Das Lebensministerium

New Pot Plants Valentine’s Day II

Technical Report HDC Project No 267

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1 Introduction and main objectives

The part II of the collaborative research program “New ornamental plants for early season sale” based on wide experiences of former projects like “Developing of crop directions for alternative spring plants (Pillnitz 2000 – 2003) and part I of project PC 247 “New ornamental plants for early spring sale” (Pillnitz and Stockbridge 2005 to 2006). This new project PC 267 (2006 to 2007) is again in partnership of Horticultural Development Council, U.K and Saxon State Institute of Agriculture in Pillnitz, Germany. On the field of new products for the early season sale is a lot going on during the last years. Great young plant companies start new breeding lines to force the quality of early spring species. The variety on the market increases and that is the chance for the growers in the U.K and Germany to grow something ‘new’ instead of primroses and pansies. However, often the knowledge about the new species is insufficient. Michigan State University has runs projects for past several years to study the flowering requirements for a wide range of perennials. The question is how it is possible for growers to schedule the flowering. The results of this project work points out that the most important environmental cues for growth and flowering are photoperiod, vernalization and light quantity. The better the understanding of a species the more detailed information the growers can use. The main objective of this research program was like last year, to assist growers in the U.K and Germany to improve their economic returns and develop the market for early season sales of pot plants. The special focus is always the very early sale date Valentine’s Day or at least the sale at the beginning of March. Further aims were the following:

- Enlargement of the assortment of new species for early spring sale
- Improvement of steering the crop
- Providing crop details for promising species/varieties
- Coordinate the scheduling of species to the early sale date Valentine’s day or at least week 09
- Providing pieces of advice for selling mixed palettes of early spring species
- Improvement of quality by using of growth regulators
- Forcing should require a short time and the forcing should take place after poinsettia and before bedding/ patio plants
- Consideration of economic efficiency of cropping the ‘new’ species
- Consideration of customers interests especially performance, shelf life under living room conditions and shelf life under outdoor conditions (frost-hardiness test)

2 Materials and methods

2.1 Assortment Early Spring Trial 2006/2007

34 species of perennials and biennials were grown for the Early Spring Trial 2006/2007. 22 species were grown from seeds and 12 species were grown from cuttings in research station Dresden-Pillnitz. All plants were potted up into 10 cm pot size. The list of the 34 plants species with their source of start material, kind of plant type and species which came into PGR Trial is presented in Table 1.

Table 1: Species, plant types and use of plant growth regulators (PGR Trial) in the Early Spring Trial 2006/2007

Species number	Source	Species	Plant Types	PGR Trial
3	Jal	Ajuga pyramidalis ‘Metallica Crispa’	p	
4	Jal	Ajuga reptans ‘Braunhertz’	p	
5	Jal	Ajuga reptans ‘Mini Mahagoni’	p	
6	Jal	Arabis ferdinandi ‘Coburgii Variegata’	p	
7	Jal	Arabis ferdinandi ‘Old Gold’	p	
10	Jal	Cymbalaria ‘Muralis’	p	
13	Jal	Iberis sempervirens ‘Snowflake’	p	
14	Jal	Lindernia ‘Grandiflora’	p	
15	Jal	Lithodora diffusa ‘Heavenly Blue’	hs	x
16	Jal	Lithodora diffusa ‘Pete’s Favorite’	p	
20	Jal	Serissa foetida ‘Pink Mystic’	s	
24	bGD	Phlox divaricata	p	x
26	bGD	Phlox divaricata (propagation Pillnitz)	p	x
25	Jal	Ajuga reptans ‘Mini Mahagoni’ (propagation Pillnitz)	p	
F01	Je	Anacyclus pyrethrum var. depressus ‘Silberkissen’	p	x
F02	LfL	Androsace septentrionalis ‘Star Dust’	b	x
F03	Be	Aquilegia hybrida ‘F1 Spring Magic Blau - Weiß’	p	
F04	Be	Aquilegia hybrida ‘F1 Spring Magic Hellrot- Gelb	p	
F05	Be	Aquilegia hybrida ‘F1 Spring Magic Hellrot – Weiß’’	p	

