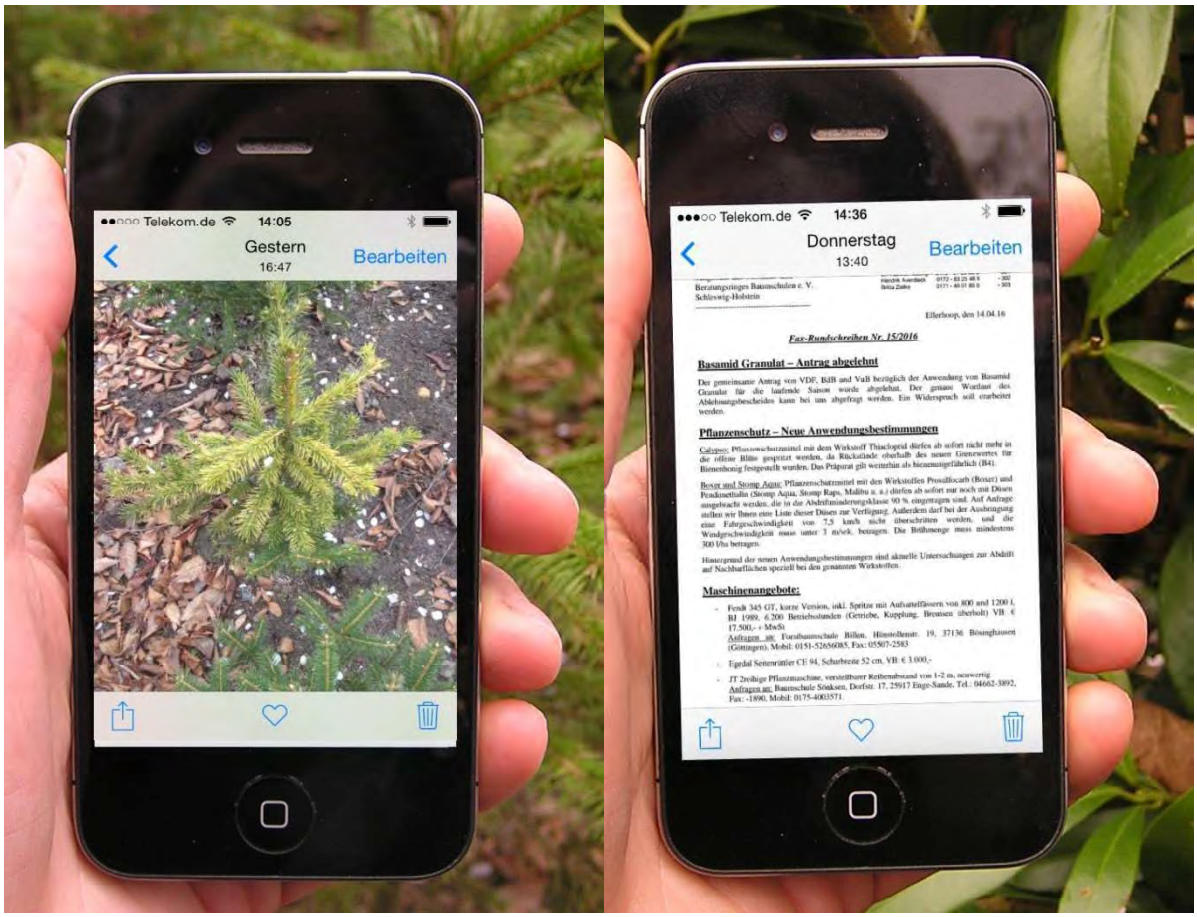
Versuchs- u. Beratungsring Baumschulen e.V. Schleswig-Holstein

Chamber of Agriculture Schleswig-Holstein Horticultural Centre

Annual report 2015



Various opportunities for the use of smartphones for advice and information exchange

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Annual Report 2015

(Dr Heinrich Lösing, Director)

In 2015, the Testing and Advisory Circle was able to continue its successful work. A total of 282 nurseries over 3,274 hectares and 42 supporting members were regularly informed of new findings from practical experience, science and industry, but in particularly also of fertiliser and plant protection measures which protect the environment by means of 40 newsletters via telephone/fax/email and at information events. Advice to individual holdings was continued as it had been previously.

The number of members has been decreasing since the dynamic structural change in the nursery industry in 1995. The following figure shows the development since 1985.

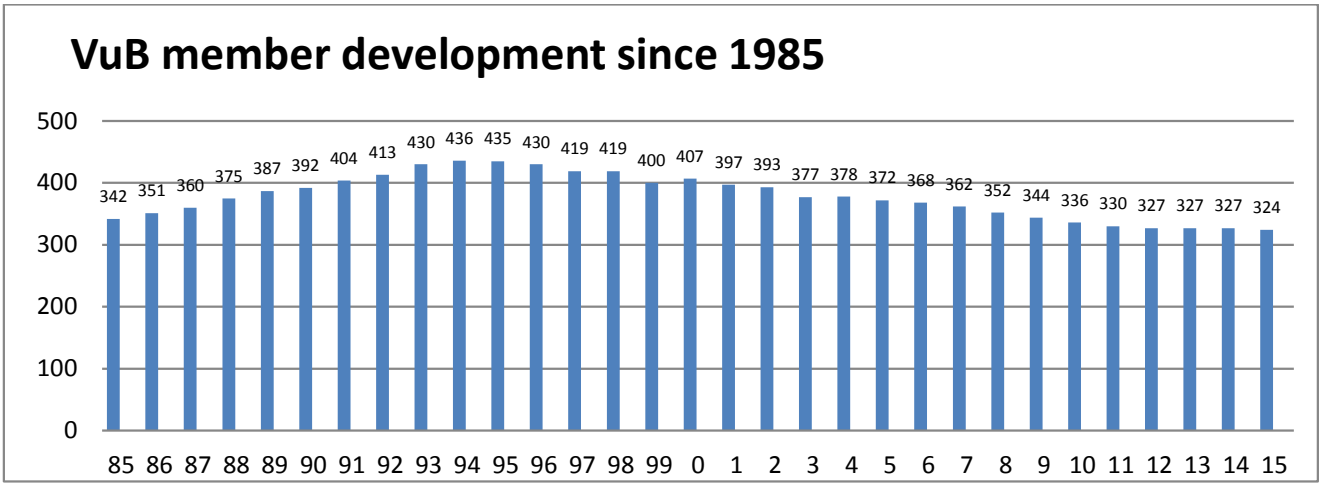


Fig. 1: Change in VuB member figures since 1985 (ordinary, corresponding and supportive members)

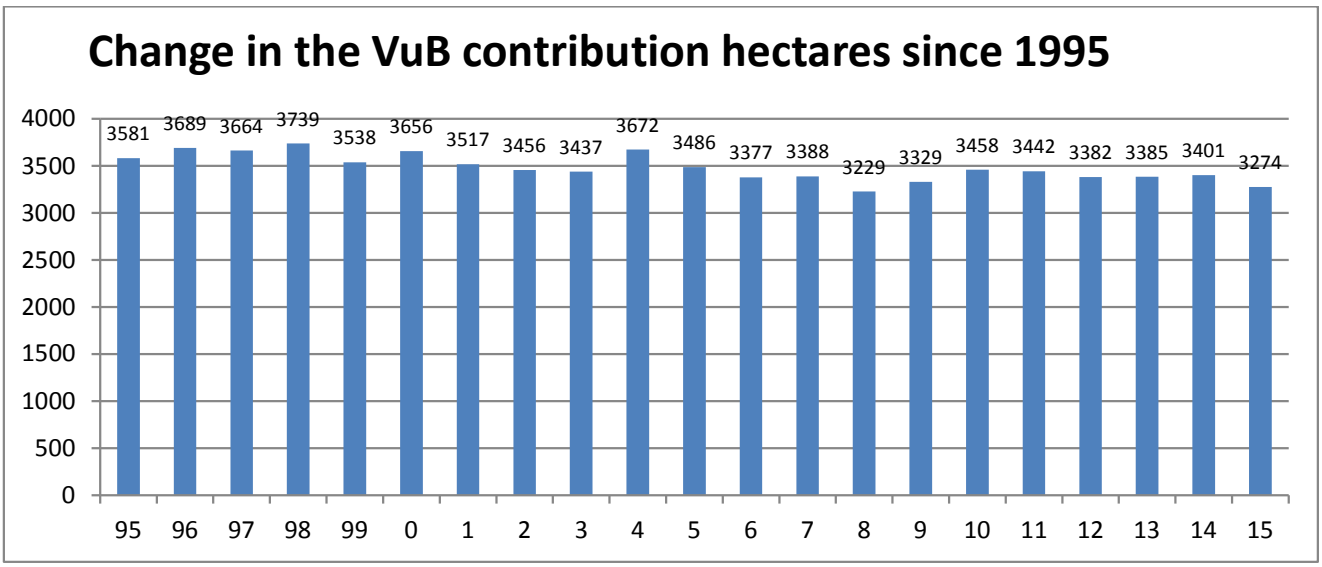
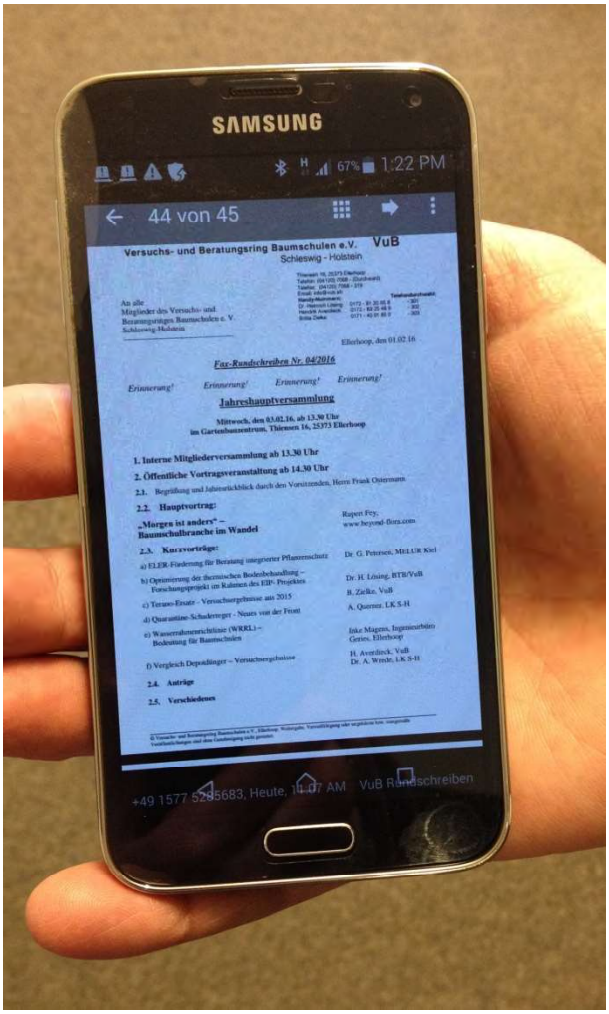


Fig. 2: Change in VuB contribution areas since 1995 (ordinary and supportive members)

There has also been a slight reduction in the contribution area (see Fig. 2), particularly as a result of the bankruptcy of two large enterprises. The loss of area as a result of business terminations is no longer balanced out by “growing businesses”. The advisory circle has continued to develop since VuB was founded in 1939. Investigations are currently being carried out into expanding the advisory capacity to include Christmas tree production as a supplement to nursery advice.



The sending of newsletters via WhatsApp is a recent addition. This service is currently used by approximately 50 members. The aim is to achieve the rapid, digital transfer of information to mobile end devices. On the other hand, the traditional sending of newsletters via post is still a service that a number of members want, so this is retained.

Fig. 3: VuB newsletter sent to a mobile via WhatsApp

There has also been significant interest in machine demonstrations this year. In February, a method which was previously not well known in Europe to protect plants against late frosts was presented at Diercks nursery in Pinneberg. With this, warmer air from higher layers is mixed with the cold air on the ground, preventing the temperature from falling below 0°C. The method is particularly interesting for companies and areas in which no water is available for frost protection irrigation. We were able to welcome around 35 people to the machine demonstration.

The device by the New Zealand-based manufacturer Tow & Blow is sold in Germany by Schillinger from Ihringen (www.schillinger-beregnungsanlagen.de). It sets itself apart from the crowd through its low weight and high degree of mobility as it is mounted on a vehicle trailer.

Presentation of the Tow & Blow wind machine at the Diercks nursery in Pinneberg

The intensive testing of plant protection products was continued in 2015. The focus remained on the development of alternatives to the herbicide Terrano, particularly this year for use on hardwood cutting beds and fagus seed beds and other seeds known as heavyweight seeds.

Visit to the seed beds at Ostermann in Ellerbek and cutting beds at Steffen in Rellingen

New routes were also followed when it came to the testing of plant protection agents. Companies are showing increasing interest in the ecological cultivation of woods. A special plant protection agent test approved by the EU ecological regulations is therefore carried out.

Visit to the trial on powdery mildew on oaks with preparations in accordance with the EU ecological regulations at the Grelck nursery in Haltenbek.

A further development in terms of the thermal treatment of seed beds against weeds in the upper layer of the soil was able to be presented at the Michelsen nursery in Pinneberg. The owner, Mr Rust, optimised an infrared burning device by HOAF from the Netherlands for use on seed beds.

Optimised infrared device used at the Michelsen nursery in Pinneberg

Demonstration of the infrared thermal device at Michelsen in Pinneberg

Since many plant protection agents do not have the necessary authorisation for nurseries, the single applications in accordance with Section 22 (2), formerly Section 18b, of the Plant Protection Act are still being processed. A total of 38 plant protection agents are currently approved in Schleswig-Holstein for members of the VuB for areas in Schleswig-Holstein.

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

Added to the programme six years ago and carried out by the German Red Cross, was training in first aid for the first aiders at work. Retraining is required every two years. The costs of this are covered by the professional horticultural association.

Fertiliser advice in nurseries continues to be a focus of our advisory work. Fertiliser recommendations are provided for around 350 substrate samples of container cultures and around 1000 open land soil samples. This high number of samples shows the high level of awareness of nursery companies of the requirement for needs-based and environmentally sound fertilisation. The guideline values in accordance with the Fertiliser Ordinance Section 3 for nitrogen in the soil, which are determined once a year, are also set out. In order to do this, the nitrogen contents of representative locations are determined for the main culture groups, and these are provided to all companies (see also under fertilisation: nitrogen contents in

nursery soils – guideline values). The costs for the sampling and analysis of the 40 N_{min} samples are covered by the Horticultural Department of the Chamber of Agriculture. The individual nursery companies will therefore comply with the necessary annual compulsory testing in accordance with the Fertiliser Ordinance. Furthermore, over the course of the growing season for 211 N_{min} tests, the nursery companies will be given fertiliser recommendations and therefore a very targeted nitrogen supply will be achieved taking into account the nitrogen supply in the soil.

Intensive testing of the calcium and micronutrient contents continued to be carried out in nurseries. The calcium content of 457 areas was determined, and the copper levels of the soil were checked in 594 samples. The zinc and manganese contents of 437 areas were measured, as was the boron content of 452 areas. The boron levels in the open field areas should be taken into account to an increasing extent.

Boron appears to play a key role in the tip burn in privet which often occurs in late summer.

In this context, two large open field tests were developed to record the tip burn in privet. In tip burn, the leaves fall from the tip in late summer, the tips dry out and often an entire grading size is lost. This problem often occurs when there are dry conditions in late summer and mostly affects trained privet plants and solitary plants. Privet hardwood cuttings are generally not affected. The idea that this is due to a lack of copper was disproved by the tests. Boron is very likely to play a key role in this. Further tests need to be carried out to provide final clarification of the cause as the extent of the damage in the testing year 2015 was significantly lower than in 2014.

Extensive testing of long-term fertilisers in different cultures was carried out in open fields, predominantly with partially coated products. A large number of new products and prototypes were tested to determine their practical suitability.

Tests with new, partially coated long-term fertilisers in open fields

An extensive comparison test was carried out in collaboration with the Ellerhoop Horticultural Centre with coated deposit fertilisers currently available on the market. Fourteen commercial slow release fertilisers were tested over periods of 5-6 months and 8-9 months.

Furthermore, within the scope of these tests eight prototypes were tested which will expand or change the range of slow release fertilisers in the coming years.
Nine potassium-based slow release fertiliser types were also tested for shrubs.

Test with standard and new, coated slow release fertilisers in groundcover plants

New, coated slow release fertilisers were tested under commercial conditions to determine their efficacy compared to known standard products, primarily on behalf of fertiliser companies. Successful tests were also carried out with new storage granules for nutrients for mixing into substrates.

Many of the tests were supported by fertiliser and plant protection agent manufacturers, substrate suppliers and nursery suppliers. For 2015, particular thanks go to Agrosolution, BASF, Bayer CropScience, Belchim, Compo Expert, DowAgroSciences, DuPont, ICL Specialty Fertilizers, FCS, Haifa North West Europe NV, Hauert Günther Düngerwerke, Heinrich Harden, HHG Heisterner Handelsgesellschaft mbH, Jost Mikronährstoff- u. Spezialdünger, Klanz Systeme natürlich anders, H. Meyer, Mivena BV, Neudorff, Plantacote NV, Syngenta, Spiess-Urania Chemicals, Stender AG, Vereinigte Kreidewerke Dammann and Yara.

The intensive testing work is not possible without practical support. We wish to thank the companies listed below for their support in 2015:

Arps, Lutzhorn
BKN Strobel, Holm
Biermann, Tangstedt
Brandt, A., Prisdorf
Breckwoldt, Ellerbek
Cordes, Holm
Deutschmann, Ellerbek
Diercks, Pinneberg
Ellerbrock, Schenefeld
Flessau, Halstenbek
Glismann, Bullenkuhlen
Goldhagen, Bullenkuhlen
Grelck, Halstenbek
Hachmann, Barmstedt
Heydorn Söhne, Klein-Nordende
Harder, Ellerhoop
Heydorn, Bevern
Hofmann, Rellingen
Kleinwort, Wedel
Kordes Rosen, Klein
Offenseth-Sparrieshoop
Kordes, Bilsen
Krohn, Halstenbek
Krüger, Quickborn
Kudenholdt, Ellerbek
Kühnen, Wedel
Lüdemann, Pinneberg
Martens, Appen
Michelsen, Pinneberg
Mohr, Bullenkuhlen
Ostermann, J., Ellerbek
Ostermann M., Ellerbek
Pein, H., Appen
Pein, U., Appen
Rechter, Appen
Schrader, Kölln-Reisiek
Schröder, H., Ellerbek
Schuldt, J.&A., Ellerhoop
Seidler, Elmshorn
Th. Sommer, Seeth-Ekholt
Stahl, Groß-Nordende
Steffen, Rellingen
Thies, Seeth-Ekholt
Timm & Sohn, Tangstedt
Vogt, E., Pinneberg
Vogt, H., Rellingen
Zorn, Tangstedt

The collaboration with the Horticultural Department of the Chamber of Agriculture and advisers to the plant protection agent industry was continued taking into account environmental protection in particular with a focus on the collection and passing on of information. The collaboration has intensified as a result of the merger at the Ellerhoop location.

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

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

Herbicides for use on conifer seed beds
(Britta Zielke, Dr Heinrich Lösing)

1. Objective of the experiment

The future approval status of the soil sterilisation agent Basamid granules, which can be used in a regular manner in other European countries, is still unknown for Germany. Against this background, a test was carried out in 2014 with 20 herbicide treatments that was repeated three times in seed beds of *Abies nordmanniana*. A number of herbicides and herbicides were used at lower doses but applied every 10 days. Other treatments included contact herbicides to burn off shortly before emergence and soil herbicides which were applied once before emergence.

The test results were encouraging. During the growing season and the following spring of regrowth of the *Abies* seedlings, no clear evidence of damage as a result of the herbicide treatment in the form of a poorer emergence result or “thinner” seedlings was able to be observed. Since the Nordmann fir seedlings are relatively resistant, it was decided to test other species in 2015. Furthermore, beyond a purely visual estimation the seedlings should be measured and counted.

Interesting results in terms of efficacy were also obtained in the 2014 tests. Treatment with low doses of herbicides but more frequent application proved to be very successful in terms of the effect. While untreated plots were covered with weeds, the “low dose strategy” led to almost entirely weed-free seed beds with no manual work required.

Fig 1: Test area at the *Picea* location at the start of the experiment in May 2015.

Burning-off weeds shortly before the emergence of the *Abies* seedlings, however, achieved hardly any reduction in the degree of coverage with weeds as there were only a few days between sowing and emergence, so only a small number of weeds sprouted in this time. The single application of soil herbicides before the emergence of the fir seeds had a good effect in some cases depending on the range of efficacy and the main weeds present at the test location.

The experimental plan was optimised for more extensive testing in 2015. Treatments were removed and others amended depending upon their performance.

2. Experimental plan

The experiment was carried out on 18 May and 22 May 2015 on sand-covered broad seed beds of *Picea abies, Picea glauca* ‘Apache‘, *Larix decidua* and *Pseudotsuga menziesii* a few days after sowing and then repeated two or three times.

The herbicides listed in Table 1 were applied at different points. For the products highlighted in turquoise, the total quantity was applied in the first application.

Multiple applications were carried out for the other products listed in the table. The products were applied regularly six times every ten days from the start of the experiment. From the third treatment date, the quantity of the product Gallant Super was increased from 0.25 l/ha to 0.5 l/ha as the lower dose did not have any effect on the annual meadow-grass.

Both treatments with the product Katana were only tested in larches and Douglas firs. All treatments were applied with a plot spraying device with Lechler injector nozzles ISN 120-025 purple and a water quantity of 512 l/ha.

Assessments were made on each treatment date. From the end of June, the weeds that were present were removed by employees of the companies in whose land the tests were carried out from the untreated plots of land. This was necessary to promote the development of the seeds and better track these. At the start of October, the coniferous seedlings were measured and counted. In order to do this, a yardstick was used to measure the length of typical seedlings for each plot of land. A counting frame was used to determine the number of seedlings on each plot of land over an area of 0.1 m².

Table 1: Treatment summary

Herbicide treatment	**Rate/ha**	**Active substance**	**Authorisation**	**Notes**
Betanal Maxx Pro + Gallant Super	3 l/ha + 0.5 l/ha	60 g/l Phenmedipham + 27 g/l lenacil + 75 g/l ethofumesate + 47 g/l desmedipham and 104 g/l haloxyfop-P	Section 22 (2) B ZG	N, Xi, B4
Boxer	5 l/ha	800 g/l Prosulfocarb	Article 51 ZG	N, Xi, B4
Goltix Gold	5 l/ha	700 g/l Metamitron	Section 22 (2) B	B4
Katana*	50 g/ha	250 g/kg Flazasulfuron	Article 51 NH	N, B4
Betanal MaxxPro + Gallant Super	0.25 l/ha + 0.5 l/ha	60 g/l Phenmedipham + 27 g/l lenacil + 75 g/l ethofumesate + 47 g/l desmedipham and 104 g/l haloxyfop-P	Section 22 (2) B ZG	N, Xi, B4
Katana*	25 g/ha	250 g/kg Flazasulfuron	Article 51 NH	N, B4
Kontakt 320 SC + Gallant Super	0.5 l/ha + 0.5 l/ha	320 g/l Phenmedipham and 104 g/l haloxyfop-P	B ZG	N, Xi, B4
Goltix Gold + Gallant Super	0.5 l/ha + 0.5 l/ha	700 g/l Metamitron and 104 g/l haloxyfop-P	Section 22 (2) B ZG	B4 N, Xi, B4
Lontrel 720 G + Gallant Super	50 g/ha + 0.5 l/ha	720 g/kg Clopyralid and 104 g/l haloxyfop-P	B ZG	B4 N, Xi, B4

***** = only tested in *Larix* and *Pseudotsuga*

= single treatment date: 18 May or 22 May 2015

= multiple treatment dates: 1 June, 11 June, 23 June, 1 July, 10 July, 22 July 2017

3. Results

3.1 Phytotoxicity

There was no damage to the Nordmann fir seedlings, which were deemed to be resistant in the 2014 experiment described in the introduction. In the 2015 experiment, however, damage occurred to spruce, larch and Douglas fir seedlings.

The older the seedlings were, the more easily visible the impact of the herbicide treatment was, particularly in the case of multiple treatments. In October, the seedlings were measured and counted. In addition to differences in terms of the number per square metre and the length of the seedlings, in some cases deformities were also observed.

3.1.1 *Picea abies*

Picea abies seedlings reached a size of around 5 cm in the untreated plots. The spruce seedlings in these plots at least temporarily had competition for light, water and nutrients as a result of the weeds there. As an average, the smaller spruce seedlings could only be found on the plots treated once with 5 l/ha of Goltix Gold.

An average of 124 seedlings grew on untreated plots over an area of 0.1 m². A number were probably also removed by hand during the weeding process. There was a tendency for there to be even fewer seedlings, namely an average of just 109 per 0.1 m², on the plots treated once with 5 l/ha of Boxer before emergence. In contrast to this, significantly more seedlings (155 per 0.1 m²) could be found on the plots treated multiple times with low doses of Kontakt 320 SC + Gallant Super. Furthermore, plants with partially rotated tips or brown-coloured needles were also able to be observed on plots treated multiple times with Lontrel.

