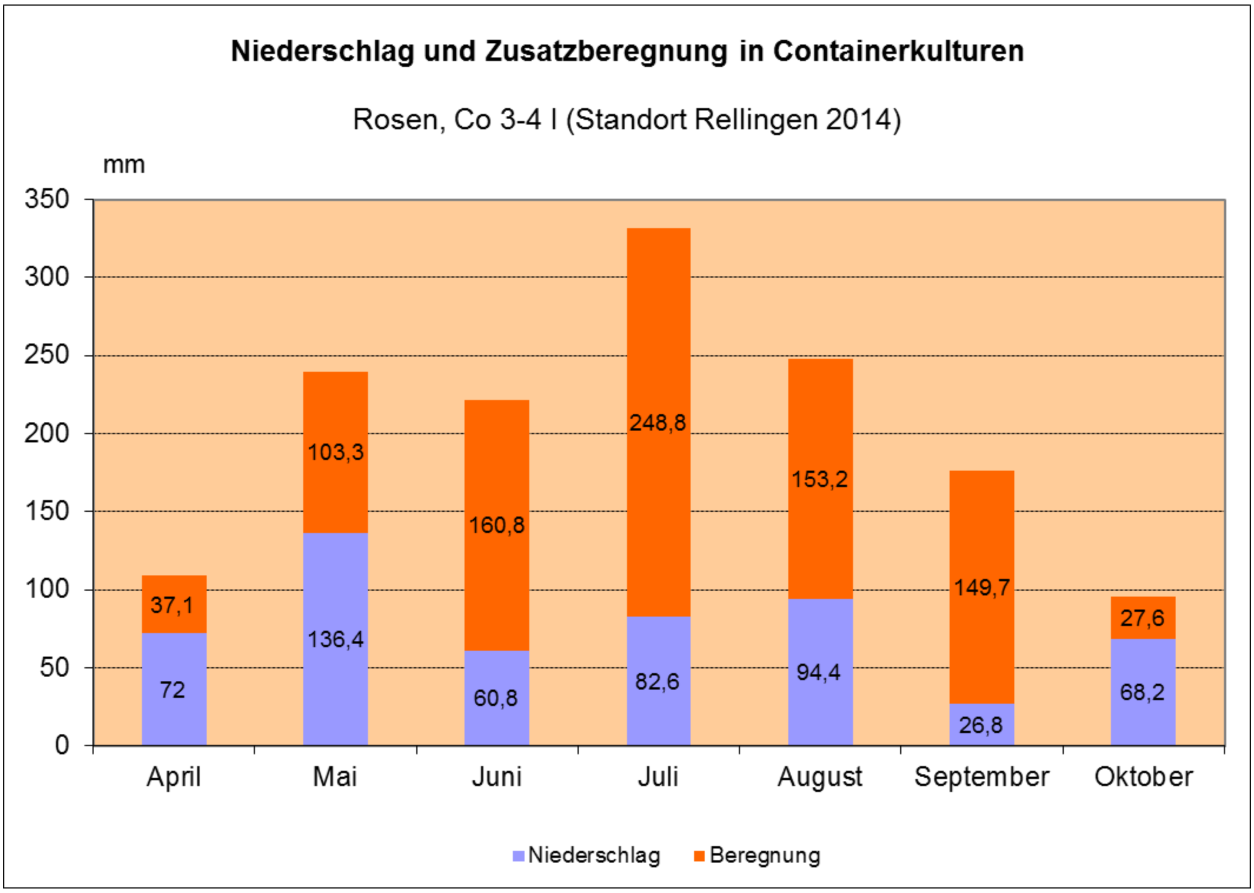
Monthly precipitation, Thiensen 2014 and 2013 (compared with the 30 year average 1960-1990)
März = March, Mai = May, Juni = June, Juli = July Summe = total
30-year average