Species number	Source	Species	Plant Types	PGR Trial
F06	Be	Aquilegia hybrida ‘F1 Spring Magic Marine – Weiß’’	p	
F07	Be	Aquilegia hybrida ‘F1 Spring Magic Rosa - Weiß’	p	
F08	Be	Aquilegia hybrida ‘F1 Spring Magic Weiß’	p	
F09	Kieft	Aquilegia vulgaris ‘Winky Double White- White’	p	x
F11	Kieft	Barbarea rupicola ‘Sunnyola’	p	
F12	Kieft	Calceolaria biflora ‘Goldcap’	p	
F13	Kieft	Erigeron karvinskianus ‘Stallone’	p	x
F14	Je	Erinus alpinus ‘Dr. Hähnle’	p	
F15	Kieft	Erysimum perovskianum ‘Goldrush’	p	
F16	Be	Geum coccineum ‘Cooky’	p	x
F17	Je	Horminum pyrenaicum ‘Rubrum’	p	
F18	Je	Horminum pyrenaicum	p	x
F19	Je	Lychnis alpina	p	x
F20	Je	Lychnis alpina ‘Snow Furry’	p	x
F21	Be	Papaver miyabeanum ‘Pacino’	p	x
F22	Be	Papaver nudicaule ’Gartenzwerg’	p	x
F23	LfL	Silene pendula ‘Lausitz’	b	x

Key to terminology:

Be	– Benary	bGD	– Botanical Garden Dresden
Je	– Jelitto Seeds	Jal	– Jaldety Israel
Kieft	– Kieft Seeds	LfL	– Saxon State Institute of Agriculture
p	– perennial	b	– biannual
s	– shrub	hs	– half-shrub

x – test with growth regulators in different variants

2.2 Procedure of the Early Spring Trial 2006/2007

After potting, the plants were grown under outdoor conditions for establishment or bulking. Bulking means a period to increase the vegetative size of plants in photoperiods short enough to prevent induction but long enough for vegetative development to occur. From week 41 plants were either grown in an unheated polythene tunnel or in a frost-free glasshouse. The following weeks should

give the opportunity for vernalization. Vernalization is a cooling period so that plants overcome the inhibition so that induced flowers are able to occur and that flower stems stretch above the leaves. Forcing started in week 50 in four glasshouse compartments with different lighting treatments. A second set started in week 01 in two glasshouse compartments with the same lighting treatment but different temperatures. The PGR Trial started with forcing only in week 50 in four glasshouse compartments with different lighting treatments. When there was enough plant material, the plants were placed in three replications with 16 plants per plot. The two middle rows with 8 plants were used for collection of data. The PGR Trial had no replications per variant and always 8 plants per plot. The plants were spaced with about 32 plants / m². The production and treatment list is given in Table 2.

Table 2: Production and treatment diary for Early Spring Trial 2006/2007

Week	Date	Location	Treatment
27		Glasshouse (H 14.2)	Sticking cuttings from Jaldety in QP 40 trays, substrat: Brill type 3, Lithodora in mixture of peat and sand 1:1, small polythene tunnel for rooting, first watering with Previcur N 0.15%
29		Glasshouse (H 14.1)	Sowing of seed propagated species, substrat: Brill for propagation, first watering with Previcur N 0.15%, first time cold store with 8℃
31-34		Glasshouse (H 14.1+ H 14.7+14.8)	Pricking of seedlings in QP 40, substrat: D400 with Xylit SMLfL
32	9 Aug 06	Outdoor	Outdoor terrain prepared for further cultivation
31-38		Outdoor	Potting rooted seedlings and cuttings (plugs) in 10 cm pots, substrat: Gramoflor for primroses, Lithodora in substrate mixture: D400 with Xylit SMLfL and peat 1: 1
39	28 Sept 06	Outdoor	Fertiliser applied – 0.1% Ferty 3 green (15-10-15)
39	26 Sept 06	Outdoor	0.035% Confidor WG 70+ 0.15% Polyram WG+ 0.2% Aminosol
41		Polythene tunnel and glasshouse (H 14.2 + 14.3+ 14.4 + H 13.2)	Plants moved into unheated polythene tunnel or cold glasshouse for vernalization. In the glasshouse day/ night: heating at 2ºC and venting at 4ºC; in the polythene tunnel venting started at 8-10ºC
41	11 Oct 06	All locations	0.2% Dithane Ultra+ 0.02% Discus+ 0.2% Wuxal Amino