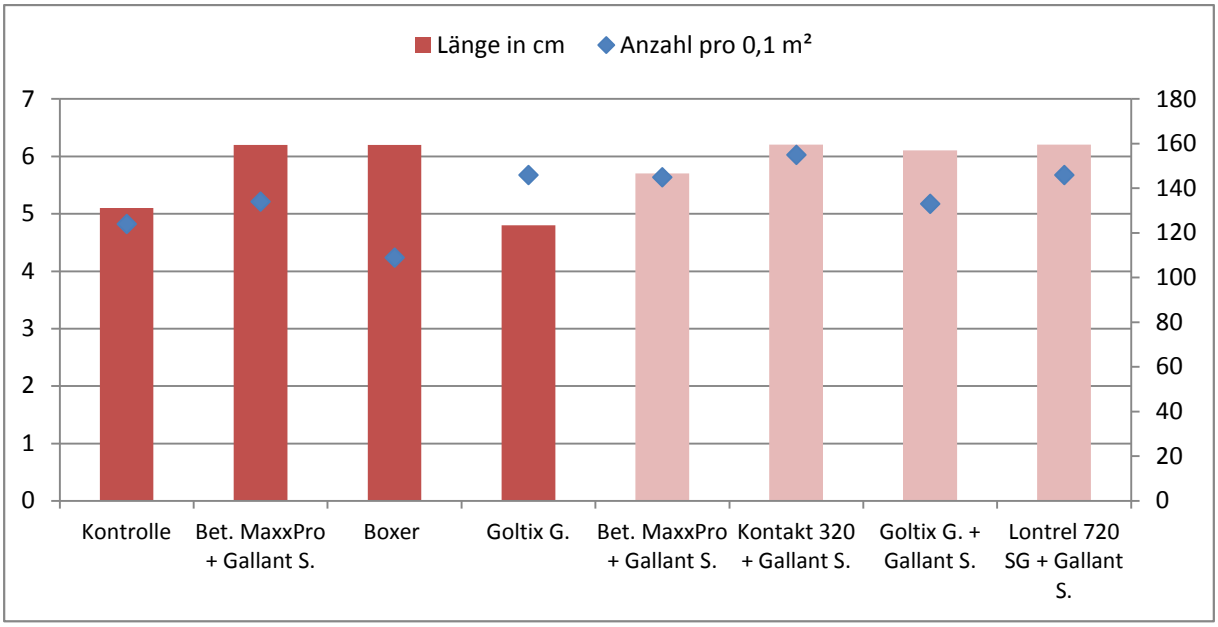


Fig. 2: *Picea abies* seedlings; average size and number per 0.1 m² on 7 October 2015 (averages of three replicates). Treatments in which the herbicide was applied multiple times at lower doses are marked by pink bars in the graphic.

3.1.2 *Picea glauca* ‘Apache‘

The blue spruce seeds were overall not as dense. In the untreated plots, there were an average of 43 seedlings over 0.1 m². There was an average of almost twice as many seedlings in the “best” treatment over 0.1 m². An average of 90 seedlings were counted in one area that was treated with multiple applications of low doses of Kontakt 320 SC + Gallant Super. There was also a pronounced difference in size. The smallest were the blue spruce seedlings following multiple treatments with Goltix Gold + Gallant Super. They tended to be larger in the areas treated with the herbicide Boxer. This may be caused by the fact that the seedlings were somewhat “thinner” here, so more nutrients were available. Damage to the

seedlings was observed on the plots treated several times with Lontrel. This was more pronounced than in the case of *Picea abies*. Several times the seedlings were slightly deformed.

Distorted plants which had not discarded their seed pods but had simply grown past them occurred more commonly in plots which had been treated with 5 l/ha of Goltix Gold before emergence.

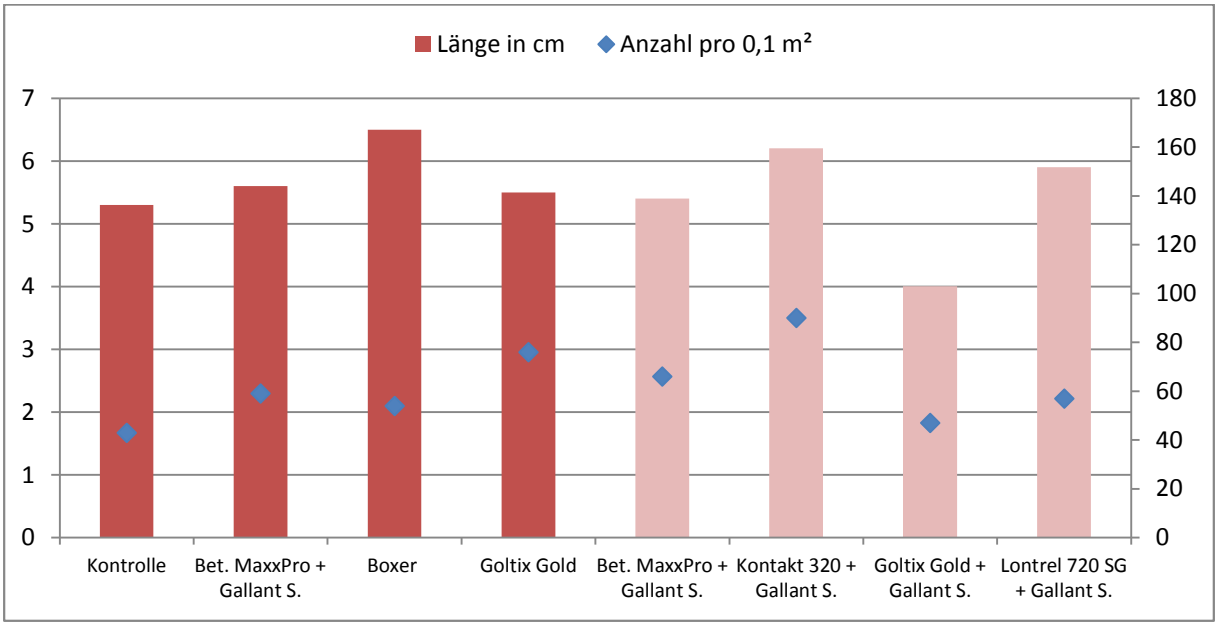


Fig. 3: *Picea abies* 'Apache' seedlings; average size and number per 0.1 m² on 7 October 2015 (averages of three replicates). Treatments in which the herbicide was applied multiple times at lower doses are marked by pink bars in the graphic.

Fig 4: Blue spruce seedlings after 6 x Lontrel 720 SG + Gallant Super (50 g + 0.5 l/ha)
Fig. 5: Increased distorted blue spruce seedlings after the application of Goltix Gold before emergence.

3.1.2 *Larix decidua*

It is typical of the larch species to achieve long lengths. They were more than 10 cm long on average. With larches, the number of plants per square metre correlated negatively with the size. There were fewer seedlings in plots treated once with Betanal Maxx Pro before emergence, and these achieved the longest lengths. The seedlings were most dense in plots treated once with the herbicide Boxer, but these seedlings were somewhat smaller.

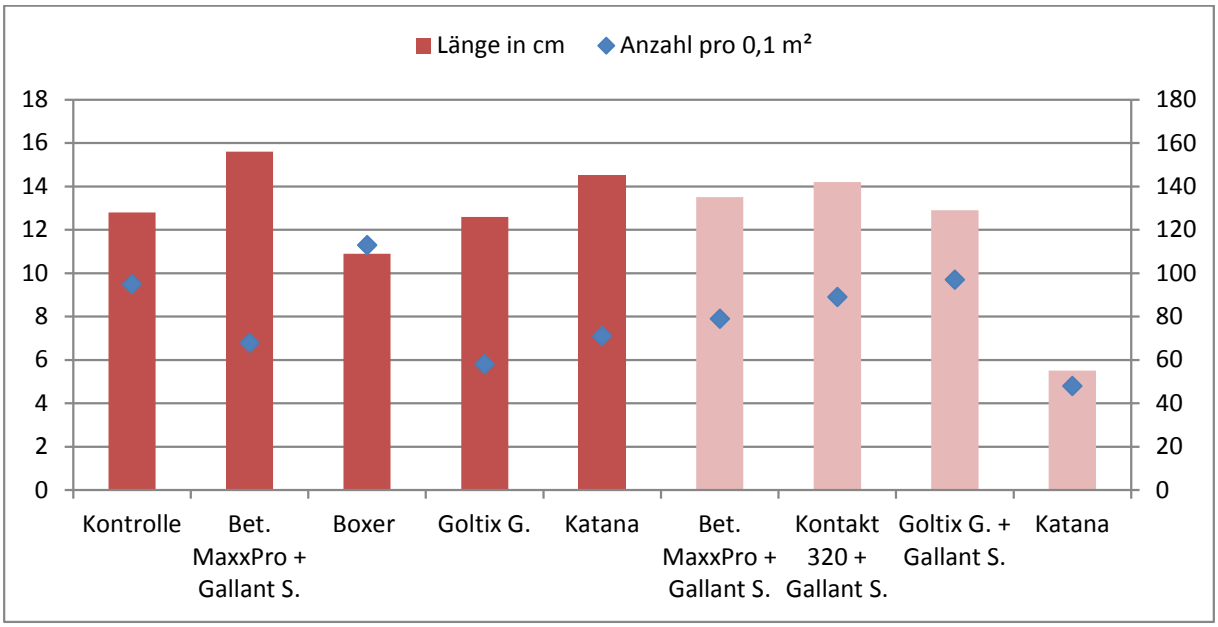


Fig. 6: *Larix decidua* seedlings; average size and number per 0.1 m² on 7 October 2015 (averages of two replicates). Treatments in which the herbicide was applied multiple times at lower doses are marked by pink bars in the graphic.

Larch seedlings reacted in a very sensitive manner to multiple treatments of low doses of Lontrel 720 SG. They were so deformed that no counting and measuring was carried out. Larch seedlings in plots which were treated once or multiple times with the herbicide Katana were also somewhat deformed and/or decimated.

Fig. 7: In July, it was demonstrated that the larch seedlings did not tolerate multiple treatments with Lontrel 720 SG + Gallant Super (50 g + 0.5 l/ha).

3.1.2 *Pseudotsuga menziesii*

Douglas fir seeds reacted in the most sensitive manner to the herbicides tested in the experiment. In many cases, the treatments led to seedlings with twisted needles. In this experiment, the Douglas fir seedlings only developed as well as in the untreated plots in those plots which were only treated before emergence. This did not apply to the Katana treatment, which led to a total failure.

The herbicides Betanal Maxx Pro or Kontakt 320 applied multiple times at low doses with Gallant Super led to a lighter green colour and in some cases unusual needle position and a reduced seedling height.

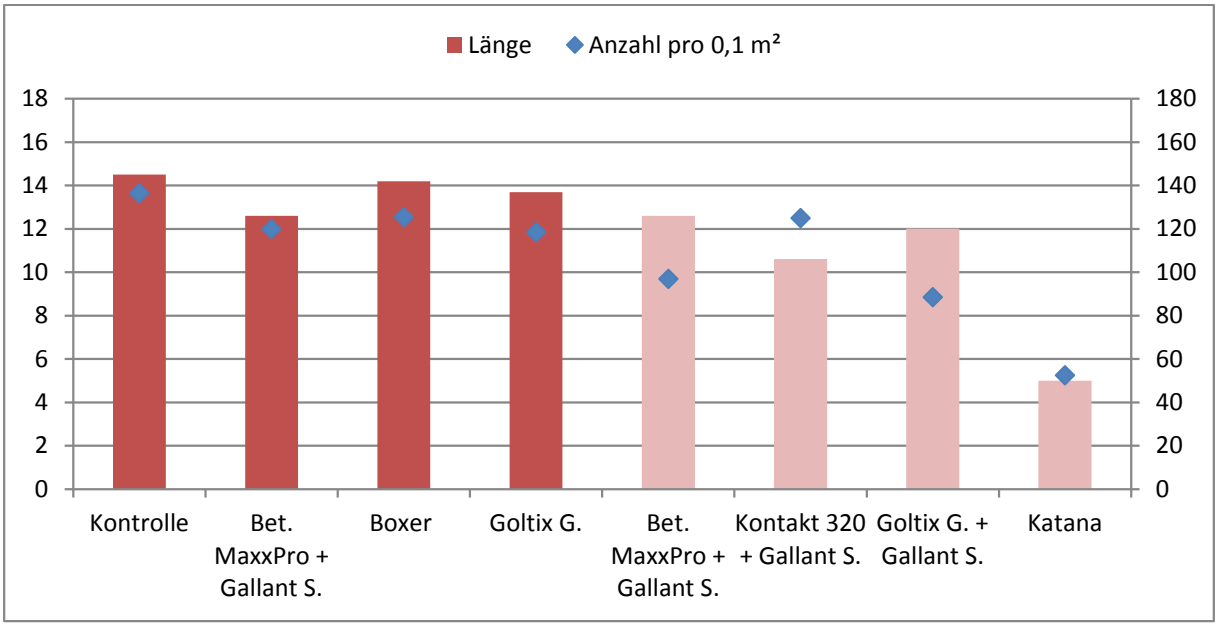


Fig. 8: *Pseudotsuga menziesii* seedlings; average size and number per 0.1 m² on 7 October 2015 (averages of two replicates). Treatments in which the herbicide was applied multiple times at lower doses are marked by pink bars in the graphic.

Figs. 9 and 10: Douglas firs treated multiple times with Katana (25 g/ha) did not develop normally either above or below the ground. The left hand side shows underdeveloped seedlings on 22 July 2015, the right hand side shows plots with gaps in on 7 October 2015.

The following table summarises the tolerance results. It includes optical changes to the seeds such as discolourations and needle twisting and a significantly lower number or length of seedlings. The results from the testing year 2014 on Nordmann fir seedlings were also included.

Table 2: Cultivated plant phytotoxicity in the 2014 and 2015 experiments

Herbicide treatment	**Rate/ha**	**Species tested**				
		Abies nordm.	***Picea abies***	***Picea glauca* A.**	***Pseudots. menziesii***	***Larix decidua***
Betanal Maxx Pro + Gallant S.	3 l/ha + 0.5 l/ha		+	+-	+	+-
Boxer	5 l/ha	+	+-	+-	+	+
Goltix Gold	5 l/ha	+	+-	-	+	-
Katana	50 g/ha				-	-
Betanal Maxx Pro + Gallant S.	0.25 l/ha + 0.5 l/ha	(+-)[1]	+	+	-	+-
Kontakt 320 + Gallant S.	0.5 l/ha + 0.5 l/ha	(+)[2]	+	+	-	+-
Goltix Gold + Gallant S.	0.5 l/ha + 0.5 l/ha	(+)[3]	-	-	-	+-
Lontrel 720 SG + Gallant S.	50 g/ha + 0.5 l/ha	(+)[4]	-	-	-	-
Katana	25 g/ha				-	-

+-[1] = tested in *Abies nordmanniana* at 0.5 l/ha + 0.25 l/ha
+[2] = tested in *Abies nordmanniana* at 1 l/ha + 0.25 l/ha
+[3] = tested in *Abies nordmanniana* alone without Gallant Super
+[4] = tested in *Abies nordmanniana* alone without Gallant Super and only at 25 g/ha
= single treatment date 18 May or 22 May 2015
= multiple treatment dates: 1 June, 11 June, 23 June, 1 July, 10 July, 22 July 2017
= not tested

3.2 Efficacy

The efficacy of the herbicide treatments were assessed at the spruce location. The seed beds appeared to be free of weeds at the start of the test. Five weeks later, the degree of weed coverage on the untreated plots was an average of approximately 22%. Almost half of these were annual meadow-grass. In addition to this, approximately equal amounts of black nightshade, geraniums and yellow field-cress also grew.

Five weeks after treatment, the plots with the lowest levels of weeds were those in which the entire quantity of a soil-based herbicide had been applied before the emergence of the seedlings. The plots of land treated multiple times with Goltix Gold + Gallant Super at low application quantities showed almost as low a degree of coverage. In the test of the multiple treatments, this treatment showed the best effect as it works well against annual meadow-grass, in contrast to the other treatments. Through its effect on annual meadow-grass, the herbicide Goltix Gold supported the weak effect of the too low a dose rate of Gallant Super (first two treatments at 0.25 l/ha). Since the products Kontakt 320 SC, Lontrel 720 SG and Betanal MaxxPro, applied at low doses, had no effect against annual meadow-grass, there were more weeds on plots of land where these herbicides had been used in combination with the insufficient (0.25 l/ha) quantity of Gallant Super.

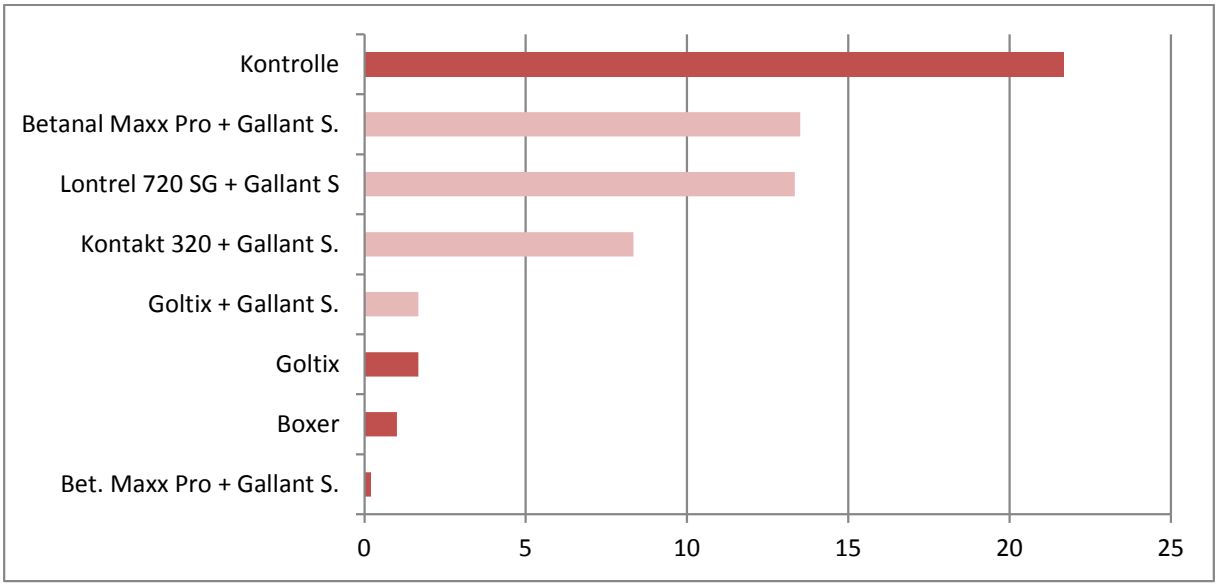


Fig. 11: Percentage weed cover at the spruce location on 23 June 2015 (average value from three replicates). Treatments in which the herbicide was applied multiple times at lower doses are marked by pink bars in the graphic. At the start, the quantity of the herbicide Gallant Super in “low-dose variants” was 0.25 l/ha. This is not sufficient to control annual meadow-grass, which in some parts of this location makes up almost half of all weeds.

The treatment with Lontrel 720 SG had the best effect on black nightshade of all of the multiple treatments. The nightshades deformed and developed significantly slower. The low-dose treatments with Kontakt 320 SC, Betanal Maxx Pro and Goltix Gold had a reduced effect on black nightshades. Multiple treatments with Goltix Gold also prevented the development of yellow field-cress from seeds.

Figs. 12 and 13: Sections from the plots at the spruce location on 23 June 2015. In contrast to the untreated plot (left), significantly less manual work was required in plots with the “low dose strategy”. The plot of land on the right was treated twice at an interval of 10 days with Kontakt 320 SC + Gallant Super (0.5 + 0.25 l/ha). The third treatment was carried out on 23 June 2015m and from this point every ten days with Kontakt 320 + Gallant Super (0.5 + 0.5 l/ha).

4. Summary

The crop safety and efficacy of various herbicide strategies in broad seed beds of conifers were investigated in extensive tests. Some of the treatments were applied before emergence over sand-covered broad seeds of different conifers. The other treatments were tested as split treatments after emergence at low doses but with six applications over the seedlings.

Of the herbicides tested before emergence, Boxer proved to be the best compromise between crop safety and efficacy for the species tested (*Abies nordmanniana*, *Picea abies*, *P. glauca* ‘Apache‘, *Larix decidua* and *Pseudotsuga menziesii*). In order to decrease the risk, the application quantity should be reduced from 5 l/ha in the experiment to 3 l/ha in practice.

Treatments with low doses of herbicides but more frequent applications were also promising, at least for Nordmann firs, red and blue spruces. The treatment with Kontakt 320 SC + Gallant Super (0.5 l/ha + 0.25-0.5 l/ha) proved to be the safest in the experiments. In practice, the grass herbicides would have to be changed in order not to exceed the maximum application quantity of 1 l/ha of Gallant Super.

If application of Basamid continues not to be possible before the creation of broad seed beds in the future, these herbicide strategies will become increasingly important. The possible work saving makes it very interesting, but at the same time there is a high risk of damage.

Herbicides for use on hardwood cutting beds
(Britta Zielke, Dr Heinrich Lösing)

1. Objective of the experiment

In addition to use in established trees before emergence, a number of companies have used the soil herbicide Terano to treat hardwood cutting beds. The tolerance was disputed by some practitioners for some types and species, but the long-term effect in the soil was interesting (see VuB annual report for 2002, page 31 onwards and for 2010, page 27 onwards).

Authorisation for the herbicide Terano ended in December 2014, with the use-up period for the herbicide ending in June 2016. Against this background, new herbicides or herbicide combinations need to be tested to determine their suitability for use in hardwood cutting beds. Tests were carried out at two locations over a total of five species.

Fig 1: Hardwood cutting beds at the test site, no irrigation was possible at this location and there were only low levels of soil moisture.

2. Experimental plan

The herbicide applications were carried out between 20 April 2015 and 27 April 2015 in sunny weather and at 15°C in freshly made beds and over cuttings which had not yet sprouted. At the first location, *Forsythia* 'Spectabilis', *Deutzia scabra* 'Plena' and *Ribes sangiuneum* 'King Edward IV' were tested. The tips of the cuttings were dipped in vine wax. Since no natural precipitation was forecast and damage in the developing buds was feared, the test was carried out on very dry beds.

One week later, the treatments were carried out on hardwood cutting beds of *Ligustrum vulgare* ‘Atrovirens‘ and *Salix daphnoides*. Light rain occurred the day before the treatment, so the soil was damp at the start of the experiment.

All of the herbicides were applied with a plot spraying device with Lechler injector nozzles ISN 120-025 purple and a water quantity of 512 l/ha. The experiment on each plant species was replicated twice.

Overview 1: Treatment summary

Herbicide treatment	**Rate / ha**	**Active substance**	**Authorisation**	**Notes**
Untreated	-	-	-	-
Artist	1 kg/ha	Metribuzin (175 g/kg) + flufenacet (240 g/kg)	Section 22 (2) B	N, Xn, B4
Betanal Maxx Pro	4.5 kg/ha	Desmedipham (47 g/l) + ethofumesate (75 g/l) + lenacil (27 g/l) + phenmedipham (60 g/l)	Section 22 (2) B	N, Xi, B4
Boxer + Goltix Gold	5 l/ha + 5 l/ha	Prosulfocarb (800 g/l) and metamitron (700 g/l)	Article 51 ZG Section 22 (2) B	N, B4, Xi B4
Dual Gold + Stomp Aqua	1.25 l/ha + 2 l/ha	S-Metolachlor (960 g/l) and pendimethalin (455 g/l)	Section 22 (2) B, St, Article 51 B	N, Xi, B4 N, Xn, B4
Dual Gold + Flexidor	1.25 l/ha + 0.75 l/ha	S-Metolachlor (960 g/l) and isoxaben (500 g/l)	Section 22 (2) B, St B	N, Xi, B4 N, B4
Metobromuron 400 SC (Fresco)	3.75 l/ha	Metobromuron (400 g/l)	-	-
Spectrum + Stomp Aqua	0.6 l/ha + 2 l/ha	Dimethenamid-P (720 g/l) and pendimethalin (455 g/l)	Article 51 ZP Article 51 ZG	N, Xn, B4

3. Results

3.1 Phytotoxicity

Results on phytotoxicity were not able to be obtained for all of the species and varieties tested. The *Ribes*, sprouted over a relatively wide time period, and in the other location, the *Ligustrum* showed very poor growing results and there was almost a total failure of the crop.

The growth rate was very good for *Salix*, *Forsythia* and *Deutzia*. No damage as a result of the herbicide was able to be observed in these tested species over the entire course of the experiment.

3.2 Efficacy

The degree of weed coverage at all locations was determined 8-10 weeks after the start of the experiment and the effect of the herbicide on individual weed species was also determined. The assessments on each of the five species were repeated twice.