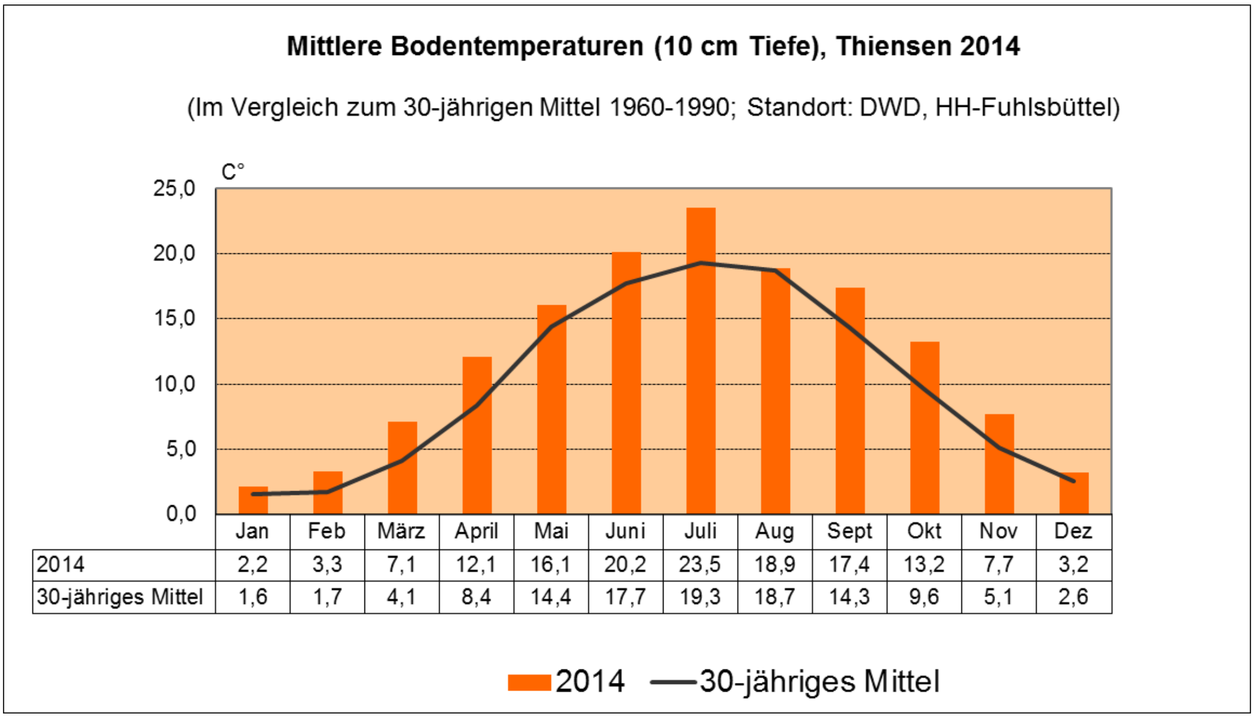
	Jan	Feb	März	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Dez	Ø
2014	1,8	5,3	7,6	11,2	13,1	16,1	20,6	16,6	16,3	13,2	7,3	3,1	11,0
2013	0,8	0,3	-0,4	7,3	12,9	15,5	19,1	18,1	13,8	11,4	5,7	4,9	9,1
30-jähriges Mittel	0	0,2	3	6,7	11,3	15	16,2	15,9	13	9,1	4,7	1,8	8,1

2014 2013 30-jähriges Mittel

Average temperature (2 m altitude) Thiensen 2014 and 2013



Precipitation and supplementary irrigation in container prodcution systems – Roses, 3-4 litre containers (Location: Rellingen 2014)
Precipitation / irrigation/watering



	Jan	Feb	März	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Dez
2014	2,2	3,3	7,1	12,1	16,1	20,2	23,5	18,9	17,4	13,2	7,7	3,2
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

Average soil temperatures (10 cm depth), Thiensen 2014 (compared with 30 year average 1960-1990; location: DWD (German Weather Service) HH- Fuhlsbüttel)