Week	Date	Location	Treatment
44		Polythene tunnel and glasshouse (H 14.2 + 14.3+ 14.4 and H 13.2)	First flowers and buds removed from some species
45	9 Nov 06	Polythene tunnel and glasshouse (H 14.2 + 14.3+ 14.4 + H 13.2)	Trimming of Iberis, Phlox, Lithodora, Erigeron (F13 gest) and Cymbalaria
46	17 Nov 06	All locations	Fertiliser applied – 0.2% Ferty 3 green (15-10-15)
49	7 Dec 06	All locations	0.20% Dithane+ 0.1% Ortiva+ 0.2% Aminosol+ 0.02% Masai
50	11 Dec 06	Glasshouse compartments (H 11.1, 11.2 ,11.3, 10.3)	Plants placed into different treatments.
50	12 and 15 Dec 06	Glasshouse compartments (H 11.1, 11.2 ,11.3, 10.3)	From Tuesday to Friday (approx 72 hours) plants pushed with higher temperatures heating day/night 20ºC/18℃, venting at 22º/22℃C and lighting treatments start: H 11.1: Supplementary lighting – 3000 lux, 20 hours, 4.00-24.00 = 0.13 mol/m2; 8.13 W/m2 PAR. H 11.2: Supplementary lighting – 80 klxh, 3000 lux, 4.00-24.00 = 265 Wh/m² PAR H 11.3: Photoperiodic lighting – 100 lux / m2, 20 hours, 4.00-24.00 = 0.0044 mol/m2; 0.275 W/m2 PAR. H 10.3: Ambient daylight (from sunset to sunrise the plants were covered to protect them from light spillage from other treatments) Fertiliser with each watering 0.05% Ferty 3 green (15-10-15-2) EC = ECwater+ ECfertilizer = 0.4+0.8=1.2
50	15 Dec 06	All glasshouse compartments	Back to lower temperatures heating day/night: 12ºC and venting 14ºC
50		All glasshouse compartments	0.3% Neem Azal + 0.2% Aminosol
51	18 Dec 06	All glasshouse compartments	Old foliage removed from plants
51	21 Dec 06	All glasshouse compartments	0.20% Dithane + 0.04% Plenum + 0.10% Aminosol

Week	Date	Location	Treatment
52	28 Dec 06	All glasshouse compartments	PGR Trial: 0.10% and 0.05% Topflor with 80 ml/m² 0.20% and 0.10% CCC 720 with 100 ml/m²
1	2 Jan 07	Glasshouse compartments (H 10.1, 10.2)	Second set of plants placed into different treatments. From Tuesday to Saturday (approx 72 hours) plants pushed with higher temperatures heating day/night 20ºC/18℃, venting at 22º/22℃ and lighting treatment starts: Supplementary lighting – 3000 lux, 20 hours, 4.00-24.00 = 0.13 mol/m2; 8.13 W/m2 PAR; Fertiliser with each watering 0.05% Ferty 3 green (15-10-15-2) EC = ECwater+ ECfertilizer = 0.4+0.8=1.2
1	6 Jan 07	Glasshouse compartments (H 10.1, 10.2)	H 10.1: Temperatures heating day/night 12℃/12℃, venting day/night 14℃/14℃ H 10.2: Temperatures heating day/night 9℃/9℃, venting day/night 12℃/12℃
1		Glasshouse compartments (H 11.1, 11.2 ,11.3, 10.3)	0.15% Previcur N only Horminium pyrenaicum
1	3 Jan 07	Glasshouse compartments (H 11.1, 11.2 ,11.3, 10.3)	PGR Trial: 0.05% Topflor with 80 ml/m² 0.10% CCC 720 with 100 ml/m²
2		Glasshouse compartments (H 10.1, 10.2)	Old foliage removed from plants
2	9 Jan 07	Glasshouse compartments (H 11.1, 11.2 ,11.3, 10.3)	PGR Trial: 0.10% and 0.05% Topflor with 80 ml/m² 0.20% and 0.10% CCC 720 with 100 ml/m²
2	11 Jan 07	All glasshouse compartments	0.10% Rovral+ 0.035% Confidor+ 0.20% Aminosol
3	16 Jan 07	Glasshouse compartments (H 11.1, 11.2 ,11.3, 10.3)	PGR Trial: 0.05% Topflor with 80 ml/m² 0.10% CCC 720 with 100 ml/m²
4		All glasshouse compartments	Fertiliser applied – 0.2% Ferty 3 green (15-10-15)
4		Glasshouse compartments (H 10.1, 10.2)	0.2% Dithane+ 0.04% Plenum+ 0.10% Aminosol
7	16 Feb 07	All glasshouse compartments	0.1% Ortiva (powdery mildew)

Key to terminology:

Discus – Kresoxim-methyl 500g/l Masai – Tebufenpyrad Confidor – Imidacloprid
Plenum 50 WG – Pymetrozin Polyram WG – Metiram PrevicurN – Propamocarb
Rovral – Iprodione Dithane Ultra – Mancozeb
Ortiva – Azoxystrobin 250g/l Topflor – Flurprimidol CCC 720 – Chlormequat
Wuxal Amino – 700g/l amino acid (9% nitrogen)
Neem Azal T/S – Azadirachtin (Neem)

2.3 PGR Trial

The first growth regulators treatments started in all greenhouse compartments in week 52 (supplementary light, photoperiodic light and ambient daylight). The spraying was two times or four times depending on application rate. In Germany, the growth regulators Topflor and CCC 720 only allowed to spray two times in application rate 0.20% CCC 720 with 100 ml/m² and 0.10% Topflor with 80 ml/m². This application rate was given week 52 and week 2. The other treatments divided the application rate to the half level and the spraying was four times in weeks 52, 1, 2 and 3 with 0.10% CCC 720 with 100 ml/m² and 0.05% Topflor with 80 ml/m². The following table (Table 3) allows an overview about variants in PGR treatments. The growth regulators were tested on 11 species, which are listed in Table 1.

Table 3: Variants of growth regulator treatments during PGR Trial

untreated	Spraying in weeks	in solution of water
0.20 % Cycocel 720	52 and 2	100 ml
0.10 % Cycocel 720	52; 1; 2 and 3	100 ml
0.10 % Topflor	52 and 2	80 ml
0.05 % Topflor	52; 1; 2 and 3	80 ml

Key to terminology : Topflor – Flurprimidol CCC 720 – Chlormequat

2.4 Shelf life test under living room conditions and frost hardiness test

This year the student Lutz Rüger from the technical University HTW engaged to shelf life test to write his diploma on this topic. He tested not only the shelf life under living room conditions but also the frost-hardiness of species at different temperatures in controlled climate chambers for 48 hours (+ 3℃; 0℃; - 3℃; - 6℃ and darkness). Into the f rost hardiness test came flowering plants direct from the glasshouse compartment or plants after shelf life test under living room conditions. The results to shelf life under living room conditions and the results to frost-hardiness are included.
The shelf life test was run in a separate room with the following controlled conditions:

artificial light with 300 – 500 lx daily for 12 hours = 0.022 mol/ m²; 1.375 W/ m² PAR
temperature 20℃ – 22℃
air humidity 40 % - 60 %

The watering was run over glass fibers (ORTMANN). The shelf life under living room conditions, in days, was recorded and notes were taken to record the reason for the discarded plant. The frost hardiness was evaluated shortly after removal from climate chamber and 4 days later.

2.5 Temperatures and light conditions

It is important to recognize the climatic variation that exists between conditions in the UK and those at Pillnitz, Germany. The following data collected during the trial period at Pillnitz can be used to compare with UK growing conditions.

Many species were flowering earlier than expected and then the results have been shown in the years 2001 to 2003 and 2006. On the other hand, a couple of species have not received enough vernalization so that even the supplementary light could not compensate this lack. There was no or less and delayed flowering. The comparison of temperatures and lighting of these years could give an answer for that. The following figure (Figure 1) shows the average temperatures of the month.