In the same way that the locations differed in terms of their soil moisture at the start of the experiment, they differed in the final assessment in terms of the efficacy of the herbicides. At the location in which the herbicides had been applied to dry ground, the percentage weed coverage in the control plots was an average of approximately 80%. In the treated plots an average of between 16% and 70% of the area was covered with weeds. The average value was just under 40% coverage.

At the other location, where the beds were damp at the start of the experiment, the level of weeds was even higher. Untreated plots had an average percentage weed coverage of more than 95%. An average of 1-60% of the areas was covered with weeds in those plots treated with herbicides. The average was 13%. **Good soil moisture at the time of application was therefore more important for the effect achieved than the selection of the herbicide.**

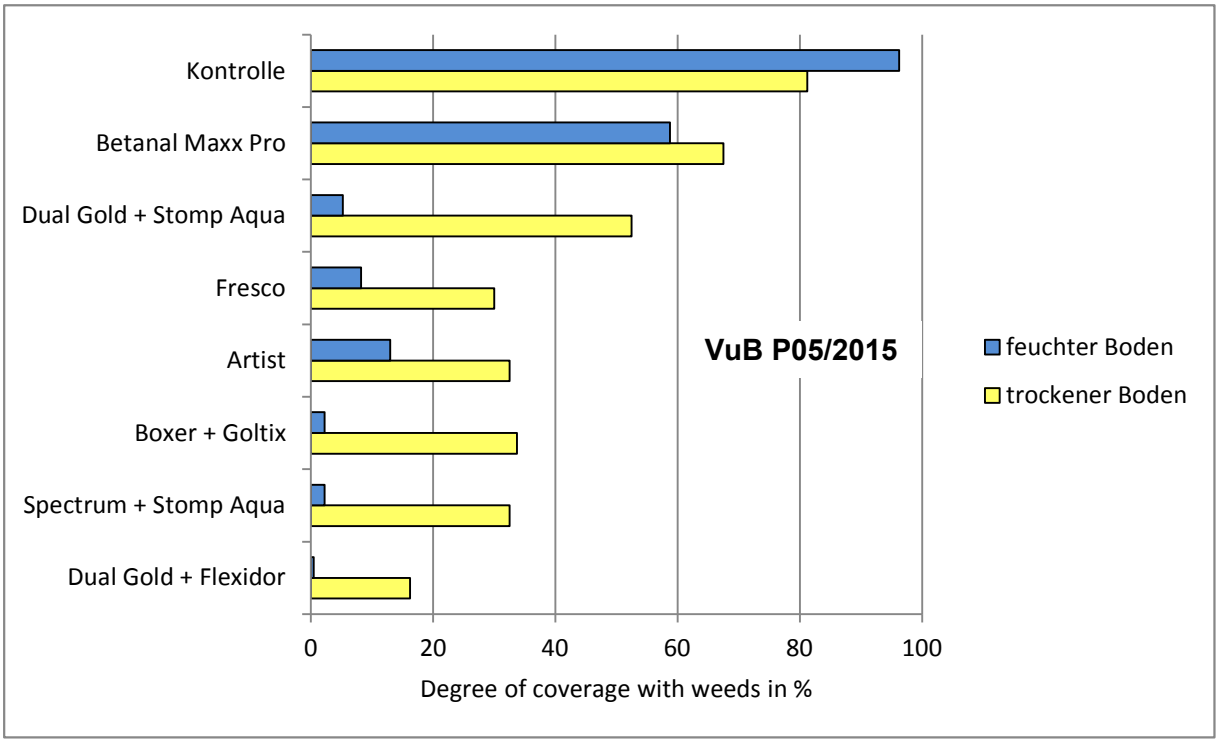


Fig. 2: Average percentage weed coverage in the final assessment shown for both locations with different soil moisture at the start of the test.

Figs. 3 and 4: Test plots at the *forsythia* location approximately eight weeks after the start of the experiment. The herbicides were applied to dry ground. Left: untreated, right: plot treated with Spectrum + Stomp Aqua. The percentage weed coverage in the treated plot was approximately 25%. This was primarily gallant soldier.

Figs. 5 and 6: Test plots at the *Salix* location approximately eight weeks after the start of the experiment. The herbicides were applied to damp ground. Left: untreated, right: plot treated with Spectrum + Stomp Aqua. The degree of coverage of weeds in the treated plot of land was less than 2%.

The range of weeds which emerged was very uniform. In all five species related plots, annual nettle and small-flowered gallant soldier made up between 5% and 45% of the coverage. In four species related plots, black nightshade also grew with a coverage of between 3% and 25%. *Chenopodium album* grew in three plots. This had a degree of coverage of between 6% and 70%. Groundsel occurred in two species related plots, but in both cases only made up a small percentage of the coverage with weeds. The following figure shows the average effect of the herbicides against the individual weeds.

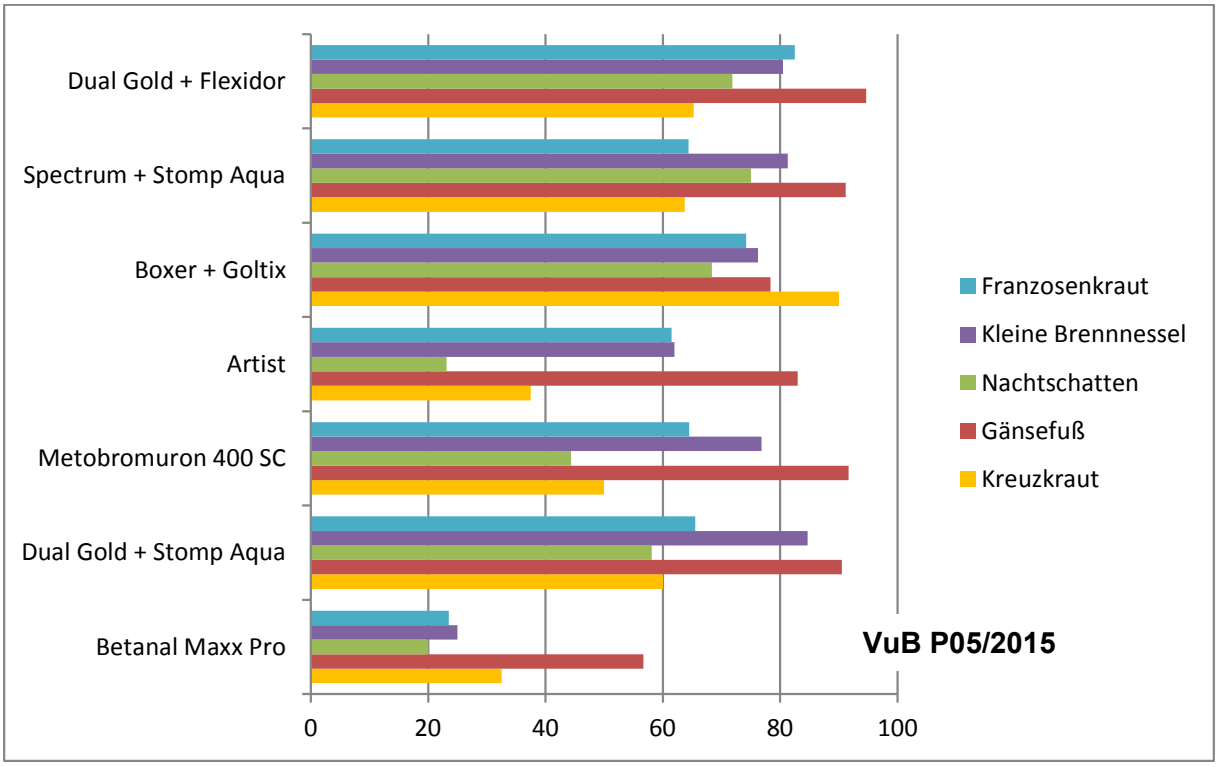


Fig. 7: Average effect of the herbicides in terms of percentage weed control approximately eight weeks after the start of the experiment. Average values made up of partial tests each of which were repeated twice. (Development of the weeds: gallant soldier and annual nettle in all five partial tests; black nightshade in four partial tests; chenopodium album in three partial tests; groundsel in two partial tests.)

The herbicide combination Dual Gold + Flexidor had the best effect against small-flowered gallant soldier. It also had a good effect against annual nettles and *Chenopodium album*. *Chenopodium album* could be well controlled with all of the products and combinations tested. Only the herbicide combination of Boxer + Goltix Gold had a good effect on the groundsel.

4. Summary

An experiment was carried out on five different species (*Forsythia* 'Spectabilis', *Deutzia scabra* 'Plena', *Ribes sangiuneum* 'King Edward IV', *Ligustrum vulgare* 'Atrovirens' *and Salix daphnoides*) to check the efficacy and tolerance of pre-emergence herbicides in hardwood cutting beds.

Results for phytotoxicity were only able to be obtained for *Forsythia*, *Deutzia* and *Salix* due to crop failures and growth difficulties. All of the herbicides tested were well tolerated when used before shoot emergence. In practice, in addition to application prior to shoot emergence it is also important that the ground around the planting holes is well compacted so the herbicides do not get into the root areas of the cuttings.

With the exception of the herbicide Betanal MaxxPro, all of the herbicides and herbicide combinations tested had a good effect on the degree of weed coverage in damp ground. **The soil moisture level at the point of herbicide treatment was more important in terms of the weed control achieved than the selection of the product.**

The herbicide Terano was permissible in hardwood cutting beds for the last time in the spring 2016 season. Looking ahead, the products Flexidor (0.5-0.75 l/ha), Goltix Gold (3-5 l/ha) and Stomp Aqua (2.5-3.5 l/ha) proved to be the most tolerated across all types and species when herbicides were used in hardwood cutting beds. In order to improve the effect, where there is known tolerance, a quantity of Boxer (3 l/ha) can be added to the Goltix Gold or the products Flexidor or Stomp Aqua can be tank mixed with Dual Gold (1-1.25 l/ha).

Herbicides for use against geraniums
(B. Zielke, Dr Heinrich Lösing)

1. Introduction

Geraniums (*Geranium sp*.) have become increasingly significant as weeds in the past few years. The repeated use of herbicides which do not affect geraniums (e.g. MaisTer fluid) has encouraged them to spread.

Geraniums sprout from spring to autumn in freshly cultivated land. They are annual or can last for more than a year, in which case they overwinter as rosettes. Two attempts made in 2014 and 2015 aimed to clarify which herbicides had the best effect on existing geraniums.

Figs. 1 and 2: Dormant geranium rosettes at the start of the test in March 2015

2. Experimental plan

The experiments were carried out on 22 May 2014 and 10 March 2015 in avenue tree areas with a high level of weeds consisting of geraniums (*Geranium molle* and *G. pusillum*). Table 1 lists the herbicide products which were used, with the tests being replicated three times. They were applied at a spray volume of 500 l/ha. Products highlighted in turquoise were tested in both years, those highlighted in white were only tested in May 2014 and those highlighted in orange only in March 2015. A backpack sprayer with a spray boom with three nozzles (110-02) was used for application. There were differences in the weather and the stage of development of the weed at the point of application between the two years. While there were already summery temperatures on 22 May 2014 and the geraniums were in full bloom, the temperature on 10 March 2015 was 7°C and the geraniums were still in the rosette stage.

Table 1: Treatment summary

Herbicide treatment	Active ingredients	Rate/ha	Authorisation	Notes
Control				
Basta 150 SL	Glufosinate (150 g/l)	3.75 l/ha	-	-
Finalsan	Pelargonic acid (176.7 g/l)	166 l/ha	ZP	Xi, B4
Katana	Flazasulfuron (250 g/kg)	0.2 kg/ha	Article 51 coniferous wood	N, B4
MaisTer fluid	Foramsulfuron (30 g/l) + iodosulfuron (0.93 g/l)	1.5 l/ha	Article 51 ZG	Xn, B4
Pointer SX	Tribenuron (482.3 g/kg)	0.06 kg/ha	Section 22 (2) B	N, Xi, B4
Quickdown + Toil	Pyraflufen (24. 2 g/l)	0.8 l/ha + 1.2 l/ha	Potatoes	N, Xi, B4
Roundup PowerFlex	Glyphosate (480 g/l)	3.75 l/ha	B, O, F	N, B4
Salsa + Breakthrough	Ethametsulfuron	0.025 kg + 0.3 l/ha	-	-
Touchdown Quattro	Glyphosate (360 g/l)	5 l/ha	ZG, B, O, F	B4
U-46 M-Fluid	MCPA (500 g/l)	2 l/ha	Section 22 (2) B	N, Xn, B4

= 2014 and 2015 = 2014 = 2015

3. Results

3.1 Application to the plants in bloom, May 2014

From the flowering period, weeds appear to be less sensitive to herbicides. After the use of herbicides, changes were observed in the weeds, but they often did not completely die and their seeds often still reached maturity.

In the test carried out in late May, ten days after treatment only the herbicide Quickdown applied in combination with the adhesive agent Toil had a noticeable effect on the geraniums. The herbicide also led to the death of the groundsel and the wild chamomile also present.

Another assessment was carried out four weeks after treatment. The effect of the herbicides Katana, Touchdown Quattro and U 46 M-Fluid against geraniums was proven at this stage, but this was too late to suppress the formation of seeds. As the growing season continued, the geraniums slowly died after flowering on all plots including the untreated plots.

Figs. 2-5: 2014 test, ten days after the start, only Quickdown + Toil had a rapid effect on the geraniums. The herbicide had no effect against annual meadow-grass.

3.2 Application during the rosette stage, March 2015

In this experiment too, the herbicide Quickdown had the most rapid effect on the geraniums. The leaves on the geraniums died 14 days after treatment, but the heart of the rosette survived and the weed later recovered.

Figs. 6-9: plots on 29 April 2015, seven weeks after the start of the experiment

The herbicide Finalsan also only affected the leaves that were present at the point at which the treatment was administered. The heart of the plant remained unharmed, and four weeks after the start of the experiment the plants had recovered and new green leaves had formed.

Both products containing the active substance glyphosate had a very good effect on the geraniums. One month after treatment it was still evident that the rosettes were yellow and were not continuing to grow. Seven weeks after treatment the geraniums in these plots had died out completely. The geraniums behaved in a similar manner after the use of the herbicide U 46 M-Fluid too.

However, four weeks after treatment with Katana, Pointer SX and Salsa there was a lack of certainty about whether the geranium had fully died out. Seven weeks after treatment it was evident that this was the case. With an average of 90%, the herbicide Katana had the best effect. Pointer SX had an average effect of 80% and the effect of Salsa was an average of 58%.

4. Summary

Two attempts with different herbicides against existing geraniums on avenue tree areas showed that in addition to the product used it is the stage of development of the weed which matters for a good effect to be achieved.

At the point of flowering, only the herbicide Quickdown had an effect on the geraniums. The products Basta, Katana, Touchdown Quattro and U 46 M-Fluid only accelerated the pre-programmed dying out of the weed after flowering slightly.

Products containing the active substance glyphosate, U 46 M-Fluid and Katana, however, had an almost complete effect when applied to geranium rosettes in early spring. The process of dying out lasted four to seven weeks. The products Finalsan and Quickdown merely “burned” off the leaves of the rosettes. The geraniums recovered from this.

Geranium seeds can retain their ability to germinate for several years in the soil. If the conditions are favourable, they will germinate. Freshly planted transplanting bed in areas with a known geranium problem can be treated with the herbicides Vorox F or Sencor Liquid. If geraniums germinate in spring seed beds, the small weeds can be burned off before crop emergence using the herbicide Finalsan.

Insecticides for use against vine weevil
(Britta Zielke, Dr Heinrich Lösing)

1. Introduction

The vine weevil (*Otiorhynchus sulcatus*) is one of the most significant insect pests in tree production in container and open field cultures. While the adults cause visible damage to the plants by notching the leaves and needles, the larvae can cause severe damage even leading to the destruction of entire crops by eating the roots. The larvae of the vine weevil can be effectively biologically controlled using nematodes of the species *Heterorhabditis* and *Steinernema*. As a preventative measure, the insecticide granule Exemptor or the fungus *Metarhizium anisopliae* (Met52), which is pathogenic to insects, can be used against the larvae with different degrees of efficacy.

In addition to this, crops should be monitored for the entire growing season for signs of any adult infestation. The adults normally appear in June/July. In greenhouses and container areas, however, the classic lifecycle of the adults can shift. Insecticides are used to control existing adult infestations.

The aim of the experiment described below was to check the efficacy of insecticides against adult vine weevils. The insecticides Coragen, Plenum 50 WG, Spintor, Steward, Trebon 30 EC and a test agent were checked for their effect on contact and eating. In order to do this, adults were immersed in a solution made up of the insecticide or fed treated plants.

Figs. 1 and 2: Can the results be transferred form laboratory tests to commerce?

2. Experimental plan

Numerous adult vine weevils were collected from a nursery for the experiment in July 2015. Until they were used in the tests, they were kept in a terrarium and fed with *Euonymus fortunei* leaves.

Untreated *Euonymus fortunei* 'Emerald n Gold' in a 9 cm pot were used as the host plants. Some of the plants remained untreated and were used to feed the bugs immersed in the insecticide solution and as a control in the feeding experiment. On 23 July 2015, one litre of insecticide solution of the products listed in Table 1 was used on the assumption that 20 m² could be treated with this (500 l of solution per ha).

Table 1: Treatment summary

Insecticide product	Active ingredient	Rate/ha	Authorisation	Notes
Control				
Coragen	Chlorantraniliprole (200 g/l)	125 ml/ha	Fruit, maize	N, B4
Experimental agent				
Plenum 50 WG	Pymetrozine (500 g/kg)	360 g/ha	ZP	N, Xn, B1
Plenum 50 WG	Pymetrozine (500 g/kg)	720 g/ha	ZP	N, Xn, B1
Spintor	Spinosad (480 g/l)	300 ml/ha	ZP	N, B1
Steward	Indoxacarb (300 g/kg)	170 g/ha	Section 22 (2) B, St	N, Xn, B4
Trebon 30 EC	Etofenprox (287.5 g/l)	200 ml/ha	Article 51 ZP	N, Xi, B2

For the "immersion test" to check the effect of contact with the insecticides, containers were prepared with untreated food which could be sealed in a bug-proof manner using a net. Each of five live adults were immersed individually in the insecticide solution using tweezers for a duration of one second and then placed in the prepared vessels. This was replicated four times. The bugs in the control treatment were immersed in water.

For the "feeding tests", eight test plants (500 l solution per ha) were treated per treatment. For the first part of the feeding test, on the day after the applied solution had dried the above ground part of four plants was cut off for each treatment and placed into four test vessels which had been prepared and could be sealed with a net. Five live vine weevils were placed into each of these vessels.

The second part of the "feeding test" aimed to provide information about how resistant the insecticides were to rain. The remaining four treated test plants for each treatment were

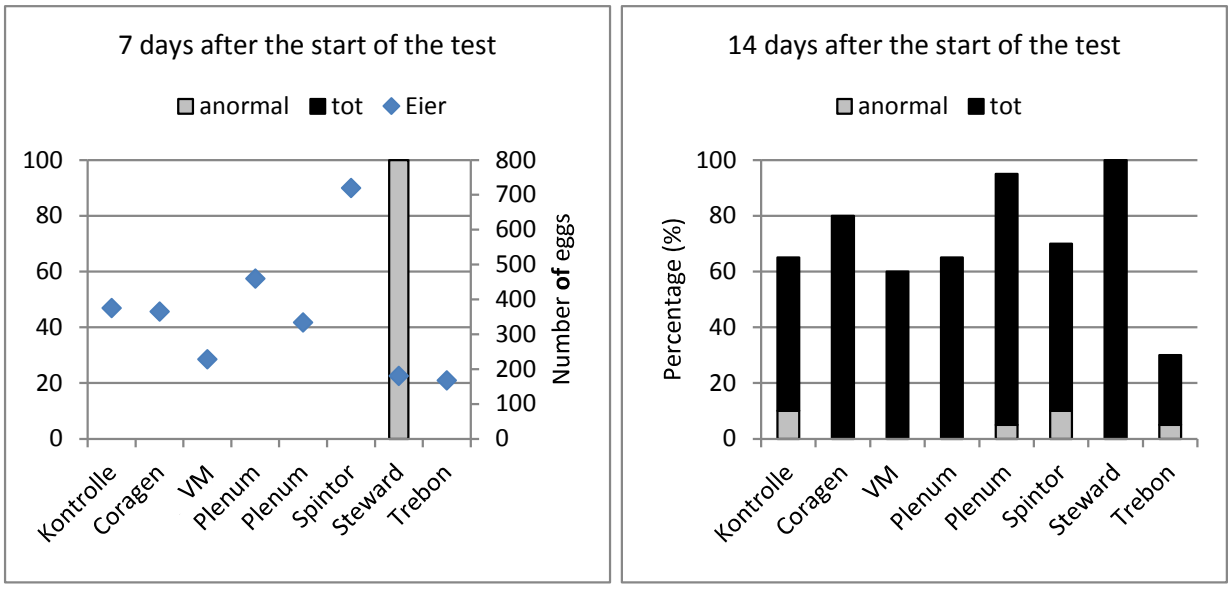
placed in black crates in the VuB testing area for one week. In this week, around 100 l/m² of precipitation fell. Once the rain had dried, the rest of the test plants were cut off on 30 July 2015 and their branches placed in test vessels with five live vine weevils in each case.

Assessments were carried out on all three experiments on the first and third day after the adults had been placed in the test vessels containing parts of plants, and further assessments were undertaken after one week and 14 days. The number of affected or dead adults was determined during the assessments. The vital functions such as eating, defecation and egg laying were observed.

3. Results

3.1. “Immersion test“

The most notable observation one day after the adults had been immersed into the insecticide solution was the large number of eggs laid by bugs in the Steward treatment. Adults treated with the experimental agent and Trebon showed behavioural abnormalities. Some of these adults moved slowly and did not draw their legs into their bodies. The adults appeared to recover from this. In contrast to this, the behavioural changes which occurred as a result of the Steward treatment three days after immersion were serious and irreversible. The adults only moved in an uncoordinated manner and appeared to eat less. In terms of the number of eggs laid, attention was drawn to the Spintor treatment one week after immersion. At around 700 eggs, almost twice as many were counted for this treatment than for other treatments (see Fig. 3). Dead adults only started to appear 14 days after the start of the experiment, but then they occurred in all treatments (see Fig. 4).



Figs. 3-4: Results of the immersion treatment: Percentage of adults with behavioural changes and percentage dead adults seven and 14 days after the start of the experiment. The number of eggs laid seven days after the start of the test is also listed.

3.2 “Feeding test” on the day after the treatment of the test plants

One day after the adults had been placed into the test vessels with treated plant material, the initially high number of eggs laid by adults in the Steward treatment was once again noticeable in this experiment too. In addition to this, these adults showed the highest levels of behavioural change. They moved in an uncoordinated manner or were only able to twitch. In contrast to this, the adults in the experimental agent treatment appeared to be frozen. They laid almost no eggs and stayed motionless on the bottom of the test vessel. If they were rolled onto their backs, they did not draw their limbs into their bodies (see Fig. 5).

Figs. 5-6: The first adults started to show atypical behaviour one day after the start of the feeding test. The left hand side shows “frozen” adults after feeding on parts of the plants treated with the experimental agent. Right: normal behaviour of the adults in the untreated control.

Three days after the adults were placed in the vessels, the situation was the same for the experimental agent and Steward treatments. The number of eggs laid did not increase any further, in contrast to the other treatments. In addition to this, almost all of the adults in the Spintor treatment showed significant behavioural abnormalities. The first dead adults were from this treatment. One week after the start of the test, the number of dead adults in the Spintor variant had increased to 80% (see Fig. 7). Fourteen days after the start of the experiment, there were many dead adults in all of the treatments, including the untreated control (see Fig. 8).