Explanation of symbols

The detailed explanation of symbols can be found in the Annex to the 'Yellow List'

ZP = Ornamental plants, ZG = ornamental trees and shrubs, B = tree nursery, O = fruit growing, F = Forest/forest trees, St = Perennials
Xi = Irritant, Xn = Harmful to health, T = toxic, T+ = highly toxic, F = highly flammable, C = caustic, N = dangerous to the environment

Explanations relating to bee protection conditions:

B1	(= NB661 u. NB6611) dangerous to bees
B2	(= NB662) dangerous to bees, except when applied after the daily bee flight up to 23:00 hours
B3	(= NB663) Bees are not at risk by virtue of the agent being used as laid down in the licence
B4	(= NB664 u. 6641) not dangerous to bees

For mixtures of insecticides, particularly in the case of the products, Karate Forst, Karate Zeon, Mavrik, Mospilan SG or Trafo, with a fungicide of the Ergosterol biosynthesis inhibitor group (e. g. Folicur, Luna Experience, Matador, Mirage 45 EC) the hazard to bees changes. Mixtures must be used in such a way that flowering plants are not affected.

The new bee protection conditions 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 open land on plants, which will no longer flower in the year of treatment. The same also applies to weeds in the stock! Under glass, treatment of plants with Dantop, Confidor WG 70 or Warrant 700 WG is only allowed before flowering, if the plants are not intended to be used in open land afterwards in the year of treatment.

Waterway protection marking:

NW 468	Do not allow application of liquids and their residues, agents and their residues, emptied containers or packs, as well as cleaning and rinsing fluids to penetrate the waterways. This also applies to indirect ingressions via the sewage system, farm and road drains as well as rain and waste water channels.
NW 642	Application of the agent in or directly alongside above-ground waterways or coastal waterways is not permitted (section 6 (2) PflSchG – German Plant Protection Act). Irrespective of this, the binding minimum distance from surface waterways, according to regional law, must be complied with. Contraventions may be punished by a fine of up to EUR 50,000.
NG 403	No application on drained areas between 1 November and 15 March
NG 405	No application on drained areas.
NG 407	No application on pure sand, slightly silty sand and slightly clayey sand.
NG 408	No application on drained areas between 1 June and 1 March

Instructions on the handling and storage of plant protection agents can be inspected on the Internet on http://www.iva.de/praxis/pflanzenschutz
Notes explaining other distance requirements can be found on the Internet on http://www.bvl.bund.de; enter code list in the search function.
Notes on the definition of storage classes can be obtained from VuB.

Resistance management – avoidance of loss of efficacy in plant protection agents

(Britta Zielke)

In biology, we mean by resistance, the ability of an organism to withstand external influences. For example, some varieties of plants have been cultivated and selected with respect to their resistance against certain diseases and pathogens. For example, as a result of the many years of cultivating resistance in the apple we have succeeded in putting scab and mildew resistant varieties on the market.

However, resistance also means the ability of pathogens in plants to resist the remedies used. The populations also consist of many different individuals, which are susceptible in different ways to the active substances within plant protection agents. In the case of weeds, fungi or pests, as everywhere in the animal and plant world – there are constantly random genetic modifications. Individual plants that originate by accident and are more resistant survive the use of a repeatedly applied remedy and are therefore selected. In the absence of competition, they can easily multiply and pass on the resistance feature. The propagation of resistance depends on the reproductive potential and mobility of the pathogen.

Fig. 1: Common groundsel
(photo: Lösing)

One example of herbicide resistance relevant to tree nurseries is common groundsel (*Senecio vulgaris*). As a result of rapid germination almost right through the year, short growth period up to flowering, large number of seeds per plant and dissemination of the seeds by the wind, common groudsel is pre-destined to be resistant to herbicides. The resistance of common groundsel to simazine and Afalon are well-known.