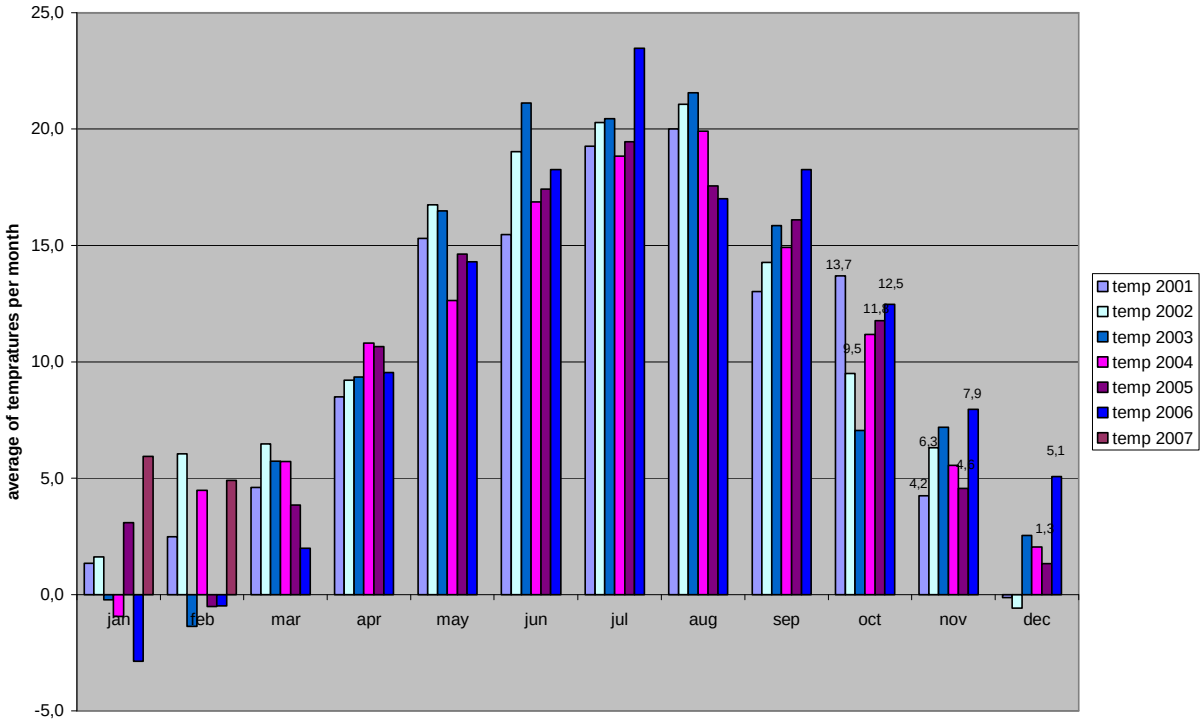


Figure 1: Average temperatures per month in different years

An important time is the time of storage. These are the weeks to realize the vernalization. The average outdoor temperatures in October, November of 2001 and 2002 were lower than 2006. The highest average temperatures were in autumn 2006. In autumn 2001 and 2002, the vernalization until week 50 was enough for species like Lychnis alpina and Erinus alpinus (successful flowering) but not in 2006. The flowers were not induced or did not stretch above the leaves even with supplementary light, which often has the opportunity to compensate the lack of vernalization. There are still a lot of questions about the time and amount of degrees for exact vernalization for each species. Michigan State University did a lot of research on the field of vernalization especially with perennials. With a fix temperature at 5°C ,that was defined as an optimum for vernalization, perennials were tested in an environmentally controlled chamber (25 to 50 foot-candle) for 4 up to 15 weeks. The result was often that the plants came into flowering after vernalization of 4 to 6 weeks but with more weeks of vernalization, there was an improved flowering characteristic such as percentage of plants flowering, reduced time to flower and increased flower number. Michigan State University tested about 31 species under rubric early spring ephemerals that means perennials require vernalization and react day-neutral. There are results for species we had in this year Early Spring Trial. These results will be mentioned later within the chapter of the single species. The following table shows the sum of average temperatures from outdoor from the 6 October to the 11 December 2001, 2002, 2005 and 2006. That comparison shows that the autumn of 2006 was extreme in temperatures (Table 4). The sum of average temperatures was 40% higher than the average of the other years. The warm temperatures were useful for growing and compensating quite often the late potting date but there was not enough time for effectual vernalization to week 50 the start of forcing.

Table 4: Sum of average temperature outdoor at Pillnitz in autumn 2001, 2002, 2005, 2006

Autumn	Sum of temp. from averages per days in °C x da ys 6 Oct to 11 Dec
2001	483.7
2002	414.4
2005	459.1
2006	635.8

For all environments in Early Spring Trial 2006/2007, the details are given in Table 5.

The temperatures for polythene tunnel are valuated. There was no extra data logger in the polythene tunnel.

The table (Table 5) expresses the extreme situation in 2006/2007. In polythene tunnel, there were only 11 days that had temperatures below 4°C. Compa red to the years 2001, 2002 and 2005 the plants have had in average 70% more days below 4°C (about 40 days) during storage in polythene tunnel. An interesting fact is that plants for the second start of forcing in week 01 at 2007 were able to collect more days of lower temperatures to satisfy the need of vernalization.