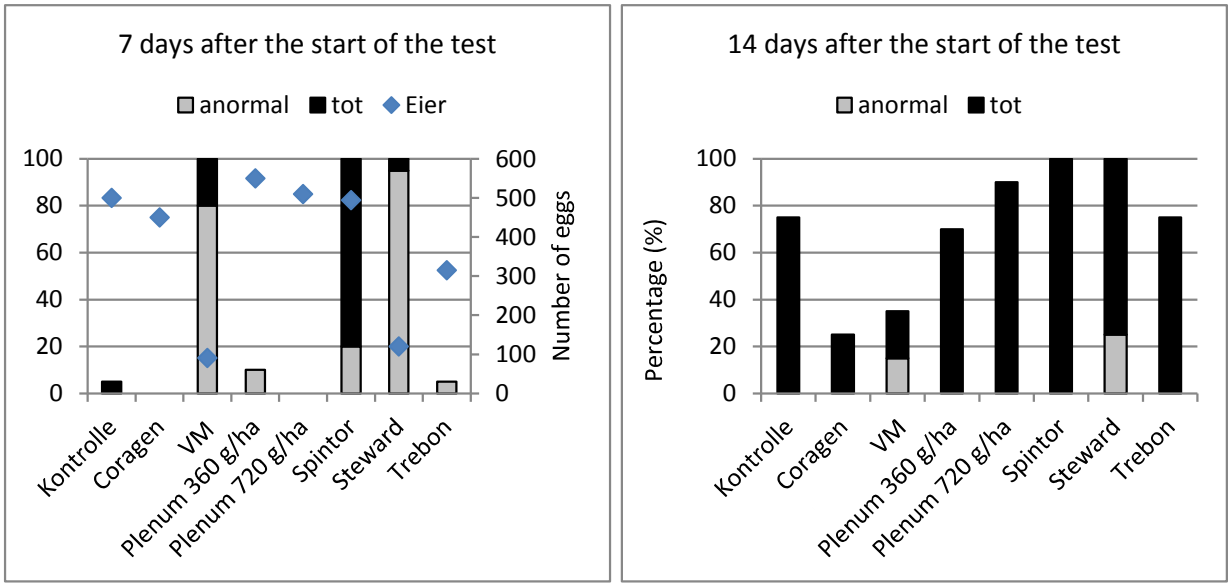
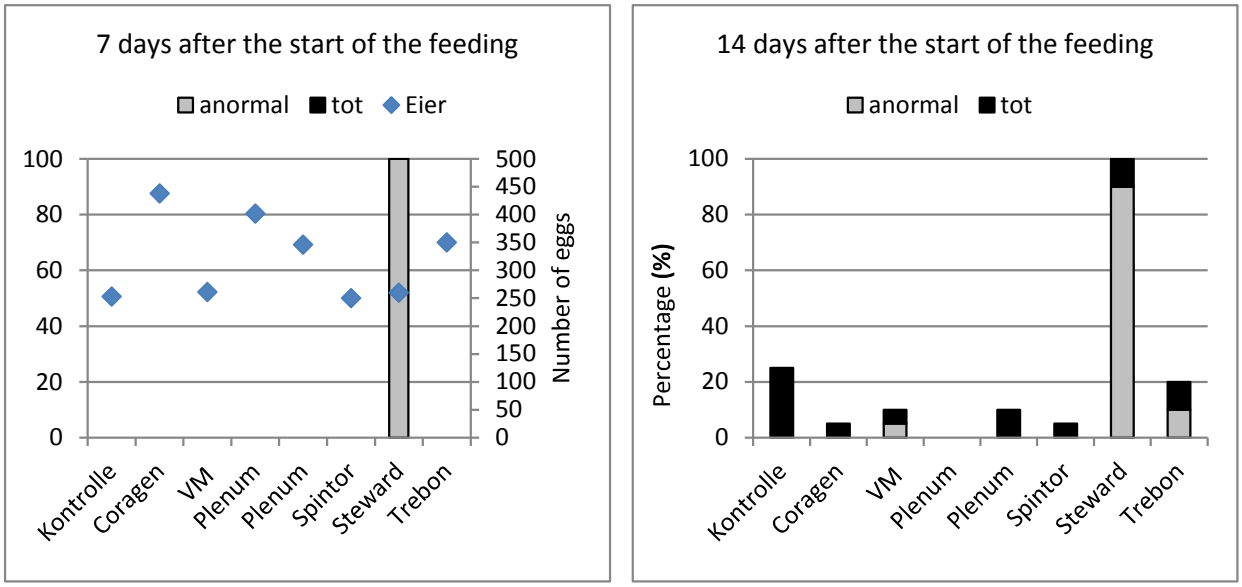


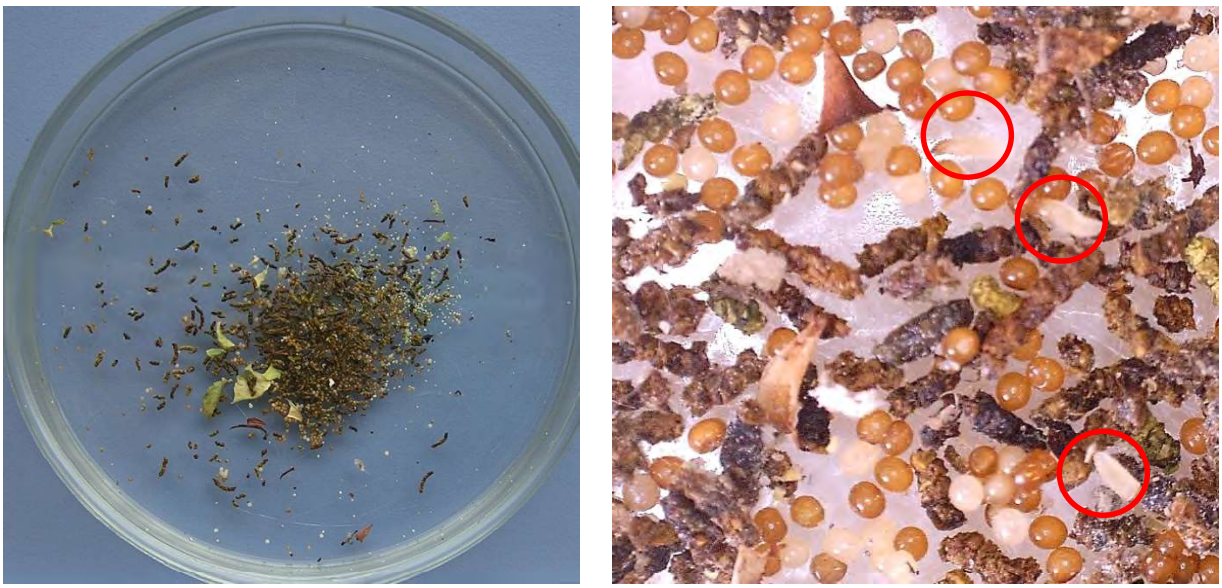
Fig. 7-8: Results of the feeding test part 1: Percentage of adults with behavioural changes and percentage dead adults seven and 14 days after the start of the experiment. The number of eggs laid seven days after the start of the test is also listed.

3.2 “Feeding test” one week after the treatment of the test plants

Precipitation did not need to be simulated in this test. From the day after the spray deposit dried, around 100 litres of rain per square metre fell on the treated test plants. Nevertheless, in the subsequent test the consumption of the treated plant materials of the Steward treatment had the same effect on the vine weevils as in the other experiments. One day after they had been placed in the test vessels, the adults had already laid more than ten times as many eggs as in the other treatments. Twenty percent of the adults were also already showing behavioural changes. Three days after the start of the test, almost all of the adults in the Steward treatment were moving in an uncoordinated manner. In terms of egg laying, the adults in the Spintor treatment had caught up and even overtaken them. The adults in this treatment did not, however, exhibit any other behavioural abnormalities. There were similar situations one week and 14 days after the start of the experiment (see Figs. 9-10). Fourteen days after the start of the experiment the first dead adults started to appear and were then identified in all treatments. At this assessment point, it was determined that the plant parts treated with the product Steward exhibited the lowest level of adult feeding damage. In the experiment “feeding one week after the treatment of the test plants”, the vine weevil larvae from the eggs laid during the test period also hatched. These larvae also occurred in the Steward treatment.



Figs. 9-10: Results from the feeding test part 2 (one week after treatment): Percentage of adults with behavioural changes and percentage dead adults seven and 14 days after the start of the experiment. The number of eggs laid in the graph on the left was recorded three days after the start of the test.



Figs. 11-12: Over the duration of the experiment (14 days), the vine weevils in a test vessel passed around 0.15g of faeces and eggs (left). In the close-up, it is possible to see that the larvae from eggs laid during the experiment have hatched. Larvae also occurred in the Steward treatment in which the adults displayed severe behavioural changes.

4. Summary

A laboratory experiment was carried out to compare the effect of the insecticides Coragen, Plenum and an experimental agent against vine weevils with the standard treatments of Steward and Spintor. The contact action of the treatments was tested by immersing the bugs in an insecticide solution, and the effect of consuming treated material by feeding the bugs treated plant material one day and one week after treatment.

The test showed how resistant adult vine weevils are to insecticide treatment. Immersion into insecticide solutions only had a significant effect from which the bugs did not recover in the Steward treatment.

Immersion treatments were overall less effective than the effect from consuming treated material. The assumption which is widespread in practice that plant protection measures against vine weevils should be carried out at night can be called into question. Lower levels of wetting are always achieved with spray treatment than with immersion treatment.

The consumption of treated plant material had a good effect in some cases. The death rate among the adults was highest after feeding on plants treated with the insecticide Spintor. Eighty percent of the adults were dead seven days after feeding on freshly treated material. More than 80% of the adults displayed behavioural abnormalities seven days after feeding on parts of plants that had been treated with the experimental agent and the product Steward. In nature, the coordination difficulties experienced by the adults would have led to them being eaten by other creatures.

The insecticide Spintor seemed to be washed off the plants by large quantities of rain. Once the test plants had been exposed to 100 l/m² of rain, feeding on these plants by the adults no longer had a toxic effect on them. Only the consumption of plants treated with Steward still showed an effect on the adults after this quantity of rain. The adults displayed significant behavioural changes.

Some insecticide treatments stimulated the early laying of eggs. However, the number of eggs laid and their fertility rarely seemed to be reduced. In nature, the eggs laid by adults exhibiting behavioural changes would probably not have been laid in a targeted manner and would therefore have been less successful.

Overall, early efforts to control adults appears to be important: where possible immediately after hatching when the adults are still sensitive and have not produced any eggs.

Efficacy of fungicides against *Cladosporium* ssp. on forsythia
(Magdalena Hetger (Geisenheim University), Dr Heinrich Lösing, Britta Zielke)

1. Objective of the experiment

Flecks on the leaves of forsythias caused by a fungal pathogen have been occurring for a number of years. The pattern of the damage is characterised by brightening and curvature of the leaves and oily-looking flecks on the lower side of the leaf. In the case of a severe infestation, the one-year-old shoots lose their leaves prematurely and there is discolouration of the young bark.

As recently as 2014, the parasol mushroom *Fusicladium* was still thought to be the cause (see annual report for 2014, page 13). The pathogen has now, however, been identified as the related pathogen *Cladosporium* ssp. through light microscopy and molecular biology tests (Hetger Bachelor's thesis 2015).

Fig 1: Development of the infestation of *Cladosporium* ssp., the infestation gets more severe from left to right

A previous experiment with six fungicides in 2014 showed that the products Cercobin FL, Luna Sensation and Mirage 45 EC had an effect on the fungal pathogen (see annual report for 2014, pages 13-16).

In 2015, another experiment was carried out on this subject. Eight fungicides from different active substance groups were tested at two locations on the *Forsythia* varieties 'Spectabilis' and 'Lynwood Gold' for their efficacy against *Cladosporium* ssp. The experiment was carried out on 30 June 2015 and each treatment replicated three times. The initial infestation was low. At both locations, five treatments were carried out at intervals of ten days. Table 1 lists the eight fungicides used. They were applied with a knapsack sprayer with a hollow-cone nozzle to the point of run-off. This corresponded to a water volume of approximately 1000 l/ha. Table 2 shows the treatment dates and the weather conditions.

Table 1: Overview of fungicides tested with active substances, quantities used, authorisation and references

Fungicide product	Active substance	Rate/ha	Authorisation	Notes
Control	-	-	-	-
Amistar Opti	Chlorthalonil 400 g/l + azoxystrobin 80 g/l	2.5 l/ha	Section 22 (2) B, St	N, Xn, B4
Cercobin FL	Thiophanate-methyl 500 g/l	1 l/ha	Section 22 (2) B, St	Xn, B4
Delan Pro	Dithianon 125 g/l + potassium hydrogen phosphonate 375 g/l	1.875 l/ha	-	-
Folicur	Tebuconazole 250 g/l	1 l/ha	Section 22 (2) B	N, Xn, B4
Luna Sensation	Fluopyram 250 g/l + trifloxystrobin 250 g/l	0.8 l/ha	Section 22 (2) B	N, Xn, B4
Malvin WG	Captan 800 g/kg	1.8 kg/ha	Section 22 (2) B, O	B4
Mirage 45 EC	Prochloraz 450 g/l	1.2 l/ha	Section 22 (2) B, St	B4
Signature	Pyraclostrobin 67 g/kg + boscalid 267 g/kg	1.5 kg/ha	ZP, O	B4

Table 2: Treatment times and weather conditions

Date	Test area	Temperature	Wind	Weather
30/06/2015	Both	23°C	0-1 m/s	Sunny
10/07/2015	Test area 1	15°C	3-4 m/s	Changeable
13/07/2015	Test area 2	20°C	0-1 m/s	Cloudy
20/07/2015	Test area 1	21°C	1-2 m/s	Cloudy
23/07/2015	Test area 2	17°C	0-1 m/s	Changeable
31/07/2015	Test area 1	14°C	0-1 m/s	Changeable
03/08/2015	Test area 2	22°C	0-1 m/s	Sunny
26/08/2015	Both	20°C	2-4 m/s	Sunny

The infection with *Cladosporium* was evaluated in both test areas on two dates using a grading system. As part of this, the upper 30 cm of the plants were taken into account and the average infestation on the plot divided into one of the following classes: 1 = no infestation identifiable on the leaves or bark; 2 = slight infestation, parts of the plant are mostly healthy; 3 = moderate infestation, yellow discolouration of the leaves; 4 = severe infestation, yellow discolouration and necrosis of the leaves; 5 = very severe infestation, leaves and bark are affected.

2. Results

The forsythias grew considerably during the test period. At the start of the experiment they were around 50 cm, and by the end they had reached a size of 2 m. The slight infestation which was present at the start of the test worsened in the untreated plots. The leaves were badly affected in the centre and lower region of the plants, but the infestation was barely visible at the end of the experiment, particularly on the bark of the shoots. The infestation increased less significantly in the treated plots of land. Most fungicides had a very good effect on the infestation with *Cladosporium*. The effect of the scab fungicides Delan Pro and Malvin WG was slightly less.

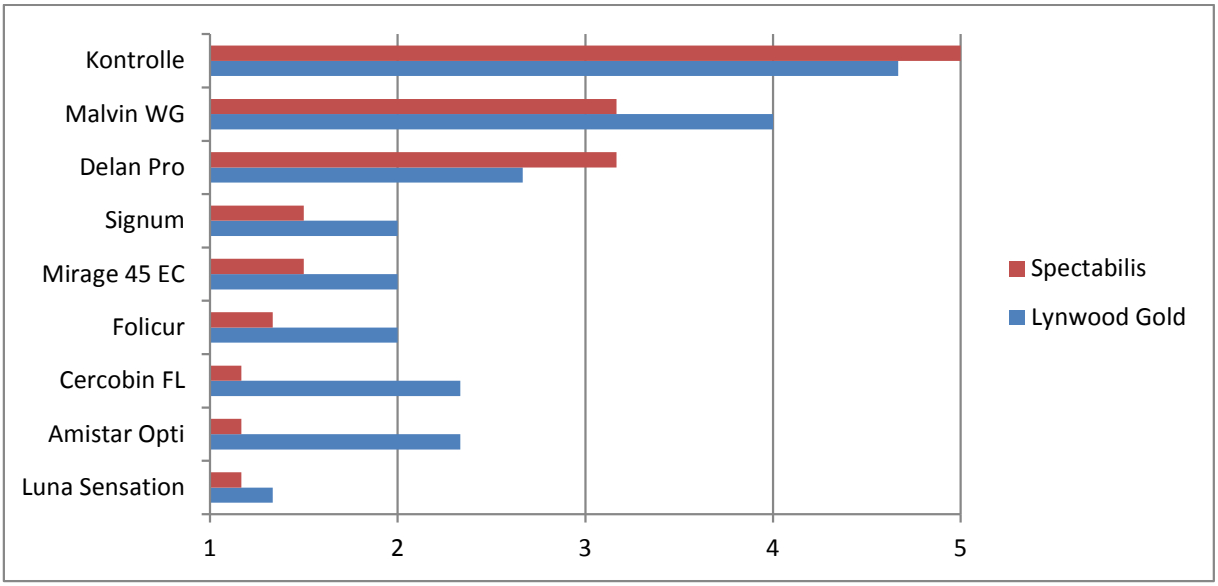


Fig. 2: Infestation level grades from 1-5: 1 = no infestation, 2 = slight infestation, 3 = moderate infestation, 4 = severe infestation, 5 = very severe infestation

A severe infestation with *Cladosporium* had a particularly great effect on the growth of *Forsythia* ‘Spectabilis‘ plants. Untreated plants tended to remain somewhat smaller.


Figs. 3 and 4: Sections from the plots at the 'Lynwood Gold' location at the end of the experiment on 11 September 2015 On the left are the untreated plants; on the right the plants treated six times with Luna Sensation.

3. Summary

An experiment was carried out at two locations to determine the effect of eight different fungicides on *Cladosporium ssp.* in forsythia.

An infection was successfully prevented with the products Amistar Opti, Cercobin FL, Folicur, Luna Sensation, Mirage 45 EC and Signum. The fungicides Delan Pro and Malvin WG were slightly less suitable.

In order not to exceed the maximum usage frequency of the products, in practice there will be a need to alternate between various products authorised in accordance with Section 22 (2) against pathogens which cause flecks on leaves. These include Amistar Opti, Folicur, Luna Sensation, Mirage 45 EC and Signum.

Testing the compatibility of alternative fungicides and insecticides for the control of powdery mildew on oaks

(Magdalena Hetger (Geisenheim University), Dr Heinrich Lösing, Britta Zielke)

1. Experiment plan/experiment structure

The compatibility and safety of fungicides in combination with insecticides which primarily act against sucking insects was investigated as part of a student paper. It was primarily substances authorised for ecological cultivation in accordance with the EU ecological regulations which were selected. The testing of safety was carried out on oak seed beds (*Quercus robur*). An overview of the plant protection agents examined and the active ingredient of each is set out below.

Table 1: Fungicides tested with active ingredients and rates used per ha

Product	Active substance	Rate/ha
Buttermilk	Plant fortification by means of sodium phosphate	50 l/ha
Frutogard M	Leaf fertiliser made of brown algae extract and plant-based amino acids, 5.5% P_2O_5 17.5% potassium oxide	2.5 l/ha
Kumar	850 g/kg potassium hydrogen carbonate	2.5 kg/ha
Kumulus WG	800 g/kg sulphur	3 kg/ha
Kumulus WG + Cocana	800 g/kg sulphur + wetting agent based on potassium salts of fatty acids	3 kg/ha + 2.5 l/ha
Organic plant spray - common horsetail and oats	Plant fortification agent 500 mg/l silica	25 l/ha
VitiSan + Prev B2	994 g/kg potassium hydrogen carbonate + wetting agent based on fatty alcohol ethoxylate and orange oil	3 kg/ha + 2 l/ha

Table 2: Insecticides tested with active ingredients and rates used per ha

Product	Active substance	Rate /ha
Neem Azal T/S	1% azadirachtin, 4% natural NEEM core extract	3 l/ha
Neudosan Neu	515 g/l green soap	2%
Neu 1153 I	Pyrethrins	0.6 l/ha
Spruzit Neu	4.59 g/l pyrethrins, 18.36 g/l natural pyrethrum, 825.3 g/l rapeseed oil	0.5%

The treatments were administered using a full and double application rate of the insecticides by means of a plot spraying devices with Lechler injector nozzles IDN 120-025 purple, a

pressure of 5.5 bar and a water volume of 512 l/ha. The plots were examined for damage one day, five days and approximately three weeks after treatment.

2. Results

As a result of the average crop tolerance tests, the following statements were able to be made: the compatibility with the insecticides Neu 1153 I and Neem Azal T/S was very good. All of the products investigated dissolved well. With the Spruzit Neu, however, a thin oily film formed on the surface of the water when tank mixed. The preparation Neudosan Neu in combination with Kumulus WG and Kumulus WG + Cocana led to the formation of significant amounts of foam.

In the assessment of the plants five days after the application of the full rate treatments, isolated instances of slight leaf deformation were observed on individual leaves with the combinations listed below: Neu 1153 I + buttermilk, Frutogard + Vitisan + Prev B2, Spruzit Neu + Kumar + Kumulus + Cocana, Neudosan Neu + horsetail extract. The damage only occurred for a short period of time.

More significant damage was identified in the case of the double rate treatment of the insecticide. Slight red leaf discolouration was already visible on the first day after application with the Neu 1153 I treatment in combination with Kumulus WG or Vitisan + Prev B2. Red discolouration of older leaves and necrosis of younger leaves occurred in the case of mixtures of Spruzit Neu with Frutogard or with Kumulus WG. The same symptoms also occurred following the use of Neem Azal T/S in combination with Kumulus WG. The damage was visible over the entire plot distributed over individual leaves, but the plants were not permanently damaged.

Images 1 and 2: Damage caused by double rate insecticide in the combination treatment, left: necrosis of young leaves, right: red discolouration of the leaves

3. Summary

Various fungicides against powdery mildew in combination with insecticides were tested for compatibility and safety as part of a student paper. Only preparations with authorisation in accordance with the EU ecological regulations were taken into account. With the exception of the formation of foam in the case of individual combinations, all of the combinations tested were compatible. Only very isolated damage symptoms were observed when the authorised application quantity was applied to oak as a test plant. When the concentration of insecticides was doubled, the combinations with Spruzit Neu and Neudosan Neu showed damage in the form of necrosis and leaf discolouration. Permanent damage to the test plants was not observed.

Alternative products to control powdery mildew on oaks

(Magdalena Hetger (Geisenheim University), Dr Heinrich Lösing, Britta Zielke)

1. Experimental plan

This experiment was a student internship project to investigate whether it is possible to keep oak seedlings mildew-free over the growing season using alternative products that can be used in ecological cultivation.

In order to do this, an experiment with eight treatments and three replications was carried out on *Quercus robur* seed beds. The products listed in Table 1 were applied from 16 June 2015 at intervals of approximately ten days. The treatments were administered at the times listed in Table 2 using a plot spraying devices with Lechler injector nozzles IDN 120-025 purple, a pressure of 5.5 bar and a water quantity of 512 l/ha.

Fig. 1: Test area

Table 1: Overview of the products with active substances and rates used per ha

Product	**Active substance**	**Rate/ha**
Control	-	-
Buttermilk	Plant fortification	50 l/ha
Frutogard M	Leaf fertiliser made of brown algae extract and plant-based amino acids, 5.5% P_2O_5 17.5% potassium oxide	2.5 l/ha
Kumar	850 g/kg potassium hydrogen carbonate	2.5 kg/ha
Kumulus WG	800 g/kg sulphur	3 kg/ha
Kumulus WG + Cocana	800 g/kg sulphur + wetting agent	3 kg/ha + 2.5 l/ha
Organic plant spray - common horsetail and oats	Plant fortification agent 500 mg/l silica	25 l/ha
VitiSan + Prev B2	994 g/kg potassium hydrogen carbonate + wetting agent based on fatty alcohol ethoxylate and orange oil	3 kg/ha + 2 l/ha

Table 2: Treatment times and weather conditions

Date	Temperature	Wind	Weather
16/06/2015	15°C	2-3 m/s	Cloudy
25/06/2015	21°C	1-2 m/s	Bright to cloudy
06/07/2015	21°C	2-3 m/s	Sunny
16/07/2015	17°C	0-1 m/s	Cloudy
31/07/2015	14°C	0-1 m/s	Changeable
10/08/2015	24°C	0-1 m/s	Cloudy
21/08/2015	17°C	0-2 m/s	Sunny
31/08/2015	27°C	0-2 m/s	Sunny

Assessments were carried out in accordance with a graded evaluation system on four of the dates. Each plot was divided into one of the five infestation levels: 1 = no infestation, 2 = slight infestation, 3 = moderate infestation, 4 = severe infestation, 5 = very severe infestation. At the end of the experiment, the size of 50 average plants was determined, and this was repeated.

2. Results

At the start of the experiment, there was a uniform slight infection. Over the course of the experiment, the powdery mildew infection level increased on the untreated plots in particular. The effect of a number of products was observed at the first assessment date on 16 July 2015. In contrast to a moderate infestation on the untreated plots, there was only a slight infection level in plots treated with Kumulus WG, buttermilk or Vitisan.

Over the course of the month of August, the differences between the untreated and treated plots decreased. At the end of the experiment, on 10 September 2015, ten days after the last treatment, there were only two treatments showing positive results. With the exception of plots treated with Kumulus WG alone or in combination with Cocana, the plants in the trial was uniformly white with powdery mildew. These other plots were either at a severe or very severe level of infection at the time of the assessment. Plots which had been treated with the active substance sulphur, however, were either at a slight or moderate level of infection.

The plots which had been treated with the products Kumar and Vitisan, which have the same active ingredient but different formulations, hardly differed in terms of the observed infection level. There was a tendency for the Vitisan applied in combination with PrevB2 to have a better effect in this experiment.