In the case of 'monogenic resistance', a group of active substances loses total effectiveness within a short time. Strobilurins as active substances of fungicides (e.g. azoxystrobin (Ortiva) or trifloxystrobin (Flint)) intervene very specifically and only at one point of action in the metabolism of a pathogen. Given corresponding selection pressure and as a result of repeated treatments with products of the same group, resistance (monogenic) can quickly set in. Once a pathogen has developed resistance to an active substance from the strobilurin group, this also affects other active substances in this group (cross resistance).

One example of resistance relevant to tree nurseries in the area of fungicides is grey mould. Its large group of host plants and its tolerance towards the location (e.g. seed beds, cooling houses, film houses etc.) enable it to occur in almost any tree nursery. The spores produced in large quantities are spread by the wind. Observation from commercial nurseries that some fungicides are no longer effective against grey mould, were confirmed by laboratory tests. In the Pinneberg district, even multi-resistant strains of the fungus were found. In such a case virtual no classes of fungicide are effective any more.

Fig. 2: Grey mould on young lavender plants (photo: Lösing)

Unlike monogenic resistance, 'polygenic resistance' results in a gradual, step-by-step reduction in efficacy, so-called 'shifting'. This can be offset in the initial stage by using higher quantities of products. Under-administration, on the other hand, accelerates the process. The azole group (e.g. tebuconazole (Folicur), propiconazole (Desmel/Tilt)) is threatened with shifting. It has been discovered in Belgium that there is presumably a strain of box leaf drop (*Cylindrocladium*), which is less sensitive to the active substance, tetraconazole.

In the case of pests, the Test and Advisory Council has, for many years, emphasized the importance of changing active substance groups when combating spider mites. Spider mites have a large group of host plants and in warm weather, a very short generation succession. Their great reproductive potential encourages resistance.

Experts from the plant protection industry throughout the world have formed world-wide active working groups on dealing with resistance. They are concerned with maintaining the efficacy of plant protection agents and with securing the world's food supply. There is one committee each for herbicides (Herbicide Resistance Action Committee www.hracglobal.com), for fungicides (Fungicide Resistance Action Committee www.frac.info) and for insecticides (Insecticide Resistance Action Committee http://www.irac-online.org).


Fig. 3: Spider mites

The experts classify all active substances according to their mode of action, into so-called resistance groups and give them numeric or letter codes.
The risk of resistance developing varies for the resistance groups. There is a very high risk of resistance forming, as already described, in the case of repeated use of fungicides of group 11 (strobilurins). On the other hand, the risk for contact fungicides, such as sulphur and copper can be ignored.
Where pathogens are repeatedly treated, it is sensible to use agents from various resistance groups and hence with various mechanisms of action. Increasingly, manufacturers and the trade (e.g. catalogue of H. Meyer) are identifying the active substance groups in their product information. A summary of the resistance groups is also provided by a corresponding column in the Yellow List of the VuB.
Other measures, which contribute to the long-term maintenance of efficacy of plant protection agents, are the avoidance of under-administering plant protection agents and desisting from unnecessary treatment.
In addition, contact active substances, where there is no risk of resistance, can be included in spray programmes.

Important note: Exclusion of liability

We draw your attention to the fact that all verbal or written recommendations and information given by us are done so to the best of our knowledge, to the exclusion of any liability.

They are based on test results, practical experience and industry recommendations and are in line with the present state of our knowledge. They may only serve as aids to decision-making and this applies particularly to all test reports and test results, which may not be adopted in practice without taking account of the special operational circumstances. In case of doubt, we recommend you perform your own small-scale experiments, in order to collect local experience. In this context we also refer to the precise observance of all regulations, instructions for use and precautionary measures.

Many conditions affect the action of crop protection and fertiliser products, such as the condition of plants, soil quality, local situation, cultural management practices, interaction with other agents and factors, as well as the weather. As such conditions and proper use are outside the control and influence of the Test and Advisory Council's tree nurseries, liability for the efficacy and consequences of use is excluded.