Table 5: Temperature conditions at Pillnitz Early Spring Trial 2006/2007

Location	Sum of temp. from averages per days in ℃ x days 11 Oct to 11 Dec 2006 (week 50)	Days with temp. below 4℃	Days with temp. below 3℃	Days with temp below 0℃
H13.2	650.9			
H14.2	658.8			
H14.3	637.7	4		
H14.4	611.8	6		
Polythene tunnel	618.5	11	8	3
Location	Sum of temp. from averages per days in ℃ x days 11 Oct 2006 to 2 Jan 2007 (week 01)	Days with temp. below 4℃	Days with temp. below 3℃	Days with temp below 0℃
H14.3	788.2	7		
H14.4	747.8	16		
Polythene tunnel	725.2	29	24	6

During the forcing period, the four glasshouse compartments were exposed to different amounts of light. This is illustrated in figure 2 With supplementary lighting in glasshouse compartment H 11.1 (20h-3000lx) plants received about 40% more light until Valentine's Day compared to the photoperiodic and ambient daylight treatments. The glasshouse compartment with the light sum collection H 11.2 (80klxh) received 12% less light until Valentine's Day compared to H 11.1 (20 h – 3000 lx). The average of hours of lamps burning time was until Valentine's Day in glasshouse compartment H 11.1-18:26 hours and in glasshouse compartment H 11.2-13:20 hours. This is in average a difference of 5 hours less burning time per day. With the second start of forcing in week 01 the plants received a PAR 262.8 mol/m² in the two greenhouse compartments H 10.1 and H 10.2 until Valentine's Day and reached the sum PAR 362.3 mol/m² one week later on 25 Feb 07 in week 8.

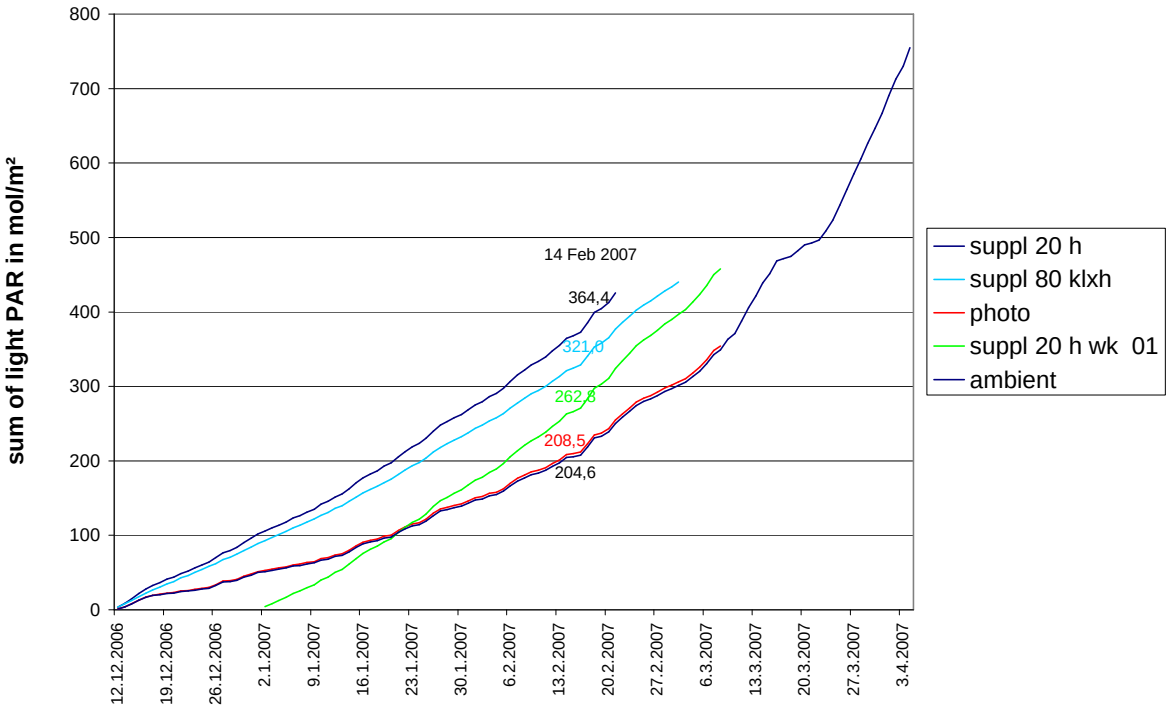


Figure 2: Development of light summaries in the different light treatments

In the glasshouse compartment with supplementary light, the temperature was a little higher because of the radiation from the lamps.