Figs. 2-3: Sections from the untreated/Kumulus WG treated plots on 10 August 2015

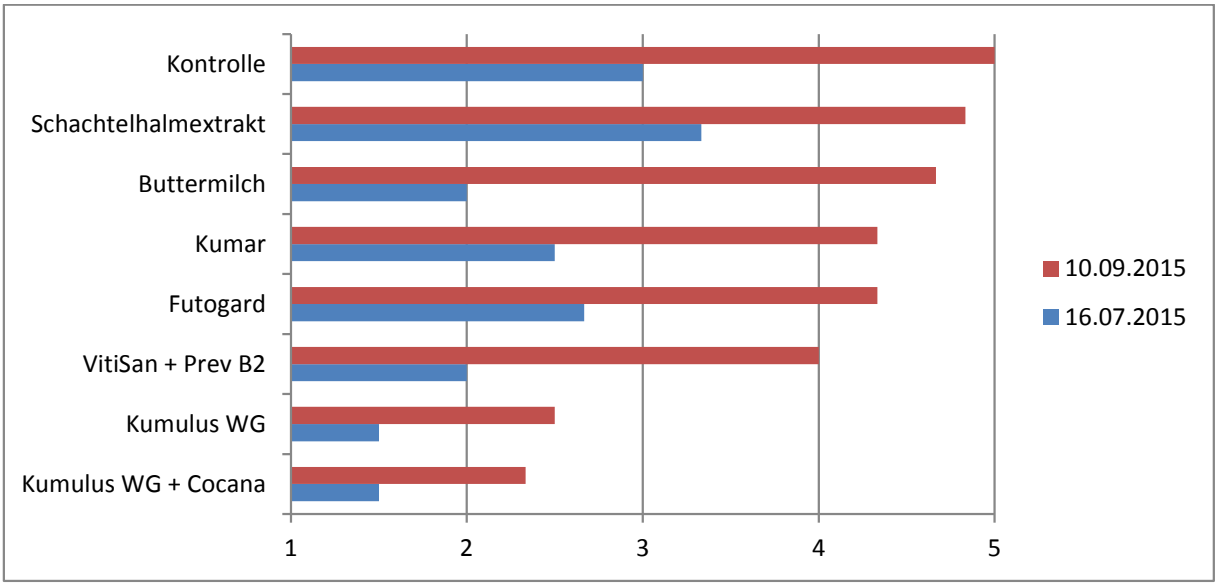


Fig 1: Infection level by plot on 16 July and at the end of the experiment on 10 September 2015. Average values from three replicates. (1 = no infestation, 2 = slight infestation, 3 = moderate infestation, 4 = severe infestation, 5 = very severe infestation)

Plant height measurements at the end of the experiment showed that the oak seedlings in plots infected with powdery mildew were significantly smaller than those in plots where the plants were only slightly infected. While plants in the control variant had an average size of 41 cm, those in the plots treated with Kumulus WG had an average size of 57 cm.

3. Summary

An experiment was designed in order to obtain knowledge about powdery mildew control using products for ecological production. The household remedy buttermilk and two plant fortification agents based on brown algae and horsetail extracts were compared with products containing the active substances potassium hydrogen carbonate and sulphur.

Eight treatments were carried out at intervals of ten days over the growing season. In this experiment, the oak seedlings could only be kept mostly mildew-free by the repeated use of the product Kumulus WG alone or in combination with the wetting agent Cocana.

In practice, a maximum of 15 treatments with the product Kumulus WG or other sulphur preparations are possible to treat ornamental plants up to a size of 50 cm. However, the application rate should be reduced to 2.5 kg/ha, which may make shorter spraying intervals necessary.

Nitrogen contents in nursery soils – guideline values in accordance with the Fertiliser Ordinance, Section 3 for 2015

(Hendrik Averdieck)

The revised Fertiliser Ordinance will probably become applicable during summer 2016. It is expected to include simplifications for nurseries as the obligations to determine the fertiliser requirement, carry out a nutrient comparison and recording obligations will no longer apply for all crops which are in the broader sense ornamental plants.

For the time being, however, the specifications of the ordinance as at 24 February 2012 continue to apply. According to this, before applying fertiliser at levels of more than 50 kg/ha nitrogen (total-N) and more than 30 kg/ha phosphate (P_2O_5) per year, the quantity of nutrients available to plants in the soil must be determined.

For nitrogen, the quantity of nitrogen available in the soil should be determined once a year; for phosphate one soil analysis per area is required at least once every six years. However, the determination of the available quantity of nitrogen does not necessarily have to be in the form of a number of N_{min} tests on the area, but rather values from representative locations determined by the advisory circle can be used for the company's own areas.

In 2015, a further 40 nursery areas divided into the main culture groups were examined to determine their N_{min} content in mid-February. The results were provided to companies via newsletters and publications. The costs of these tests were borne by the Horticultural Department of the Schleswig-Holstein Chamber of Agriculture.

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

Furthermore, nursery companies in Schleswig-Holstein carried out N_{min} tests on a further 211 areas over the course of 2015.

N_{min} – guideline values 2015		
Crop	**Type of soil**	NO_3-N +NH_4-N [kg/ha] (0 - 60 cm soil depth)
Free areas for hardwood cutting beds, rose rootstocks and fruit tree rootstocks	Clayey sands and sandy clays	**23**
Deciduous wood seedlings and transplanting beds	Clayey sands and sandy clays	**16**
Coniferous seedlings and transplanting beds	Clayey sands and sandy clays	**11**
Budded roses	Clayey sands and sandy clays	**27**
Shrubs, light feathers and hedge plants	Clayey sands and sandy clays	**25**
Solitary and fruit-bearing trees	Clayey sands and sandy clays	**22**
Conifers	Clayey sands and sandy clays	**33**
Evergreen deciduous trees	Clayey sands and sandy clays	**25**
Avenue trees	Clayey sands and sandy clays	**23**
Christmas tree crops	Clayey sands and sandy clays	**15**

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

Attempts to remedy tip burn in field-grown privet

(Hendrik Averdieck)

1. Introduction and implementation of the experiment

Shoot tip burn in *Ligustrum vulgare* 'Atrovirens' often occurs in open field areas. In the early stages of the damage, the youngest leaves on the shoot tips get a violet tinge and twist slightly (Figs. 1-3). They are only loosely attached to the branches and can easily be brushed off. In the advanced stage, the shoot tips of the plants affected become bald and die backwards from the tip.

Figs. 1-3: Initial stages of shoot tip burn in privet with violet discolouration, twisting and abscission of the youngest leaves and early dying back of the shoot tips.

Figs. 4-5: Massive tip burn in a privet crop

The intensity of the dieback can range from a few centimetres to 20-40 cm (Figs. 4-5). The affected plants in a whole grading size often lose length.

The following statements can be made in connection with the occurrence of tip burn:

- The pattern of damage can occur in different soil types, from very sandy to clayey soils.
- The extent of the damage can vary significantly from one year to the next, even on the same plants.
- Hardwood cutting beds are rarely affected, and the damage mostly occurs in shrubs which have been transplanted twice and in solitary trees.
- The damage mostly occurs later on in the growing season, often only in August to September.
- The development of tip burn is often preceded by an extensive period of drought.

To date, the damage has always been thought to be a lack of copper linked to drought. However, in 2014 the damage also occurred to a massive extent in areas which were regularly fertilised with copper and had good copper levels, large open field tests were carried out to address the cause in greater detail.

In autumn 2014, as part of the process of the planned tests, extensive leaf and soil analyses were carried out in one healthy and one damaged privet population in two companies in order to provide further clues as to the cause of the damage.

The soil analyses were examined by a special laboratory in the Netherlands, with 40 soil parameters tested. There were no clear differences between the areas with healthy and damaged plants for any of the parameters tested. However, all of the areas had very low levels of copper and boron available to the plants (boron available in hot water), so the assumption can be made that the problem must be linked to the nutrients copper or boron (Tab. 1).

Tab. 1: Extract from the soil analysis values of two companies indicating deficiencies

		Company 1		**Company 2**		**Optimal values**
Parameters	Unit	Healthy	Damaged	Healthy	Damaged	
Copper (available to the plants)	mg/kg TS	0.05 (relatively low)	0.03 (very low)	0.01 (very low)	0.02 (very low)	0.12
Boron (soluble in hot water)	mg/kg TS	0.03 (too low)	0.07 (too low)	0.03 (too low)	0.03 (too low)	0.35

The leaf analysis of healthy plants and those with severe tip burn also did not show any indication of a possible nutrient deficiency (Tab 2.). The severely damaged privet plants in company 1 even have a higher copper content as a result of the copper fertilisation. The boron content in the leaves was in the region of the guideline value for all samples, but it was at the lower limit in company 1.

Tab. 2: Leaf analysis values of damaged and healthy privet plants from two companies

		Company 1		Company 2	
Parameters	Unit	Healthy	Damaged	Healthy	Damaged
Nitrogen (N)	% TS	3.05	2.38	3.42	2.73
Phosphorous (P)	% TS	0.32	0.30	0.23	0.35
Potassium (K)	% TS	1.84	2.27	1.91	1.91
Magnesium (Mg)	% TS	0.23	0.21	0.23	0.29
Calcium (Ca)	% TS	0.77	1.20	1.20	1.20
Sulphur (S)	% TS	0.29	0.23	0.26	0.35
Copper (Cu)	mg/kg TS	4.8	24.0	7.5	6.2
Manganese (Mn)	mg/kg TS	46	36	62	59
Zinc (Zn)	mg/kg TS	23	17	25	23
Boron (B)	mg/kg TS	15	15	19	28
Molybdenum (Mo)	mg/kg TS	0.086	0.150	0.100	0.064
Iron (Fe)	mg/kg TS	73	300	110	89
Silicon (Si)		610	1000	640	780

On the basis of the soil test results, open field experiments were carried out in both companies in which soil or leaf fertilisation was applied in the form of either copper alone, boron alone or both nutrients at the same time (Tab. 3).

The lengths of the plots of land in the test were 8 m and 10 m, and the tests were replicated times.

The fertiliser granules were applied to the soil in March 2015 and the preparations were applied by spray application four times on the following dates:
16 June, 30 June, 15 July and 4 August.

The spray treatments were applied with a plot spraying device with Lechler injector nozzles ISN 120-025 purple and a water quantity of 512 l/ha.

Fig. 6: View of one of the two test areas in March. The privet shrubs which had been planted the previous year had been cut back to just above the ground

Tab. 3: Treatment summary for fertilisation with copper and boron in the privet areas

	Fertiliser type	Rate/ha	Nutrient quantity copper	Nutrient quantity boron
1	Excello-Kupfer spezial (5.0% Cu)	100 kg/ha	5.0 kg/ha	---
2	Excello-331 spezial (1% B, 0.2% Cu)	200 kg/ha	0.4 kg/ha	2.0 kg/ha
3	Mivena blend trace elements (0.6% B, 0.6% Cu)	334 kg/ha	2.0 kg/ha	2.0 kg/ha
4	Haifa Coated Bor 12M (12% boron)	50 kg/ha	---	6.0 kg/ha
5	Folicin-Bor plus fluid (140 g/l B)	4 x 1.5 l/ha	---	0.84 kg/ha
6	Folicin-Cu fluid (117 g/l Cu)	4 x 2.0 l/ha	0.94 kg/ha	---
7	Folicin-Bor plus fluid + Folicin-Cu fluid	4 x 1.5 l/ha 4 x 2.0 l/ha	0.94 kg/ha	0.84 kg/ha
8	Wuxal Boron (96 g/l B)	4 x 2.0 l/ha	---	0.77 kg/ha
9	Stefes Bor (150 g/l B)	4 x 1.5 l/ha	---	0.90 kg/ha
10	Stefes Bor Quantum (boron content unknown)	4 x 0.1 l/ha	---	? kg/ha
11	Control	---	---	---

2. Results

In contrast to the previous year, in 2015 the symptoms of tip burn occurred in almost none of the privet areas of nursery companies. No damage was seen in the plots in either of the two test areas, so no differences were able to be identified between the treatments.

Figures 7 and 8 show the same privet crop at company 2 in which the tests were carried out. Severe damage was caused by tip burn here in 2014, but in 2015 no symptoms occurred.

In company 1, slight symptoms of damage did indeed occur in the test plots in late September/early October. The low levels of manifestation, however, meant that the ability to choose between the treatments was minimal.

An attempt was nevertheless made to provide assessment grades of the severity of the symptoms in the individual plots (Fig. 9). Grade 0 means no tip burn occurred. Grade 1 means a slight amount of tip burn occurred with a few dead shoot tips and hardly any leaves with violet discolouration. Grade 5 means many dead shoot tips and leaves with significant violet discolouration.

Fig. 7-8: Severe tip burn in 2014 and no damage in the same privet population in 2015 (date of the right photo: 7 September 2015)

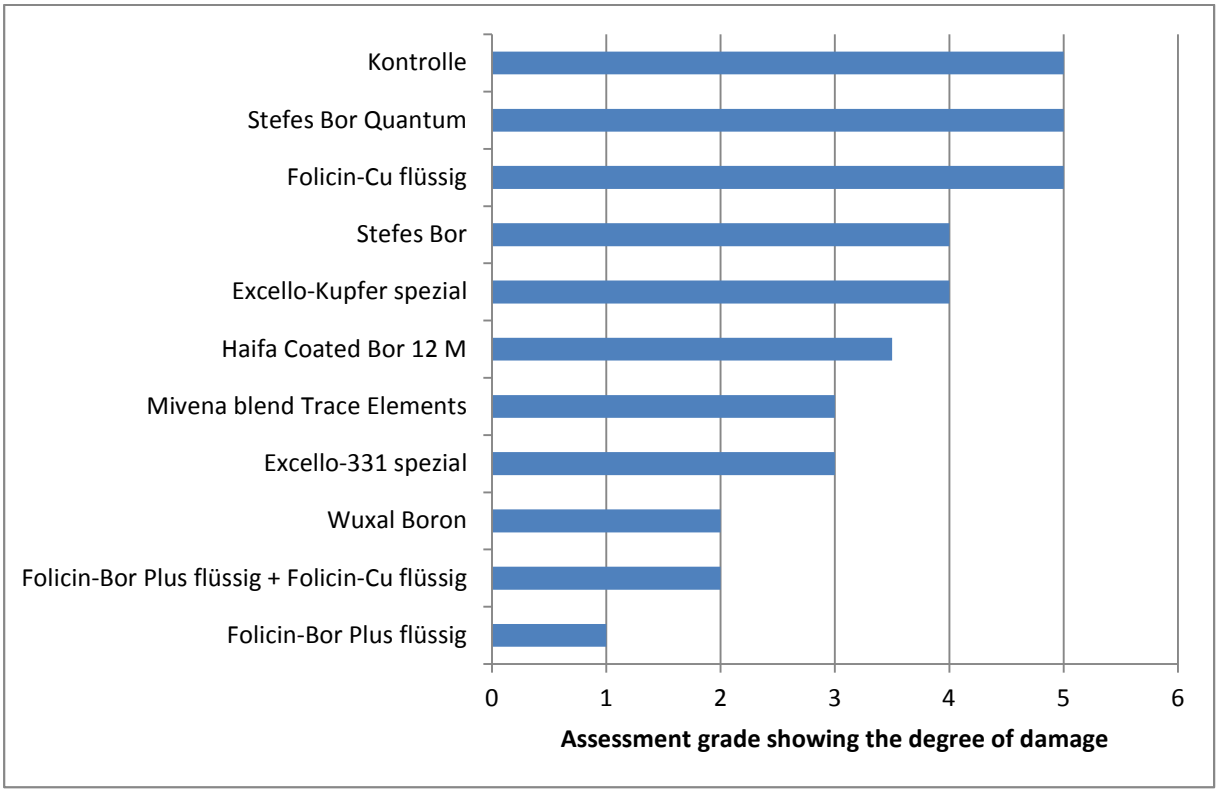


Fig. 9: Extent of the tip burn depending on the fertilisation with boron or copper (0 = no damage, 1 = hardly any dead tips, barely discoloured leaves, 5 = many dead tips, significantly discoloured leaves). Date of the assessment: 13 October 2015

The lowest extent of tip burn occurred in plants sprayed with Folicin-Bor Plus fluid, the combination of Folicin-Bor Plus fluid + Folicin-Cu fluid and Wuxal Boron. Since spraying with Folicin-Cu fluid alone achieved a very poor result, the effect of the combination spraying must have come from the Folicin-Bor Plus fluid element. The scattered boron fertilisers led to a result which was not quite as good as the sprayed boron fertilisers, but the result was better than in the plots of plants only fertilised with copper.

The result with the coated boron fertilisers from Haifa was in the somewhere in the middle. The boron release of the product, which acts over a period of 12 months, may have been too slow, or the surface distribution of the scattered product, only 50 kg/ha, may not have been sufficient for an equally good boron supply in the ground. A higher application quantity of this product should be checked, but it could have a negative impact due to the high boron content of 12%.

The two boron products by the company Stefes showed no significant effect. The results with the pure copper products Excello-Kupfer spezial and Folicin-Cu fluid were also poor. Figures 10-13 show the differences in the extent of the damage between the treatments on 13 October 2015, although as mentioned the extent of the damage was not great.

Figs. 10 and 11: Hardly any dead shoot tips and only slight violet discolouration on the leaves in plots of land treated with Excello-331 spezial (left) and Folicin-Bor plus fluid (right)

Figs. 12 and 13: Early tip burn in plots treated with Folicin-Cu fluid (left) and the untreated control (right) on 13 October 2015

3. Summary

Tip burn has occurred in privet areas for several years, but the extent of the damage varies significantly from year to year. In 2014, the damage was so severe that an entire grading size was often completely lost. In order to identify and remedy the cause, major open field tests were carried out in 2015. Extensive leaf and soil analyses from healthy and damaged areas taken beforehand did not provide a clear indication of the cause. In general, however, the copper and boron contents of the areas were very low. Granular and fluid boron and copper fertilisers were therefore used alone or in combination in the experiments. However, tip burn occurred hardly at all in nursery companies in 2015, and even in the experiment mild symptoms only developed in one of the two areas late on in the year.

In the plots fertilised with boron, the damage was overall visibly less than in those fertilised with copper. Hardly any damage occurred in the plots treated with Folicin-Bor Plus fluid, Folicin-Bor Plus fluid + Folicin-Cu fluid and Wuxal Boron.

Along with the control, the plots treated with Folicin-Cu fluid showed the most extensive symptoms. The plots of land treated with Excello-Kupfer spezial were hardly any better. The products Stefes Bor and Stefes Bor Quantum also had minimal effects. On the basis of the results, boron deficiency is more likely to be the cause of tip dieback than copper deficiency.

The cause of the different manifestations of tip burn in 2014 and 2015 may be drought conditions in the summer. In 2014, only 220 mm of precipitation fell in the period from June to September while in 2015 a total of 404 mm fell in the same period. In September 2014, the month in which the symptoms developed on a massive scale, just 26.5 mm fell. In the experiment, slight damage only developed during October. This month was also very dry, with a total of just 42.0 mm of precipitation.

Since boron is transported to the upper parts of the plant in the xylem by means of the transpiration flow, it is very strongly linked to the intensity of water absorption, in the case of soils with boron contents which are near to the limit of a sufficient supply, drought can lead to symptoms of boron deficiency in the short term.

Testing the partially coated product Granustar CRF Allround in nursery production

1. Introduction and implementation of the experiment

The aim of the experiment was to test the effect of the partially coated product Granustar CRF Allround (17-7-16-5) by Dutch manufacturer Mivena B.V. compared to standard fertilisation with NovaTec premium and Blaukorn premium (15-3-20-3) in field-grown nursery production. In Granustar CRF Allround (Fig. 1), 47% of the nitrogen content is coated. Of the 17% total-N in the fertiliser, 2.7% is in the form of nitrate-N, 6.3% as ammonium-N and 8.0% as urea. NovaTec premium (Fig. 2) does not have partial covering, but it does have nitrogen stabilisation which prevents a rapid conversion of the NH_4 part into NO_3-N. Blaukorn premium (Fig. 3) is a fast-active mineral fertiliser with no long-term effect. In both products, of the 15% total-N, 8% is in the form of ammonium-N and 7% as nitrate-N.

Figs. 1-3: The fertilisers Granustar CRF Allround (left), NovaTec premium (middle) and Blaukorn premium (right) used in the experiment

Since the testing areas are in zone IIIA of the water protection area of Elmshorn Köhnholz/Krückaupark, the plan was also to investigate whether a transfer of the nitrogen into deeper layers of the ground can be decreased through the partial covering of the product. The type of soil is a humous, clayey, sandy soil.

The cherry laurel species *Prunus laurocerasus* ‘Herbergii‘ was selected as a test plant.

In autumn 2014, the cherry laurel plants were growing in a row as 30-40 cm large plants. The fertilisation occurred as 1 m wide band fertilisation over the plants. The test was carried out with three replicates per fertiliser treatment and the test plots of land were 10 m long.

Table 1: Overview of the fertiliser treatments

	Fertiliser type	Formula	Nitrogen quantity per fertilisation:		Total-N per year:
			27 April 2015	6 July 2015	
1.	Granustar CRF Allround	17-7-16-4	50 kg N/ha	50 kg N/ha	100 kg N/ha
2.	NovaTec premium Blaukorn premium	15-3-20-3 15-3-20-3	50 kg N/ha ----------	---------- 50 kg N/ha	100 kg N/ha

The plants in treatment 1 were fertilised in spring and again in early July with the same quantity of Granustar CRF Allround.

In treatment 2, the spring fertilisation was carried out with NovaTec premium and the subsequent fertilisation in summer with Blaukorn premium.

Fig 4:
Overview of the test area with *Prunus laurocerasus* 'Herbergii' at the start of the experiment

Before the experiment was set up, the nitrogen content of area was determined (Fig. 5).

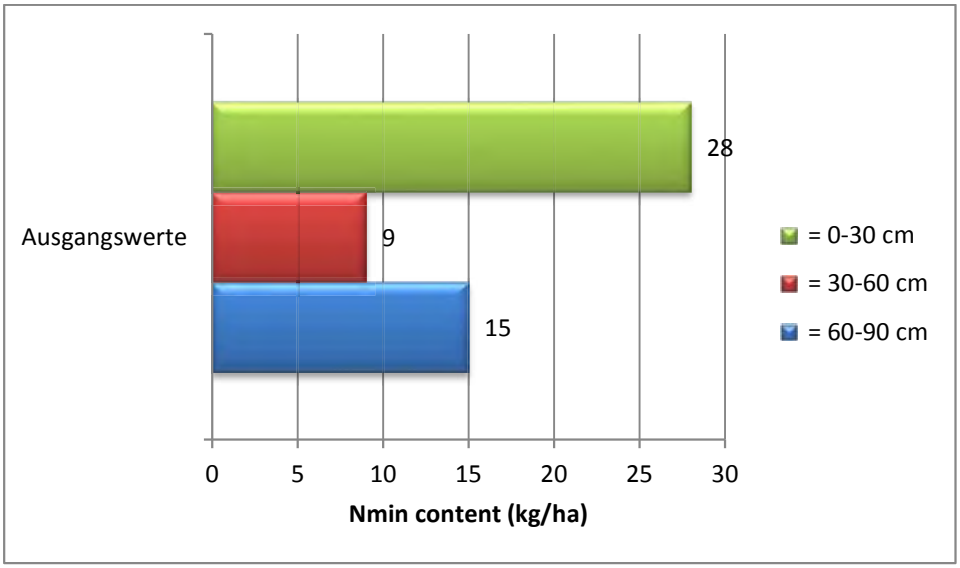


Fig. 5: Nitrogen content of the test area at the start on 23 April 2015

A nitrogen reserve of 28 kg/ha N was measured in the root zone at 0-30 cm. A total of 9 kg/ha N was found in the ground layer at 30-60 cm, and 15 kg/ha N at a depth of 60-90 cm.

2. Growth results with *Prunus laurocersasus* 'Herbergii'

There was significant shooting of the plants in late May. The shoots were already 4-5 cm by early June. There were no differences between the two treatments of fertiliser at this point.

On 6 July, additional fertiliser totalling 50 kg N/ha was added to all the plots. At this point, the plants had already grown significantly (Fig. 8). The subsequent fertilisation also occurred as a 1 m wide band fertilisation over the rows of plants (Fig. 9). At the end of the test rows, the growth of the plants decreased in some cases, although as can be seen in the images the ground had been very evenly prepared, there were no wet sinks and there was also no shade or competition for water from tall trees.

Fig. 8: View of the test area in early July

Fig. 9:
Growth of the test plants on 6 July 2015 with the additional fertilisation added in strips.

The final evaluation of the plants was carried out on 5 October 2015. The height of the plants and the number of shoots per plant were determined in the existing stock. The plants at the ends of the rows which remained smaller were not taken into account in the measurement. The plants were also sorted into sales categories.

The results are shown in the following graphs in Fig. 10-12.

Better growth was achieved in the plots fertilised with Granustar CRF Allround than in the comparison treatment, and the plants were an average of 10 cm taller (Fig. 10).

The number of shoots on the plants fertilised with Granustar CRF Allround was an average of 10; in the plots fertilised as usual with NovaTec premium + Blaukorn premium the average was 9 shoots (Fig. 11).

The difference in shoot length also had an impact on the grade out of the plants into the sale categories (Fig. 12). In the Granustar plots, 62% of the plants were graded into the 80-100 cm category. In the NovaTec + Blaukorn treatment this was just 38%. In the Granustar plots, however, almost 21% were in the smaller plant category of 40-60 cm, while in the comparison treatment this was just 14%.

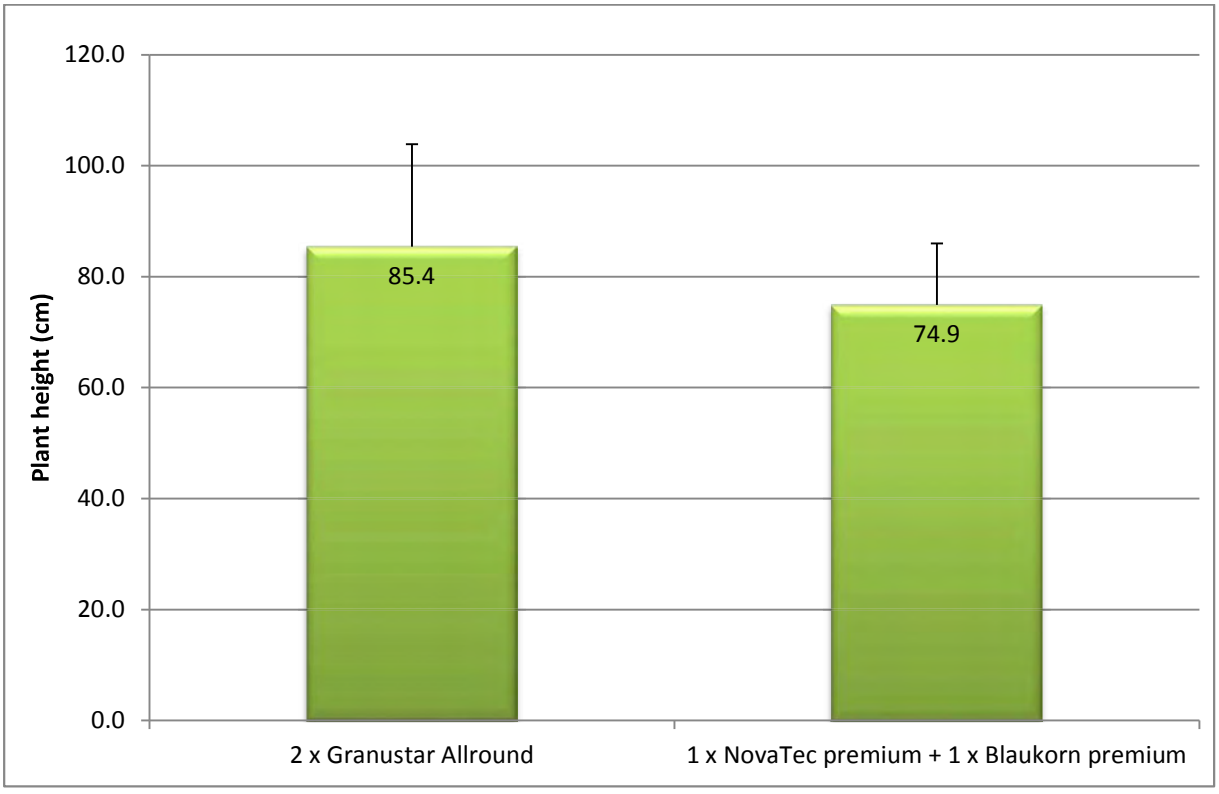


Fig. 10: Average plant height of *Prunus laurocerasus* 'Herbergii' in both treatments. The error bars show the standard deviation within the test variants.

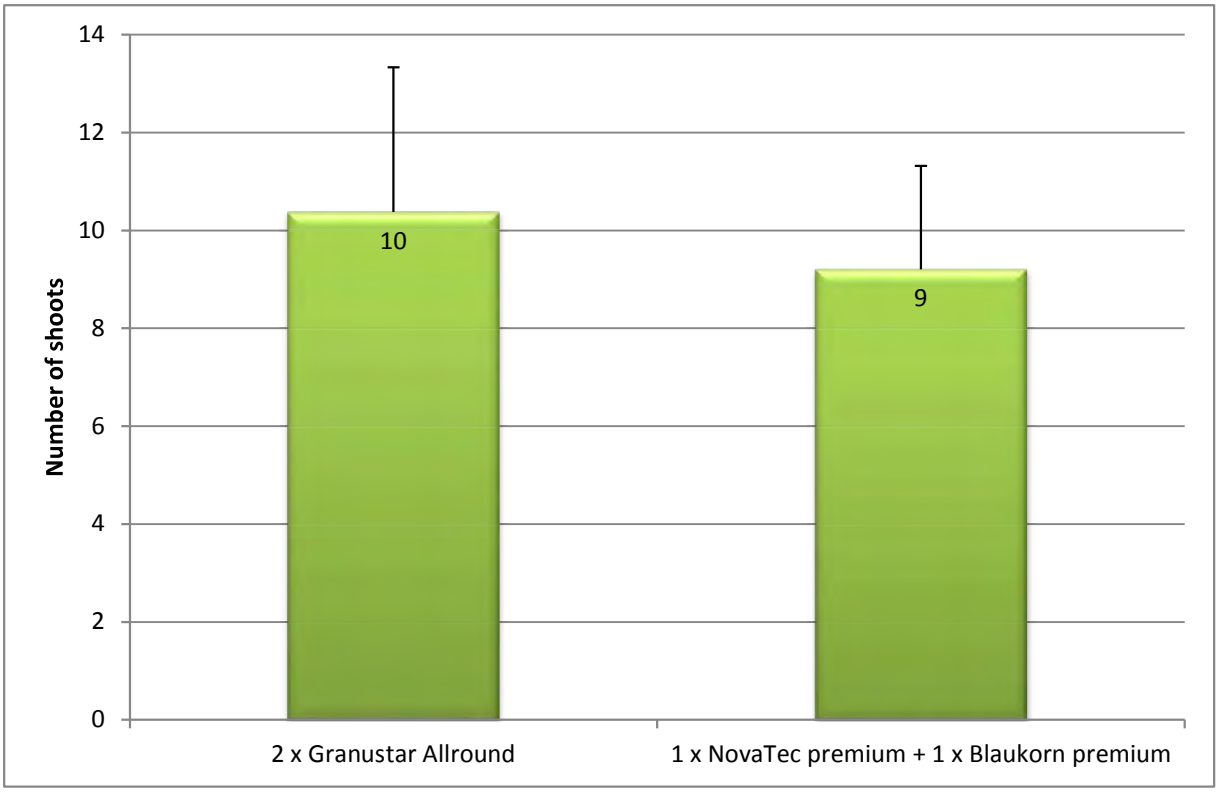


Fig. 11: Average number of shoots of *Prunus laurocerasus* 'Herbergii' in both treatments. Here too, the error bars show the standard deviation within the test variants.

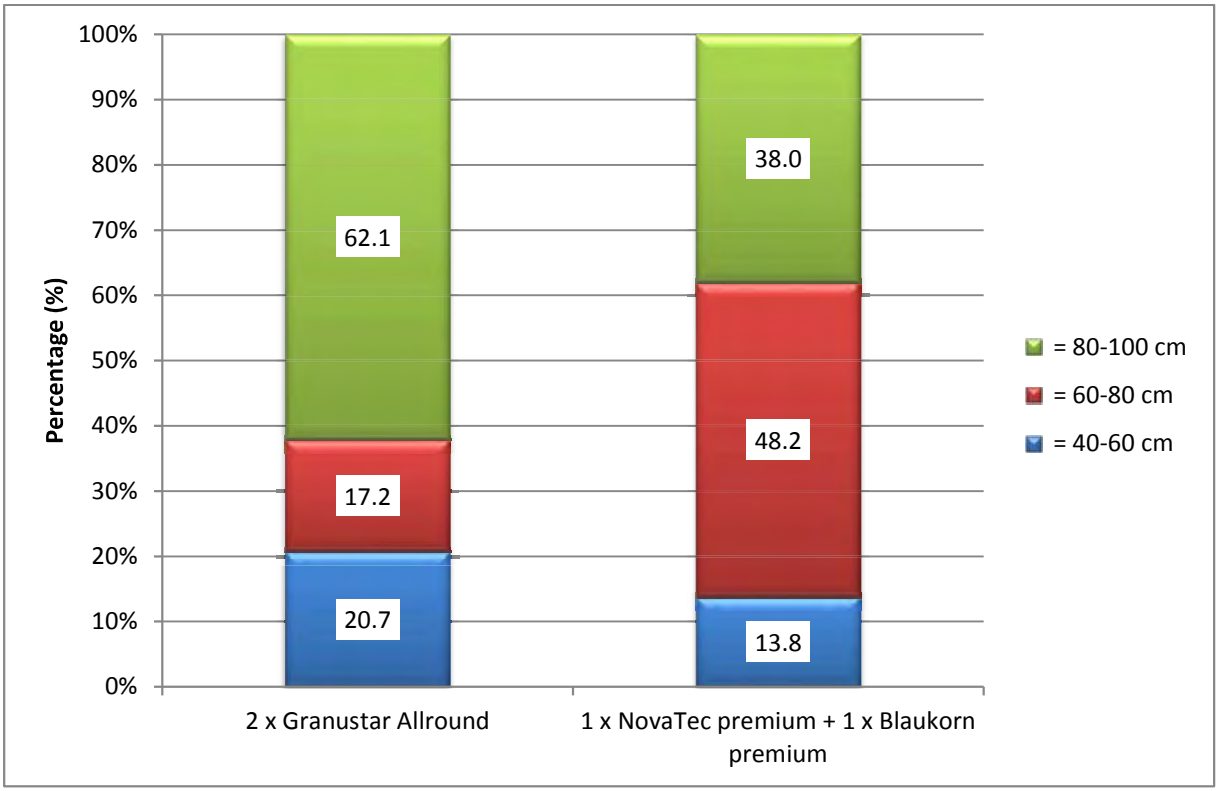


Fig. 12: Categorisation of the plants into sale categories

3. Results of N_{min} tests in autumn

On 21 October 2015, the nitrogen content of the soil was measured in the test areas (N_{min} tests). The samples were taken at soil depths of 0-30 cm, 30-60 cm and 60-90 cm. Figure 13 shows the nitrogen contents measured in the soil.

Contrary to expectations, a slightly higher nitrogen content was found in the upper soil in the NovaTec + Blaukorn treatment than in the Granustar treatment. In the Granustar treatment, however, more nitrogen was found at a depth of 30-60 cm. This indicates an overall very rapid breakdown and release of this fertiliser. The more rapid release of the nutrients benefited the cherry laurel plants in terms of their growth.

Only a small percentage of the nitrogen found was in the form of ammonium. The percentage of ammonium was slightly higher in the Granustar variant.

No advantage of the partially coated product in terms of low levels of nitrogen transfer was therefore able to be proven in this test.

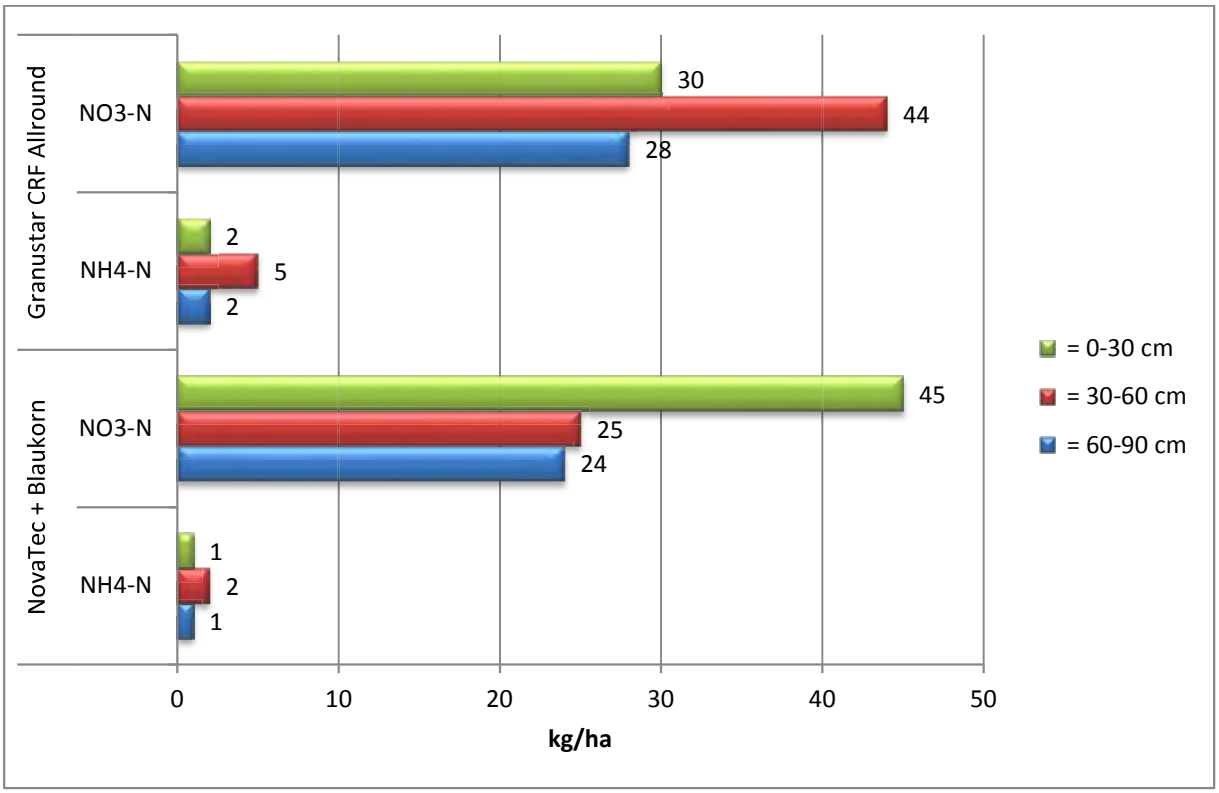


Fig. 13: NO_3^--N and NH_4^+-N contents (kg/ha) at different soil depths in both treatments on 21 October 2015

4. Summary

In the field experiment on cherry laurel plants, the partially coated product Granustar CRF Allround was compared with the standard fertilisation of NovaTec premium + Blaukorn premium. The fertilisation was divided over two applications, each of 50 kg/ha N. The first application was carried out on 27 April 2015 and the subsequent application on 6 July.

In terms of tree development, at the end of the experiment the plants fertilised with Granustar CRF Allround showed an advantage in terms of growth as they were an average of 10 cm taller and had an average of one shoot more per plant.

In the grade out into sale categories, there was a significant advantage for the plants in the Granustar variant. A total of 62% of the plants were sorted into the 80-100 cm category. In the standard treatment this total was just 38%.

The nitrogen testing in the autumn showed a nitrogen quantity of around 100 kg/ha N in the soil up to a depth of 90 cm for both treatments. In the standard treatment, the nitrogen quantity in the upper layer of the soil up to 30 cm deep was slightly higher than in the Granustar treatment.

In the Granustar treatment, the highest nitrogen quantities were found in the layer at a depth of 30-60 cm.

This experiment was therefore not able to demonstrate decreased transfer of nitrogen as a result of the use of a partially coated product.

Comparison of 8-9 month and 5-6 month controlled release fertilisers

(H. Averdieck, VuB and Dr A. Wrede, LKSH)

1. Introduction and objective of the experiment

Since an extensive comparison of controlled release fertilisers was last carried out in 2008 and 2009 in the horticultural centre in Ellerhoop as a joint venture between the Schleswig-Holstein Chamber of Agriculture (LKSH) and VuB, last year it was once again time to carry out a new comparison. The most significant reasons for this is that the range of available fertilisers on the market is constantly changing and also that more companies are offering new products. The aim of the large-scale experiment in Ellerhoop was therefore to examine all of the commercially available 8-9 month and 5-6 month controlled release fertilisers in various tree crops and to check corresponding prototypes which have not yet been introduced onto the market.

With the exception of the products which were still undergoing development, only fertilisers in original bags with the batch number printed on them bought in a retail environment (where this was possible with a reasonable level of effort) were accepted. Table 1 provides an overview of the standard 8-9 month products and Table 2 of the 5-6 month types used.

Tab. 1: The various 8-9 month controlled release fertilisers examined in the experiment

	Fertilisers	Formula	Manufacturer/seller
1	Osmocote Exact Standard 8-9M	15-09-11	ICL Specialty Fertilizers / Everris
2	Osmocote Exact Hi.End 8-9M	15-09-11	ICL Specialty Fertilizers / Everris
3	Osmocote Pro 8-9M	16-11-10	ICL Specialty Fertilizers / Everris
4	Nutricote T 140	15-09-10	Heinrich Harden / Planta Düngemittel
5	Nutricote T 100	15-09-10	Heinrich Harden / Planta Düngemittel
6	Plantacote Pluss 8M	14-09-15	Plantacote N.V.
7	Plantacote Depot 8M (+ Radigen 100 g/m^3)	18-06-12	Plantacote N.V
8	Basacote Plus 9M	16-08-12	Compo Expert
9	GrowCote CRF 8M (without trace elements)	18-06-12	Mivena B.V. / iNova Green GmbH
10	GrowCote Plus CRF 8M	15-06-11	Mivena B.V. / iNova Green GmbH
11	Ekote Ornamentals Plus 9M	15-08-14	Ekompany Agro B.V.
12	Multicote 8 Standard	15-07-15	Haifa Chemicals Ltd.
13	Multicote 8 High N	17-11-11	Haifa Chemicals Ltd.
14	Tardit 9M	17-09-10	Hauert Günther Düngerwerke

Tab. 2: The various 5-6 month controlled release fertilisers examined in the experiment

	Fertilisers	Formula	Manufacturer/seller
1	Osmocote Exact Standard 5-6M	15-09-12	ICL Specialty Fertilizers/Everris
2	Osmocote Exact Hi.End 5-6M	15-09-12	ICL Specialty Fertilizers/Everris
3	Osmocote Pro 5-6M	17-11-10	ICL Specialty Fertilizers/Everris
4	Nutricote T 70	15-09-10	H. Harden/Planta Düngemittel
5	Nutricote T 100	15-09-10	H. Harden/Planta Düngemittel
6	Plantacote Pluss 6M	14-09-15	Plantacote N.V.
7	Plantacote Depot 6M (+ Radigen 100 g/m^3)	19-06-12	Plantacote N.V

8	Basacote Plus 6M	16-08-12	Compo Expert
9	GrowCote CRF 6M (without trace elements)	19-06-12	Mivena B.V./iNova Green GmbH
10	GrowCote Plus CRF 6M	16-06-11	Mivena B.V./iNova Green GmbH
11	Ekote Ornamentals Plus 6M	15-09-14	Ekompany Agro B.V.
12	Multicote 6 Standard	15-07-15	Haifa Chemicals Ltd.
13	Multicote 6 High N	17-11-11	Haifa Chemicals Ltd.
14	Hortobalance 7M	15-07-10	Hauert Günther Düngerwerke

In addition to the standard products mentioned in Tables 1 and 2, eight prototypes from three companies which will remain nameless were also tested.

For the 8-9 month products, one year old rooted hardwood cuttings of *Weigela* hybr. ‘Bristol Ruby‘ and *Prunus laurocerasus* ‘Novita‘ in Tb 9 were used as test subjects and were potted into 3 l containers (Tab. 3). The fertiliser application rate for the bare-rooted weigela was 4 g per litre of container volume (point fertilisation), for the cherry laurels it was 5 g per litre of substrate, The plants were potted on 31 March 2015.

Fig 1: Freshly potted cherry laurels and weigela at the start of the experiment in late March

Tab. 3: Plant subjects, forms of application, application rate and potting date (8-9 months)

Early potting date late March (31 March 2015) (Duration of the fertilisers: 8-9 months)	
Test plants	**Application rate**
Weigela ’Bristol Ruby’ (one year old rooted hardwood cuttings potted in a 3 l container)	Point fertilisation 4.0 g/l (container volumes)
Prunus laurocerasus ’Novita’ (Tb 9 potted in a 3 l container)	Mixed 5.0 g/l substrate

Most of the products in the 5-6 month trial corresponded to those of the early potting date, but in this case a shorter duration product was used. Nutricote T100 was included in both the 8-9 month and 5-6 month trials, as from experience the release period is often somewhere between the two durations. Instead of Nutricote T140, Nutricote T70 was used, which from experience is a slightly faster 5-6 month type. The Tardit 9M was replaced by Hortobalance 7M in the later potting. This product only contains a 50% coated Tardit type fertiliser; the remaining 50% is made up of the uncoated, organic long-term fertiliser Neofert. One year old rooted cuttings of *Thuja occidentalis* ‘Smaragd‘ were used as test subjects for the 5-6 month type fertilisers and were potted into two-litre containers and two-year old rooted cuttings of *Ligustrum ovalifolium* ‘Aureum‘ in the Tb 9, which were potted into three-litre containers (Tab. 4). In the case of both crops, the fertilisers were mixed with 4.5 g per litre substrate.

Radigen (slow release micro-nutrient fertiliser) was mixed in with the Plantacote Depot 6M and 8M, which do not contain trace nutrients. No trace element fertilisers were added to the remaining products. There was a misunderstanding with the manufacturer of GrowCote CRF 6M and 8M. It subsequently transpired that these products also do not contain any trace nutrients and therefore should also have received the additional administration of Radigen, this did not occur as a result of the information received at the start of the experiment.

Tab. 4: Plant subjects, forms of application, application rate and potting date (5-6 months)

Later potting date early May (4 May 2015) (Duration of the fertilisers: 5-6M)	
Test plants	**Application rate**
Thuja occidentalis ’Smaragd’ (one year old rooted hardwood cuttings potted in a 2 l container)	Mixed 4.5 g/l substrate
Ligustrum ovalifolium ’Aureum’ (Tb 9 potted in a 3 l container)	

Immediately after potting, the plants were set up in a randomised block design on a container bed area of the horticultural centre with irrigation.

The experiment was assessed at the end of the growing season in late October to early November. The assessment of the test plants was carried out in accordance with the quality assessments of the FLL (2004)[1], which determine the maximum growth height, the fresh weight of the shoot, the number of shoots and in the case of the *Thuja* the diameter of the shoots.

[1] FLL (2004): Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V.. (eds.) Quality assessments of nursery plants, 2004 edition

Fig. 2: View of the trial with *Thuja occidentalis* ‘Smaragd‘ and *Ligustrum ovalifolium* ‘Aureum‘ on 29 June 2015, around two months after the potting date

2. Results with the 8-9 month products

The results of the experiment were significantly influenced by the weather, especially since the release pattern of the controlled release fertilisers in a damp substrate is almost exclusively dependent on the substrate temperature and increases as this increases. In comparison to the 30-year average, the growing season in 2015 was characterised by higher temperatures, generally encouraging the release of nutrients from the fertilisers. In comparison with 2014, however, it is evident that the temperatures in 2015 were significantly lower (see the data from the Thiensen weather station on pages 87-88).

Since the temperatures were relatively cool in comparison, particularly in the months of September and October, the late summer and early autumn growth of the test plants was relatively weak, particularly in the case of the cherry laurels. As a result of this, those fertilisers which still had relatively high nutrient reserves at this point had provided little nutrition due to the prevailing temperatures. The early summer was also characterised by very long, cool phases, so the growth of the test plants only really started from mid-June.

In the experiment, the cherry laurels achieved a saleable quality in response to almost all of the fertiliser treatments by the end of the growing season. However, there were significant differences in terms of leaf colour. Considerable differences were also noted between the fertiliser treatments in terms of the fresh weight of the shoots achieved, the maximum shoot length and the number of shoots, and this also had effect on the grade out of the test plants into quality and sale categories (Fig. 3).