Sum of temperatures from 12 December to the 14 February (65 days):

Glasshouse 11.1 supplementary light 20h:	889.2 °C x days
Glasshouse 11.2 supplementary light 80klxh:	878.2 °C x days
Glasshouse 11.3 photoperiodic light :	841.5 °C x d ays
Glasshouse 10.3 ambient daylight:	854.3 °C x day s

Sum of temperatures from 2 January to 2 March (60 days)

Glasshouse 10.1 supplementary light 20h and 12°C:	833.3 °C x days
Glasshouse 10.2 supplementary light 20h and 9°C:	72 7.2 °C x days

To compare results from different years it is helpful to compare sum of temperatures. From start of forcing, the average temperatures from 80 days were added. The Early Spring Trial 2006/2007 collected about 1060°C x days compared to the Tria l 2002/2003 with about 870°C x days. In the year 2002/2003, the heating was 10°C and ventilatio n 12°C. That makes an important difference over the forcing period with 190°C. That seems to b e the reason that some species flowered earlier than expected this year.

The light treatments finished at different dates:

Glasshouse 11.1 supplementary light 20h:	21 Feb 07	week 8
Glasshouse 11.2 supplementary light 80klxh:	2 March 07	week 9
Glasshouse 11.3 photoperiodic light:	8 March 07	week 10
Glasshouse 10.3 ambient daylight:	4 April 07	week 14
Glasshouse 10.1 supplementary light 20h and 12℃:	8 March 07	week 10
Glasshouse 10.2 supplementary light 20h and 9℃:	8 March 07	week 10

The data in the glasshouse compartments with supplementary light were all collected to the end of rating. Only the glasshouse compartment with photoperiodic light treatment was earlier finished then the data were complete collected but the glasshouse compartment was needed for the bedding plants trial.

2.6 Recordation of data and biometric analysis

In all greenhouse compartments, the plants were monitored every second or third day during the forcing period. If one plant fulfilled the specific criteria for flowering, the measurements and ratings were carried out. Eight plants from each plot were measured wherever possible and the following records were taken:

Date of flowering
Height of leaves in cm
Height of flower in cm
Number of flowers per plant
Number of buds per plant
Number of branches per plant (Lithodora)
General value (rating 1….9, 1 = very bad; 5 = middle; 9 = perfect)

During every period / regime of the trial, the temperature, the air humidity and irradiation levels were recorded by data loggers. Appropriate visual observations on each plant species (e.g. diseases) were documented.
Digital photos were made which show the plant species in different factorial combinations after planting, at the beginning of storage, at the beginning of forcing and at flowering.

The data were analyzed with help of the statistic program SPSS. With the two factor analysis of variance, the significances of the single factors were determined as well as the interactions between the factors. The averages of data were compared by BONFERRONI test (with $\alpha = 0.05$). This test is more accurate than other multiple average tests because of the slightly different numbers of plots in the trial. All data from the trials and the most important results of the analysis by SPSS program were saved on a DVD, which is contained in the annex.

3 Results and Discussion

The main objective of the trial in Pillnitz was again to produce marketable plants by Valentine's Day (14 February) or at least to finish the crop before the bedding plant season after which the need for the space in glasshouses rapidly increases. From the 34 tested species/varieties, 25 varieties came in flowering successfully during the trial, 9 varieties failed because of low marketable value or not enough data of flowering. The following table (Table 6) allows an overview over the successful species/varieties. Table 7 lists the not successful species during this year trial. The successful species will be mentioned separately in this chapter. The first part concentrates on species, which were not in PGR Trial the second with species, which received growth regulators treatments. Not all the plants within each plot (8 plants) had reached a flowering stage. The exact number is listed in the average table of the species in the DVD annex.

Table 6: Successful species in Early Spring Trial 2006/2007

Species number	Species	General value < 4.9	less data	PGR Trial
F01	Anacyclus pyrethrum var. depressus 'Silberkissen'			x
F02	Androsace septentrionalis 'Star Dust'			x
F09	Aquilegia vulgaris 'Winky Double White- White'			x
F13 gest	Erigeron karvinskianus 'Stallone'			x
F16	Geum coccineum 'Cooky'			x
F18	Horminum pyrenaicum			x
15	Lithodora diffusa 'Heavenly Blue'			x
F21	Papaver miyabeanum 'Pacino'			x
F22	Papaver nudicaule 'Gartenzwerg'			x
24	Phlox divaricata			x
26	Phlox divaricata (propagation Pillnitz)			x
F23	Silene pendula 'Lausitz'			x
3	Ajuga pyramidalis 'Metallica Crispa'			
4	Ajuga reptans 'Braunhertz'			
5	Ajuga reptans 'Mini Mahagoni'			
25	Ajuga reptans 'Mini Mahagoni' (propagation Pillnitz)			
F03	Aquilegia hybrida 'F1 Spring Magic Blau - Weiß'			