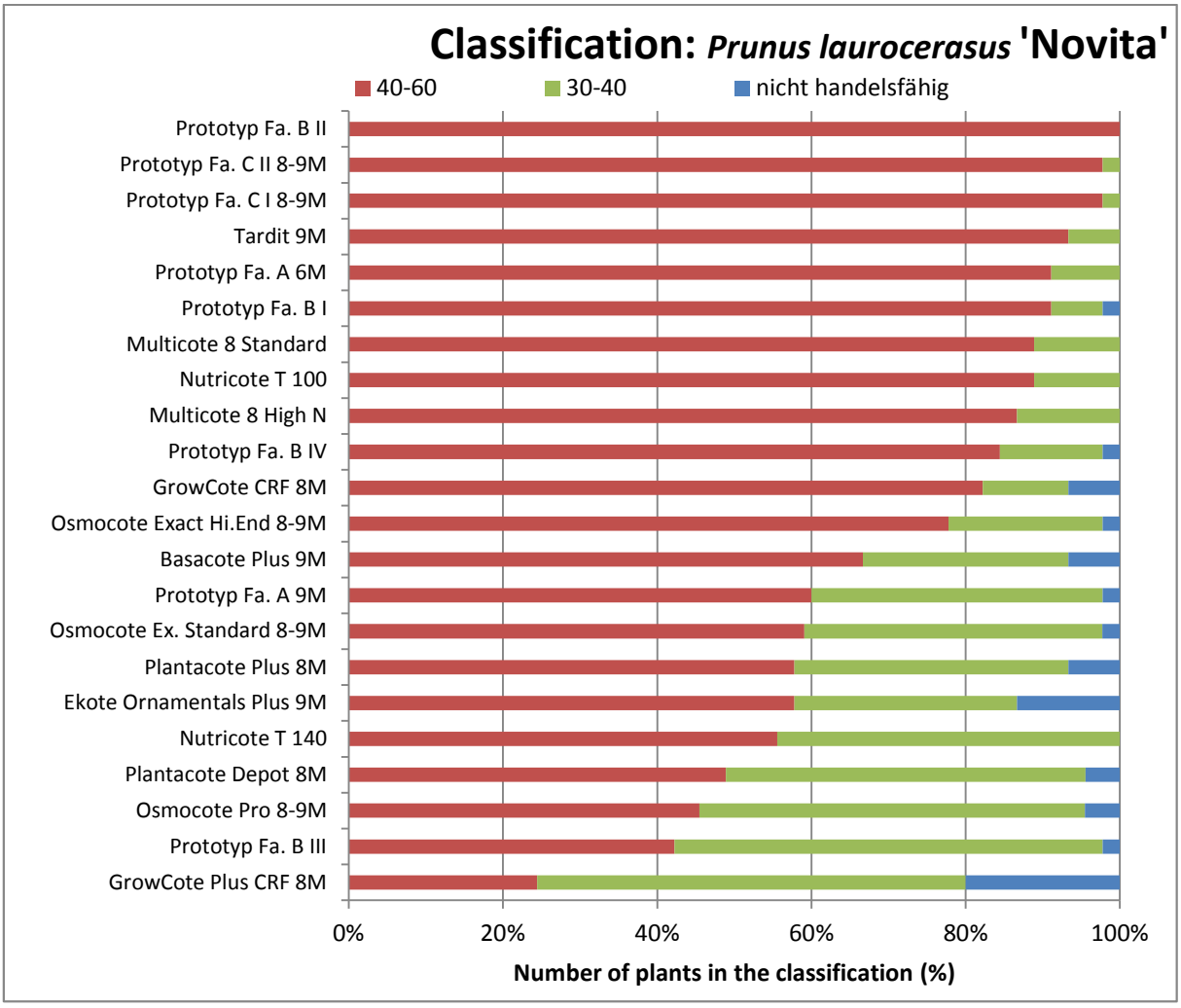


Fig. 3: Size classification of *Prunus laurocerasus* 'Novita' according to FLL by fertiliser treatment

The four prototype products were among the five best fertilisers in this experiment. Of the products which are currently available, only Tardit 9M was in this top five.

In the case of weigela, too, differences occurred between the fertiliser treatments in terms of the shoot height, the fresh weight of the shoot and the number of shoots, although these were not as pronounced as in the cherry laurels. None of the prototypes were among the top five products in the evaluation. In terms of the standard fertilisers Multicote 8 High N, Multicote 8 Standard, Ekote Ornamentals Plus 8M, Nutricote T 100, Tardit 9M and Osmocote Exact Hi.End 8-9M, the percentage of plants at grade out in the 60-100 cm category was 80% or over, with only four products coming in under 70% (Fig. 4).

What was noticeable in the bare-rooted potted weigelas was the large number of plants which failed shortly after the start of treatment. This was attributed to salt damage to the roots as a result of the point application of the fertiliser, although a layer of substrate had separated the roots and the fertiliser.

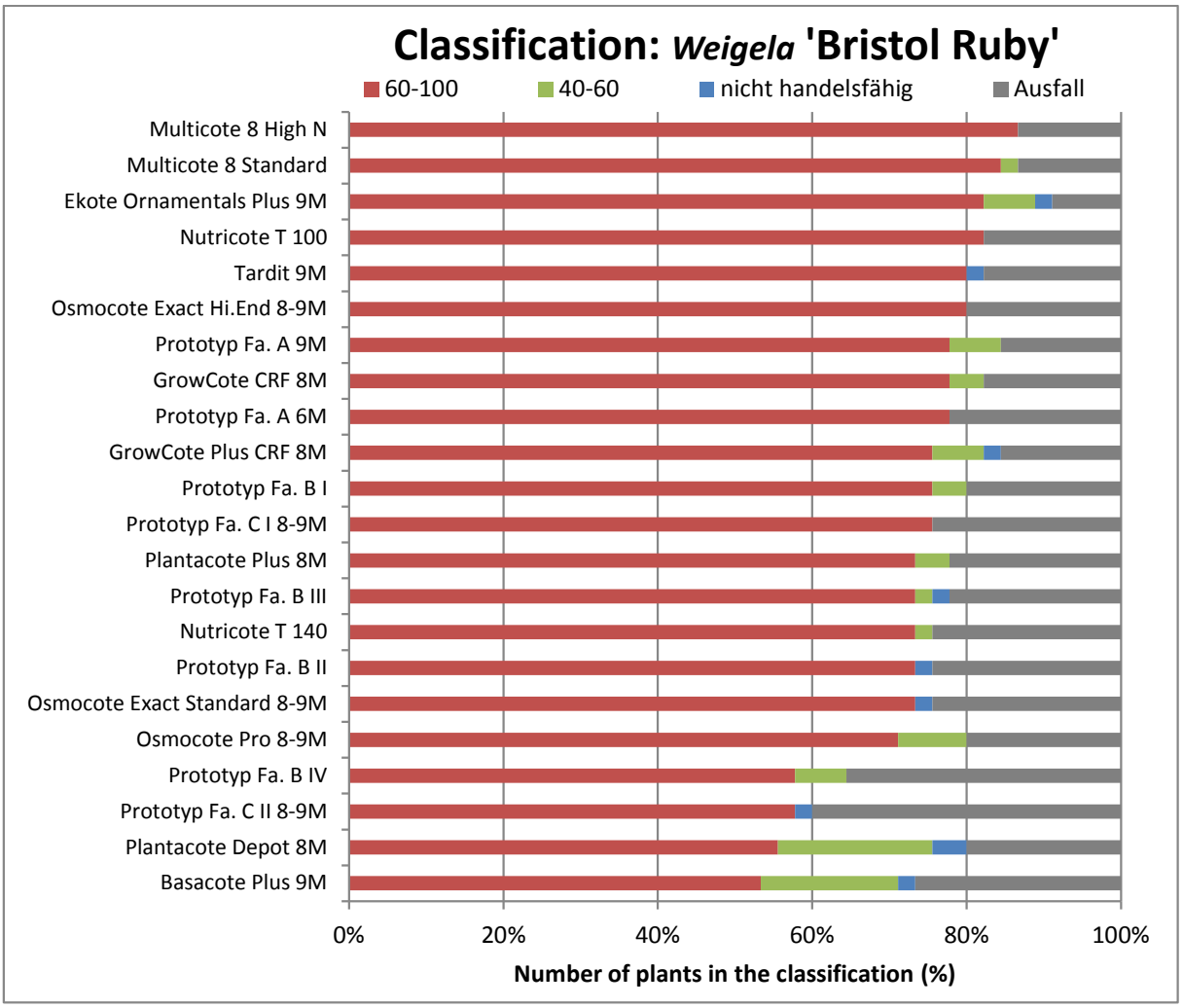


Fig 4: Size classification of *Weigela hybr.* 'Bristol Ruby' according to FLL by fertiliser treatment

Fig. 5: View of the *Weigela* 'Bristol Ruby' trial beds at the end of the experiment

3. Results with the 5-6 month products

As a result of the significantly cooler months of September and October compared to the previous year, the growth of the *Thuja* plants, which normally extends into late autumn,

slowed prematurely and products with slower release and nutrient reserves were not able to provide the levels of nutrition until the end of the growing season. Nevertheless, significant differences in growth developed between the treatments. Significantly better grade out results were achieved with the products Osmocote Exact Standard 5-6M and Osmocote Exact Hi.End 5-6M (Fig. 6).

The percentage of plants in the 30-40 cm grade out category was 60% and 47% respectively for these two products, but for the other available products it was less than 35%. Three of the prototypes tested also showed very good results and were comparable to the market leader ICL-Specialty Fertilizers/Everris. Other than the prototypes, the products GrowCote CRF 6M, Basacote Plus 6M and Nutricote T100 also performed reasonably well.

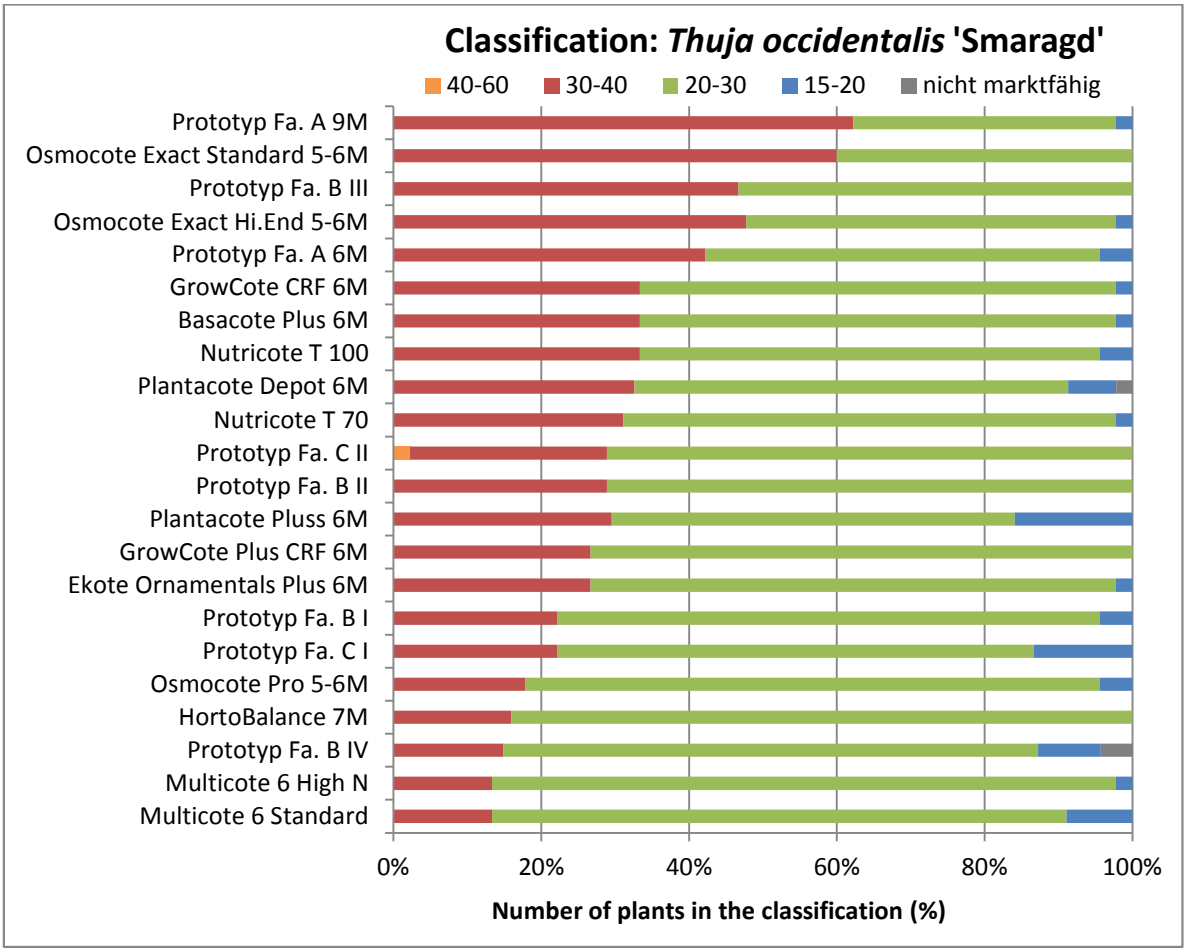


Fig. 6: Size classification of *Weigela hybr.* 'Bristol Ruby' according to FLL by fertiliser treatment

The difference between the two types of Nutricote (T70 and T100) was minimal. This result is consistent with previous test results and practical observations. The release behaviour of both types only differs slightly. The Hortobalance 7M with only 50% coated fertiliser performed poorly in the experiment. The conversion of the organic part probably occurred too

quickly and the coated part was not sufficiently able to cover the requirement over the course of the summer. The release curve determined in the laboratory for this fertiliser also indicates this.

The *Thuja* plants in the GrowCote CRF 6M treatment which were accidentally not supplied with trace nutrients nevertheless managed to achieve a reasonable grade out, which is evidence of the low sensitivity of this species to periodic nutrient deficiency.

Fig. 7: View of the trial beds containing Thuja on 29 October 2015

There were significant differences in growth by the end of growing season with the golden privet. Very good grade out results with over 80% plants in the 40-60 cm category were achieved with Osmocote Pro 5-6M and Nutricote T100. The same was true of GrowCote Plus CRF 6M and two prototype products (Fig. 9).

The fact that privet plants have a high requirement for trace nutrients was demonstrated by the performance of the plants treated with GrowCote CRF 6M, which was accidentally used without additional trace elements. The plants remained small and with thin shoots, and they lost their leaves prematurely (Fig. 10 and 11).

The differences in growth between Nutricote T70 and T100 were also small in the test plants, with slight advantages achieved by the somewhat slower T100 type. Hortobalance 7M showed a similarly poor result as seen with the *Thuja*, the duration of nutrient release was too short for a sufficient supply to be achieved.

Fig. 8: Trial beds containing *Ligustrum ovalifolium* ‘Aureum‘ on 1 October 2015

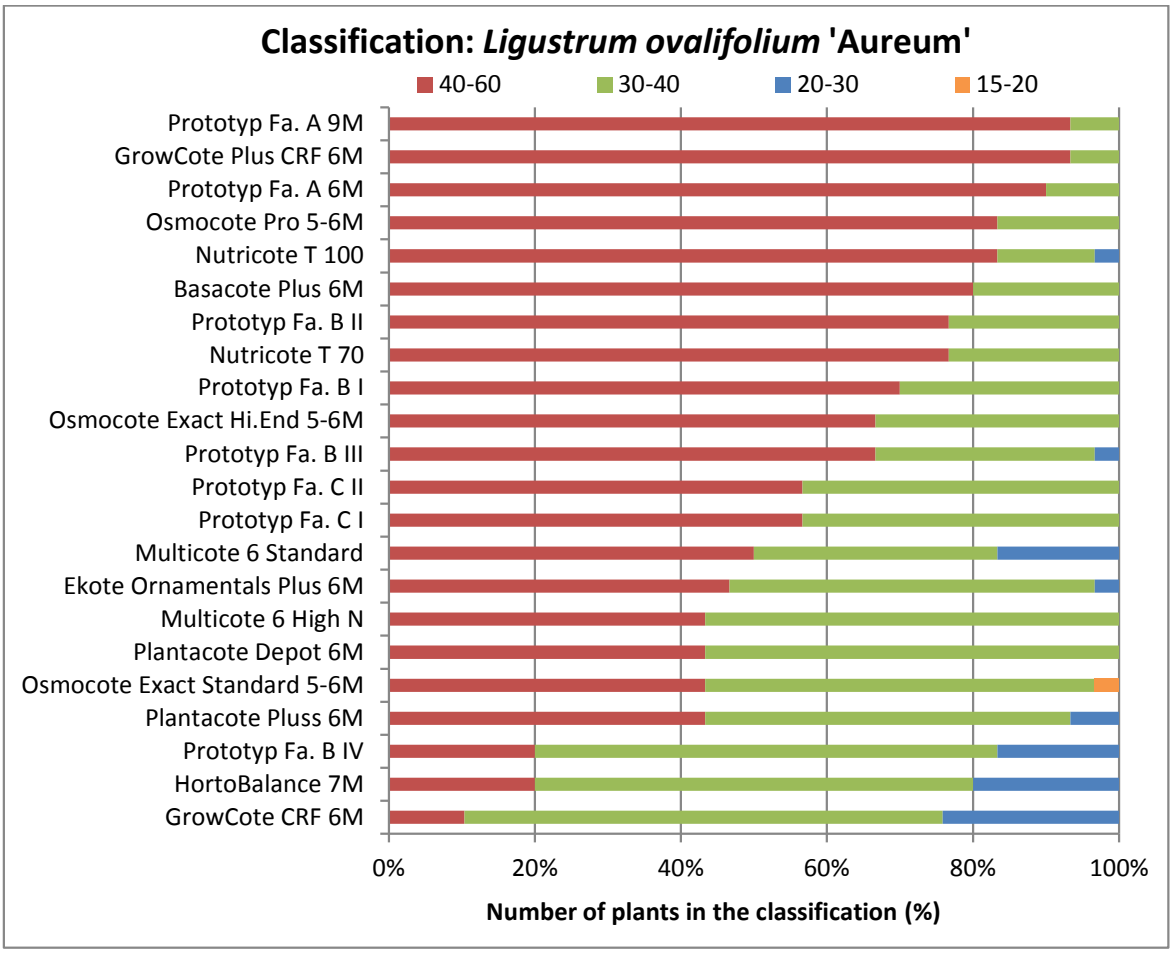


Fig. 9: Size classification of *Ligustrum ovalifolium* ‘Aureum‘ according to FLL by fertiliser treatment

Figs. 10 and 11: Very good growth result with GrowCote Plus CRF 6M with trace nutrients (left) and poorest in the test with GrowCote CRF 6M without trace nutrients

4. Summary

Container-grown crops react in very different ways to different controlled release fertilisers. The release pattern of the product (rapid initial phase, uniformity of the release during the growing season, nutrient reserves in late summer) and the supply of trace nutrients play a significant role. In addition to the product-related release pattern of the fertiliser, the release pattern is also significantly dependent on the weather conditions, which are different every year. Finding and using the optimal fertiliser for every crop would be desirable, but is not practicable.

Ensuring that the overall package is balanced is recommended. Products which are reliably good for a wide range of crops over a number of years and achieve consistent results without significant outliers and therefore offer a high level of crop certainty even when weather conditions change should be selected. What is important in this case is ensuring that good advice is obtained from skilled and reliable sales consultants, and that there is a rapid reaction if any complaints do occur.

Protection against late frosts with wind machines

Helmut Schwarz (Pinneberg) and Dr Heinrich Lösing

Everyone in the industry, from forest nursery workers to Christmas tree growers, fears the late frosts which can cause significant damage in late April to early May in actively growing tree populations. In the worst case, one night of frost can lead to the loss of entire areas. As climate change increases leading to the crops breaking dormancy earlier, the risk of late frost damage also increases. It is therefore necessary to be on the lookout for options which can help to counteract the phenomenon of “late frost” effectively.

The risk of damage to tree crops occurs as a result of what is known as inversion. If very cold air at temperatures of below zero accumulates at ground level as a result of there being almost no wind, warmer layers of air can then accumulate above this. The lack of mixing of these layers of air can cause extensive damage to the trees, particularly with any new shoots on the plants which are in the layer of cold air near to the ground.

Active participation in the demonstration of the device in the Diercks nursery in Pinneberg

Frost protection irrigation is the means of choice in this case. Temperatures of up to minus eight degrees Celsius can be successfully counteracted if it is possible to use the heat of crystallisation which is released as ice is formed. There is a water requirement of at least 35 cubic metres per hour per hectare for this, which has to be distributed evenly and finely, by means of irrigation systems installed in advance and designed for this purpose, over a period of several hours until the complete melting of the forming ice is achieved. However, since frost protection irrigation cannot be installed in every location in which forest plants,

Christmas trees and even fruit trees are grown, it is necessary to look for alternative treatments.

For almost half a century, wind machines have been used in the USA and New Zealand in particular with the aim of mixing the layers of air near to the ground which are at different temperatures such that the air temperature (wet bulb temperature) measured on the ground is increased to above zero degrees. From experience, in the case of adverse weather conditions this is possible through intensive vortex formation, so less effort is needed to protect crops in lowlands than in mountainous locations where this method is used. Due to a lack of draining options for the cold air, cold layers can form so the cold air exceeds the normal layer thickness of just a few metres. In these cases too, successful mixing of the layers of air is also possible with the wind machine presented. Depending on the location and the use, additional planning and where applicable machine expenditure may be necessary.

Experience with wind machines in Germany is still low as the use of systems of this type was previously and still is associated with high administrative costs and planning permission to set up stationary, fixed systems. A mobile wind system is now available for the first time on the German and European markets that supplements the range of stationary wind machines that are available. This was why Versuchs- und Beratungsring e.V. Schleswig-Holstein organised a machine show. A good 50 growers from Northern Germany took up the invitation to Diercks forest nursery in Pinneberg to learn about frost protection using a mobile wind machine in mid-February at temperatures close to winter conditions.

The “Tow and Blow” wind machine, which was developed and constructed in New Zealand and is sold exclusively in Europe as an agricultural tool by Schillinger Beregnungsanlagen GmbH, Ihringen, Kaiserstuhl. The device, which is certified from a safety perspective for operation in Germany (CE certified) sets itself apart through the following basic parameters:

- No additional planning permission or operating licences are needed for operation.
- The wind machine presented has been used around the world for a good six years and its construction is constantly being optimised.
- The space requirement for the system to be stationed in or at the edge of a cultivated area is 4 x 8 metres.
- The maximum area protected with one device is a good four hectares, and the rotation and wind speed are variable.
- The rotor and the airflow are constructed to ensure a high degree of efficacy of the airflow. The angle of the blower head can be adjusted.

- The rotor is driven directly by a 23 HP industrial engine which uses approximately 6 litres of benzine per hour; a 60 litre tank provides a continuous usage time of up to 10 hours; the noise levels are a maximum of 45 db at a distance of 300 m.
- The 7.5 m high (hub height), hydraulically extendible carrier arm can be rotated around 360 degrees; a full revolution should not take more than five minutes and partial revolutions can be set.
- The wind machine can be set up and made operational by one person in approximately 15 minutes. All of the functions are operated from a central control tool; temperature-controlled automatic initiation of the wind machine is an option. Starting the machine at a wet bulb temperature of plus one degree Celsius is recommended; this also leads to an early reduction in air humidity.
- The necessary investment for the wind machine presented in Pinneberg is currently estimated at EUR 31,500.00 plus VAT.

Propeller including the engine is 7.5 m (hub height)

Simple transportation of the device on a vehicle trailer

In addition to the technical data, additional information on the use of the machine was also provided by Jochen Kiss, an employee at the company responsible for the wind systems, Schilling. There is no “standard recipe” for successful use as every late frost is characterised by different parameters which need to be taken into account when protecting against frost. The maximum degree of efficacy of the wind system can only be achieved if the inversion is stable and the wind drift is less than two metres per second (testing with a smoke candle is recommended). The examples are used to show that depending on the situation in question it is necessary to determine several locations and settings for the wind machine for an area before use, and these can then be used depending on the weather conditions. The flexibility and mobility of the device then forms the basis of possible optimisation of the frost protection use.

The discussions between the growers present which took place at the end of the machine presentation showed that examining alternative methods to frost protection irrigation is generally seen as sensible. In comparison to the possible damage which can occur as a result of a lack of sufficient late frost protection, thinking about additional investment is sensible, especially since this can ensure additional flexibility within the company in terms of the frost protection measures to be carried out for tree crops which are at risk.

Study tour to Southern Germany, greater Stuttgart area

Dr Heinrich Lösing

From 25 to 28 August 2015, 30 colleagues made use of the opportunity to learn about the latest developments in nurseries and retail nurseries in the greater Stuttgart area. A total of ten companies were visited.

Darmstädter Forstbaumschulen, www.forstbaumschule.com

The nursery was founded in 1946 and now covers a production area of 34 hectares, 4 ha of which are seed beds. There are around ten permanent employees and 15 seasonal employees. The focus of production is forest plants, including *Fagus, Quercus, Picea abies, Abies alba* and *A. nordmanniana* species from ecological production.

Transplanted beds of *Picea abies*

Seed beds of *Fagus sylvatica*

Baumschule Huben GbR, www.huben.de

The company has continued to develop since the nursery was founded in 1905. It currently has 70 ha used as a nursery and a further 20 ha which are used for agriculture. The majority of the areas are in the water protection area. The company has 78 employees.

What was originally a fruit tree nursery has now become a nursery with a wide variety of open field and container production. Rare woody species are also grown here, as is standard species for the town.

The affiliated garden centre with a café, display garden and training and events rooms entice many customers. A particularly high value is placed on providing technical advice to customers. Eleven horticultural engineers are employed.


Andreas and Julian Huben


View of the display beds

Häusserman Stauden and Gehölze GbR, www.haeussermann.com

The company currently has 14 ha of shrubs and 30 ha of nursery, primarily open field. It has a garden centre attached. Around 100 people are currently employed by the company, half of whom are seasonal employees and ten of whom work in the office. The compant markets into the specialist trade. The company has six of its own vehicles for delivery.

With around 1500 plant species and varieties, the company has a wide range of shrubs, the majority of which they have bred themselves. Finished products are available in 9 cm and 11 cm pots or in 2 l and 3 l containers.


Martin Häussermann talks about his company


View of the shrub production, irrigation is via irrigation trucks

Helix Pflanzen GmbH, www.helix-pflanzen.de

To get us in the mood, Mr Müller presents the “Green Room” project in Ludwigsburg. The plan is to install vertical elements to optimise the maximum green areas in the city through a collaboration between Helix Pflanzen and scientists from the Institute of Landscape Planning and Ecology at the University of Stuttgart.

Plant production at Helix Pflanzen currently covers around 18 ha in the open field and 7 ha under glass in the Schwerte, Leipzig, Rain am Lech and Kornwestheim locations. Twenty-five people are employed by the company, with an additional 150 seasonal assistants. The main areas of plant production are ground cover trees and shrubs, ivy, lavender, erica gracilis and calluna (Garden Girls).


Presentation of the “Green Room” project


Hans Müller, Director, Helix Pflanzen

Frank Stingel Forstbaumschulen, www.forstbaumschule-stingel.de

The nursery was founded in 1958 by the father in Burgfelden and now consists of three parts (Walbertsweiler, Schwalldorf and Burgfelden) with a nursery production area of approximately 100 ha at heights of between 470 and 920 m above sea level.


Summer transplanting of *Picea abies* with three planting machines


Frank Stingel (left) talks about his nursery

The nursery has eight permanent employees and also employs seasonal workers. The focal point of the production is spruce, silver fir and pine in terms of conifers and oak, beech, sycamore and Norway maple in terms of deciduous trees. All deciduous trees are sown on site. The company's own employees gather the seeds. For the conifers, the young plants are purchased in Northern Germany.

The field of forestry services has increased significantly in the past few years, and this is essential good plant establishment post planting. According to Frank Stingel, the people who own the woods not only want the plants but also want the planting and care of service providers to be carried out for them.

Karl Schlegel KG, www.karl-schlegel.de

The nursery currently consists of around 130 ha including a subsidiary to cultivate seedlings in Elsendorf (near to Regensburg). A garden centre and an online plant shipping service are also attached (www.gartencenter-shop24.de). The company has around 100 employees. Following the sudden death of the owner, Roland Schlegel, the company was managed by the directors, Gerold Gulde and Andreas Hubl.

The nursery focuses on the production of a wide range of forest plants, shrubs and avenue trees up to 4 x v. Particular attention is paid to the cultivation of species which are native to the area.

Avenue trees, organised by region of origin

View of the company premises

Anton Wohlhüter, www.garten-land.de

The nursery was founded in 1950 and currently comprises an area of 10 ha of field production and around 5,000 square metres of polythene structures with a mobile roof known as a Cravo house. This type of polythene structure has not been commonly used in Germany to date (see photo). The company has 40 employees. Roses are a particular speciality in cultivation and marketing. The nursery is able to offer 220 varieties that it has produced itself. *Rosa laxa* is used as a root stock. Fruit trees and larger hedge plants are also offered by the company.

Fifty percent of the sales are through the company's garden centre with a covered area of 3,500 square metres. The information on the garden centre sales was also impressive. The percentage of sales was given as 50% bedding, and balcony plants as 15% and the integrated café as 5% of the total sales. Regular "open days" and the sending of advertisements to the surrounding area ensure good customer frequency. The garden centre is a member of Sagaflor (www.sagaflor.de)

Cravo growing house with a mobile roof, www.cravo.com

Various example gardens act as an attraction for private customers

Schwäb. Baumschulen Gottlieb Haage, www.haage.de

For over 100 years, a wide range of conifers and deciduous trees have been cultivated on over 100 ha at the Leipheim location and since 1953 at the subsidiary in Westerringen. There are around 45 employees, and the company employs a further 15-20 seasonal staff. Sales are primarily to forest owners and those in the garden and landscape sector. There is also a garden centre.

The locations are between 450 and 600 m above sea level. Between 600 and 750 mm of precipitation are expected in average years. However, 2015 was characterised by persistent dryness. According to Hermann Haage, extreme weather conditions have increased significantly. Heavy precipitation alternates with persistent dry periods. Hail is also very much on the increase. In order to decrease the risk, the cultivation areas are as widely spread as possible in the surrounding area.

The nursery is also the location for the specialist trade fair “Hortiregio”. It takes place every two years, and with 160 exhibitors and 1,200 visitors it is the trade far for nursery plants and technology in the south.

Cultivation areas of wild shrubs with trees typical of the region

Hermann Haage, owner of the nursery

Christioph Ulmer, www.ulmer-baumschulen.de

The nursery covers around 30 ha, distributed over 95 plots of land over an area of 12 km. As a result of early estate division, the individual plots of land are still divided among the siblings. This resulted in many small and even tiny plots of land, some of which are only 1,000 square metres in size. Nevertheless, the adaption of land for nursery production is extremely difficult.

The nursery has developed from a classic fruit tree nursery to one covering the full range. “We used to grow 80,000 fruit trees, then 30,000 and now 10,000, but in many special varieties”. There are currently 100 varieties of apple tree.

No expansion of production is currently planned. Sales to private customers currently accounts for 20% of production, and there is a plan to increase this through a garden planning service. Further groups of customers include gala construction, towns and communities, resellers and the regional exchange.


View of the high-trunk apple trees as 3 x v


Final sale area with large containers

HofGut Sirnau, owner Walter Bräuninger, www.hofgut-sirnau.de

Hofgut Sirnau was leased from the city of Esslingen in 1928 as an agricultural operation. For 35 years, the historical environment has helped with the sale of plants of all kinds, growing media, fertilisers and plant pots for demanding customers. A total of 3,500 square metres are available as a sales area, and a further 3,000 as an inventory area. The company has 12 employees.

The owner says “service and quality have to be the first priority”. The sale of the plants is a particular problem. According to the owner, the quality he needs is mostly not available in nurseries. This is why he always works closely with his suppliers.

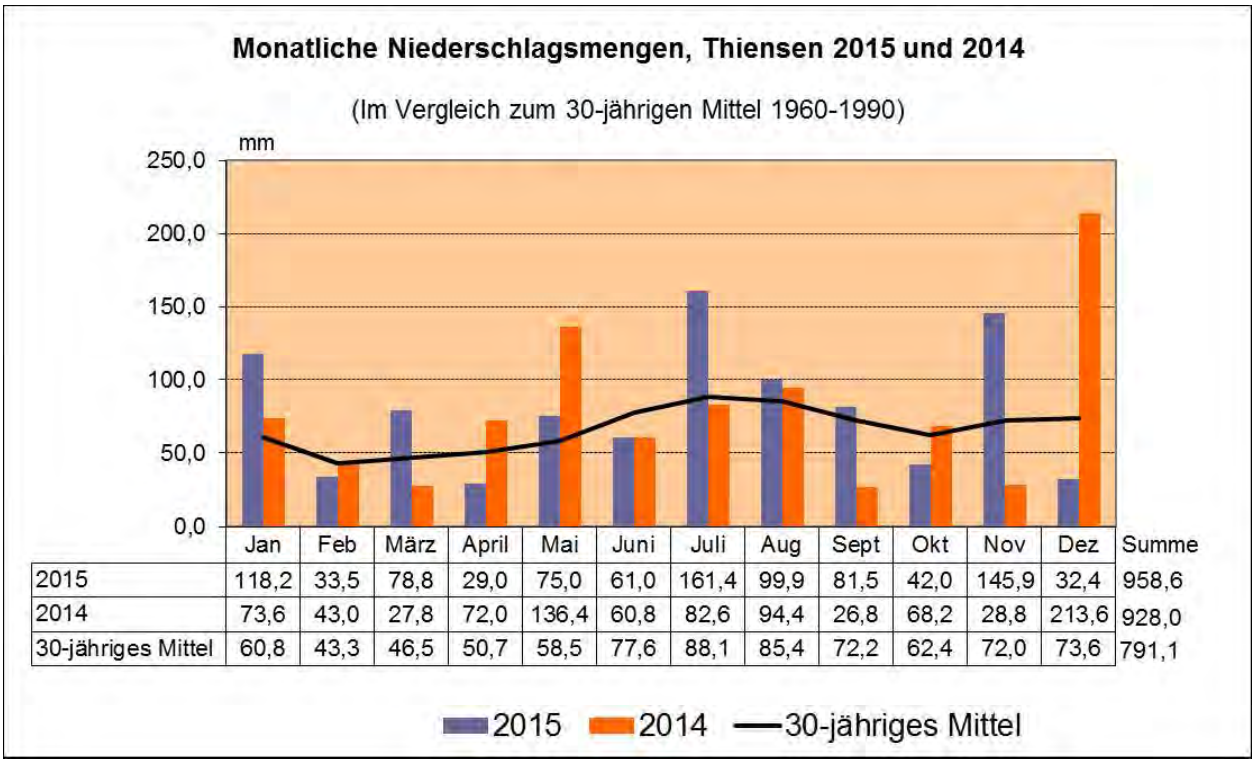
View of the historical environment

Owner of Hof Gut Sirnau, Walter Bräuninger

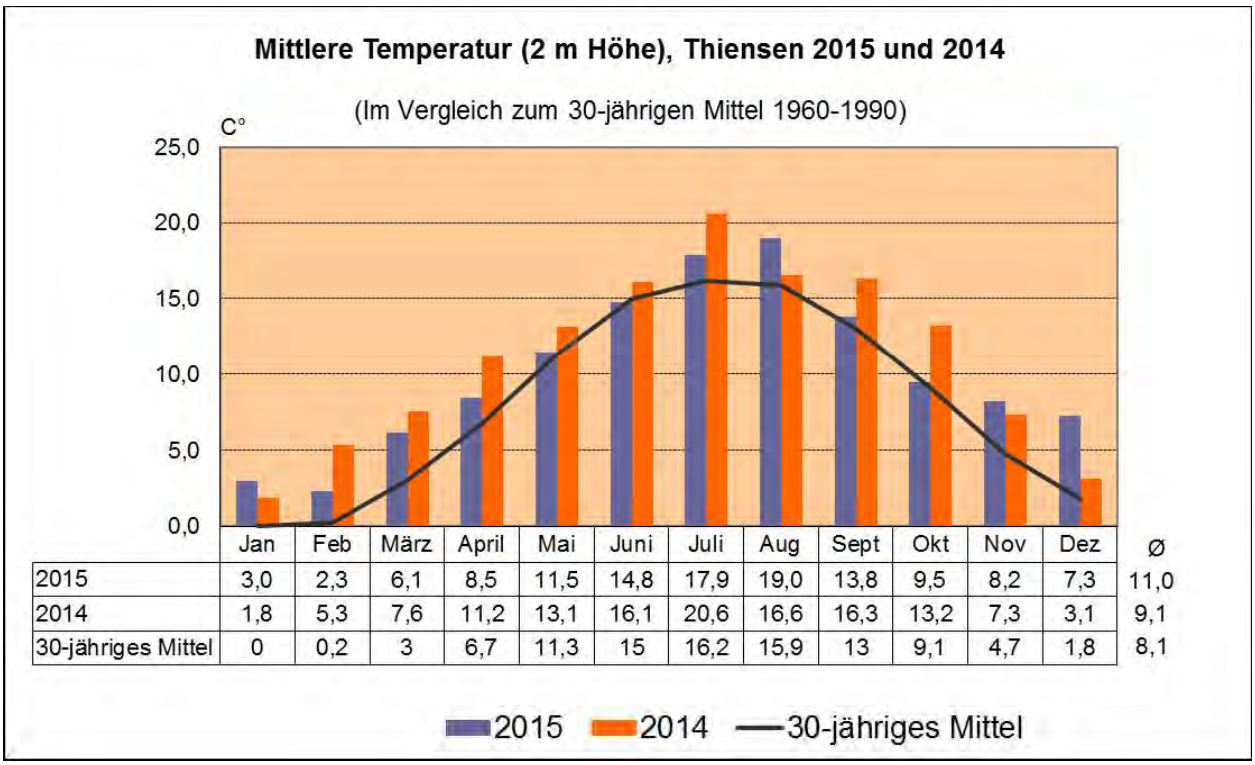
Group photo of the participants on the study trip to Southern Germany at H. Haage in Leipheim

Data from the weather station in Thiensen

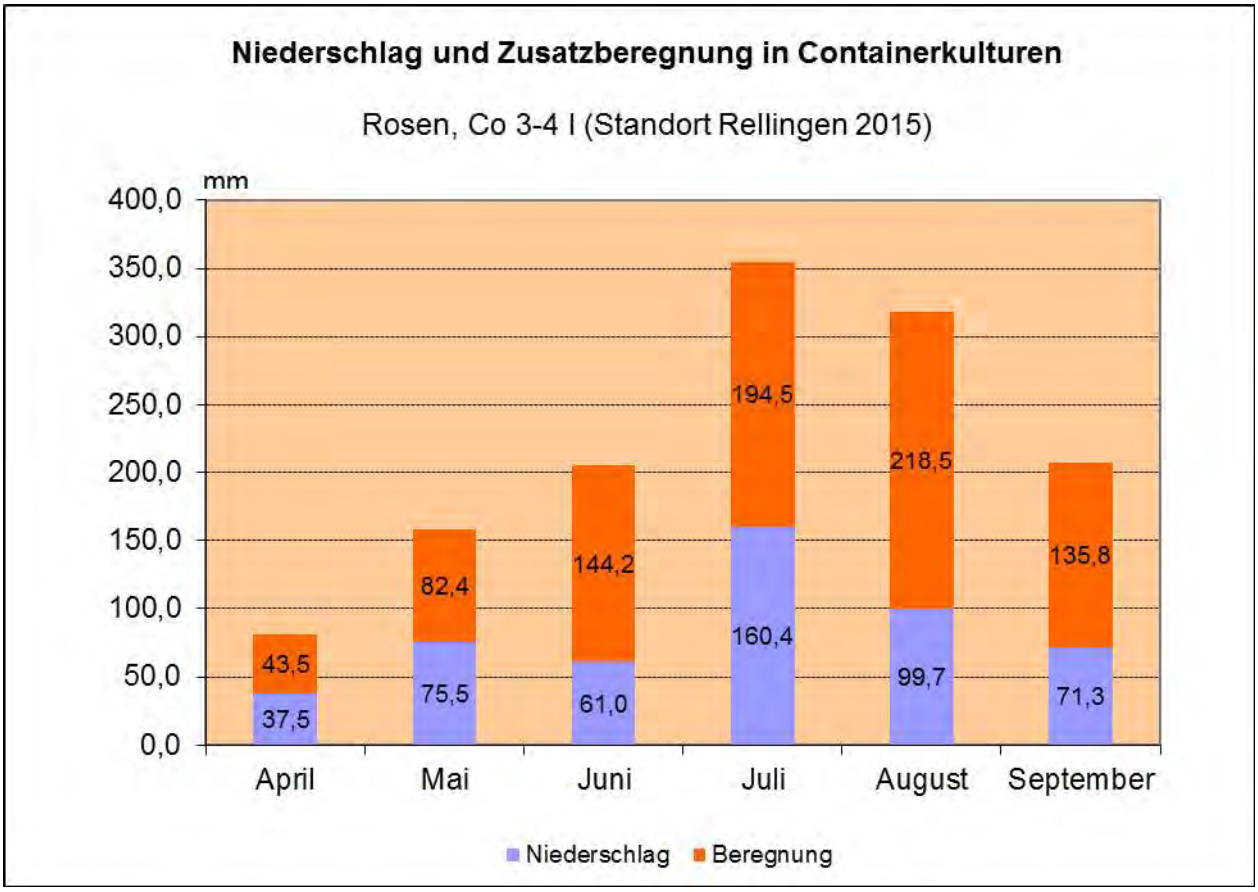
Comparison of the years 2014 and 2015 with the 30-year average (1960 – 1990)

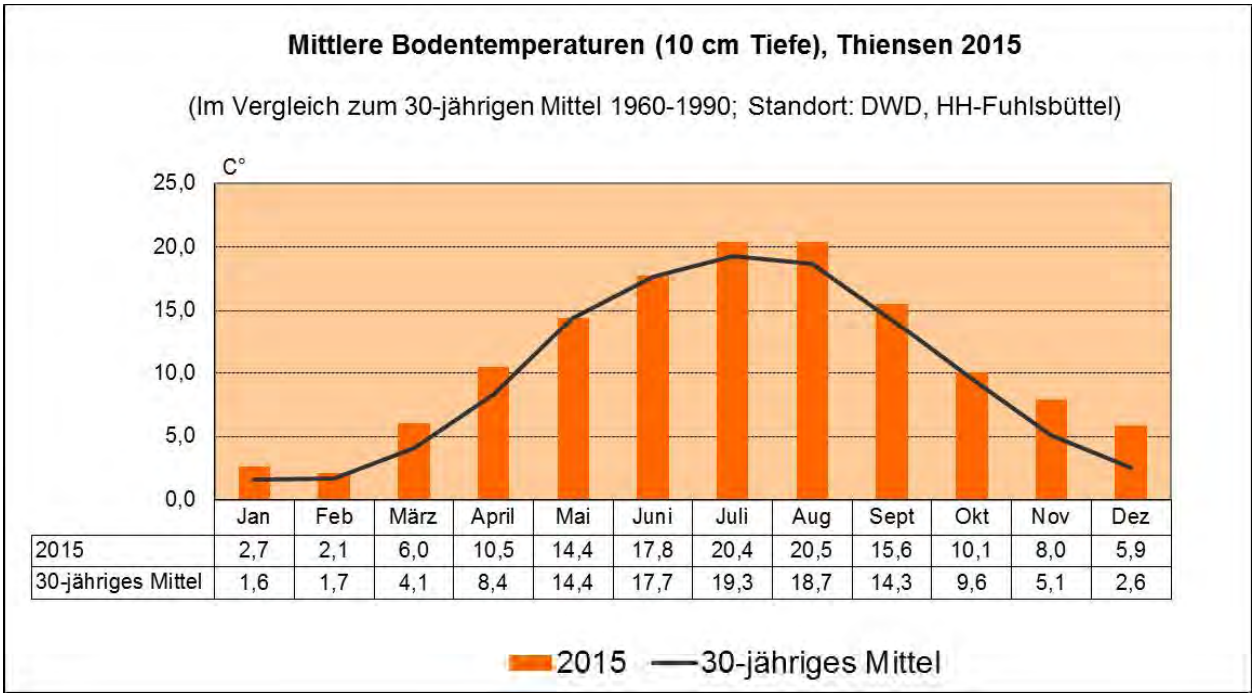


	Jan	Feb	März	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Dez	Summe
2015	118,2	33,5	78,8	29,0	75,0	61,0	161,4	99,9	81,5	42,0	145,9	32,4	958,6
2014	73,6	43,0	27,8	72,0	136,4	60,8	82,6	94,4	26,8	68,2	28,8	213,6	928,0
30-jähriges Mittel	60,8	43,3	46,5	50,7	58,5	77,6	88,1	85,4	72,2	62,4	72,0	73,6	791,1



	Jan	Feb	März	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Dez	Ø
2015	3,0	2,3	6,1	8,5	11,5	14,8	17,9	19,0	13,8	9,5	8,2	7,3	11,0
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	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





	Jan	Feb	März	April	Mai	Juni	Juli	Aug	Sept	Okt	Nov	Dez
2015	2,7	2,1	6,0	10,5	14,4	17,8	20,4	20,5	15,6	10,1	8,0	5,9
30-jähriges Mittel	1,6	1,7	4,1	8,4	14,4	17,7	19,3	18,7	14,3	9,6	5,1	2,6

Explanation of the abbreviations:

You can find an extensive explanation of the drawings in the attachment to the "Yellow List".

ZP = Zierpflanzen (ornamental plants), ZG = Ziergehölze (ornamental shrubs), B = Baumschule (nursery), O = Obstbau (fruit/orchard), F = Forst/Forstgehölze (forest/forest trees), St = Stauden (shrubs)

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

Explanations of the bee protection regulations:

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

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

The **new bee protection regulations NB501, NB502, NB504** apply to the B1 products Dantop, Confidor WG 70 and Warrant 700 WG. Confidor WG 70 and Warrant 700 WG these may only be used on plants that will not flower again in the year of treatment on in the field. This also applies to weeds in the crops. Treatment of plants under glass with Dantop, Confidor WG 70 and Warrant 700 WG is only permissible before flowering if the use of the plants in open land is not intended in the year of treatment after this point.

The insecticide Calypso may no longer be used on flowering plants.

Labelling to protect bodies of water:

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

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

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

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

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

Important note: Disclaimer

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

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

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

Appendix - Translations of text within graphs and charts by relevant section

Herbicides for use on conifer seed beds	
Länge in cm	Length in cm
Anzahl pro 0,1 m^2	Number per 0.1 m^2
Kontrolle	Control
Bet. Maxx Pro + Gallant S.	Bet. Maxx Pro + Gallant S.
Boxer	Boxer
Goltix G.	Goltix G.
Kontakt 320 + Gallant S.	Kontakt 320 + Gallant S.
Goltix G. + Gallant S.	Goltix G. + Gallant S.
Lontrel 720 SG + Gallant S.	Lontrel 720 SG + Gallant S.
Goltix Gold	Goltix Gold
Goltix Gold + Gallant S.	Goltix Gold + Gallant S.
Katana	Katana
Betanal Maxx Pro + Gallant S.	Betanal Maxx Pro + Gallant S.
Herbicides for use on hardwood cutting beds	
VuB P05/2015	VuB P05/2015
feuchter Boden	Damp ground
trockener Boden	Dry ground
Deckungsgrad mit Unkräutern in %	Degree of coverage with weeds in %
Franzosenkraut	Gallant soldier
Kleine Brennnessel	Annual nettle
Nachtschatten	Nightshade
Gänsefuß	Chenopodium
Kreuzkraut	Groundsel
Insecticides for use against vine weevil	
Anormal	Abnormal
tot	Dead
Eier	Eggs
Anzahl Eier	Number of eggs
Anteil in %	Percentage (%)
Alternative products to control powdery mildew on oaks	
Schachtelhalmextrakt	Horsetail extract
Buttermilch	Buttermilk
Kumar	Kumar
Futogard	Futogard
VitiSan + Prev B2	VitiSan + Prev B2
Kumulus WG + Cocana	Kumulus WG + Cocana
Attempts to remedy tip burn in field-grown privet	
Stefes Bor Quantum	Stefes Bor Quantum
Folicin-Cu flüssig	Folicin-Cu fluid
Stefes Bor	Stefes Bor
Excello-Kupfer spezial	Excello-Kupfer spezial
Haifa Coated Bor 12 M	Haifa Coated Bor 12 M
Mivena blend Trace Elements	Mivena blend Trace Elements
Excello-331 spezial	Excello-331 spezial
Wuxal Boron	Wuxal Boron
Folicin-Bor Plus flüssig + Folicin-Cu flüssig	Folicin-Bor Plus fluid + Folicin-Cu fluid

Testing the partially coated product Granustar CRF Allround in nursery production	
Ausgangswerte	Initial values
2 x Granustar Allround	2 x Granustar Allround
1 x NovaTec premium + 1 x Blaukorn premium	1 x NovaTec premium + 1 x Blaukorn premium
Granustar CRF Allround	Granustar CRF Allround
NovaTec + Blaukorn	NovaTec + Blaukorn
Comparison of 8-9 month and 5-6 month controlled release fertilisers	
nicht handelsfähig	Not tradeable
Ausfall	Failure
Prototyp Fa. B II	Prototype company B II
Prototyp Fa. C II 8-9M	Prototype company C II 8-9M
Prototyp Fa. C I 8-9M	Prototype company C I 8-9M
Tardit 9M	Tardit 9M
Prototyp Fa. A 6M	Prototype company A 6M
Prototyp Fa. B I	Prototype company B I
Prototyp Fa. B IV	Prototype company B IV
Prototyp Fa. A 9M	Prototype company A 9M
Prototyp Fa. B III	Prototype company B III
nicht marktfähig	Not marketable
Data from the weather station in Thiensen	
Monatliche Niederschlagsmengen, Thiensen 2015 und 2014	**Monthly rainfall, Thiensen 2015 and 2014**
(Im Vergleich zum 30-jährigen Mittel 1960-1990)	(Compared to the 30-year average for 1960-1990)
30-jähriges Mittel	30-year average
Summe	Total
Mittlere Temperatur (2 m Höhe), Thiensen 2015 und 2014	**Average temperaure (height of 2 m), Thiensen 2015 and 2014**
Niederschlag und Zusatzberegnung in Containerkulturen	**Precipitation and additional irrigation in container crops**
Rosen, Co 3-4 l (Standort Rellingen 2015)	Roses, 3-4 l container (Rellingen location 2015)
Niederschlag	Precipitation
Beregnung	Irrigation
Mittlere Bodentemperaturen (10 cm Tiefe), Thiensen 2015	**Average ground temperature (depth of 10 cm), Thiensen 2015**
(Im Vergleich zum 30-jährigen Mittel 1960-1990; Standort: DWD, HH-Fuhlsbüttel)	(Compared to the 30-year average for 1960-1990; location: DWD, HH-Fuhlsbüttel)