Species number	Species	General value < 4.9	less data	PGR Trial
F04	Aquilegia hybrida 'F1 Spring Magic Hellrot- Gelb'			
F05	Aquilegia hybrida 'F1 Spring Magic Hellrot – Weiß'			
F06	Aquilegia hybrida 'F1 Spring Magic Marine – Weiß'			
F07	Aquilegia hybrida 'F1 Spring Magic Rosa - Weiß'			
F08	Aquilegia hybrida 'F1 Spring Magic Weiß'			
F12	Calceolaria biflora 'Goldcap'			
F15	Erysimum perovskianum 'Goldrush'			
13	Iberis sempervirens 'Snowflake'			
14	Lindernia 'Grandiflora'			
20	Serissa foetida 'Pink Mystic'			

Table 7: Species in Early Spring Trial 2006/2007 with a low general value or too less data during the trial

Species number	Species	General value < 4.9	less data	PGR Trial
6	Arabis ferdinandi 'Coburgii Variegata'	x		
7	Arabis ferdinandi 'Old Gold'	x		
F11	Barbarea rupicola 'Sunnyola'	x		
10	Cymbalaria 'Muralis'	x		
F13	Erigeron karvinskianus 'Stallone'	x		
F14	Erinus alpinus 'Dr. Hähnle'		x	
F17	Horminum pyrenaicum 'Rubrum'		x	
16	Lithodora diffusa 'Pete's Favorite'		x	
F19	Lychnis alpina		x	x
F20	Lychnis alpina 'Snow Furry'		x	x

The following table (Table 8) gives an overview, which weeks the species flowered exposed to different lighting.

The weeks of flowering make clear that a lot of species are possible to grow for the same sale date (Figures 4 and 5). Therefore, there is a real chance to produce mixed palettes to the same week of sale (Figure 3).

Figure 3: week 04; mixed palette with 8 different early spring pot plants

Figure 4: week 04; arrangement for early spring sale with Geum coccineum 'Cooky'; Papaver nudicaule 'Gartenzwerg'; Calceolaria biflora 'Goldcap' and Erysimum perovskianum 'Goldrush'

Figure 5: week 08; floriga trade fair; Leipzig 2007; presentation to highlight the 'news'

Table 8: Species and their weeks of flowering exposed to different lighting and requirement of vernalization

Species number	Species	Start of forcing; lighting; temperature and the flowering in weeks						vernalization required x = yes
		week 50* 20h 3000lx 12℃	week 50* 80klxh 12℃	week* 01 20h 3000lx 12℃	week 01* 20h 3000lx 9℃	week 50* photoper./ 20h 100lx 12℃	week 50* ambient daylight 12℃	
3	Ajuga pyramidalis ‘Metallica Crispa’	2-3	2 - 3	5 - 6	n.t.	long period: 5 -10	long period: 9 -13	x
4	Ajuga reptans ‘Braunhertz’	4	4 - 6	6 - 7	7	9 -10	10 -12	x
5	Ajuga reptans ‘Mini Mahagoni’	3 - 4	3 - 4	5 - 6	6 - 7	6 - 8	7- 9	x
F01	Anacyclus pyrethrum var. depressus ‘Silberkissen’	5 - 6	5 - 6	7 - 8	8 - 9	8 - 9	10	?
F02	Androsace septentrionalis ‘Star Dust’	2 - 3	2 - 4	3 - 4	4 - 5	long period: 7 - 10	long period: 7 - 10	x
F04	Aquilegia hybrida ‘F1 Spring Magic Hellrot- Gelb’	2 - 3	3 - 4	4 - 5	5 - 6	6 - 8	8 - 10	x
F09	Aquilegia vulgaris ‘Winky Double White- White’	4 - 5	5 - 6	8	n.t.	8 – 9	12 - 13	x
F12	Calceolaria biflora ‘Goldcap’	4 - 5	6 - 7	7 - 8	9 - 10	8 - 9	no flower until week 14	?
F13 gest	Erigeron karvinskianus ‘Stallone’	4 - 5	4 - 5	7 - 8	9 - 10	7 - 9	8 - 10	?
F15	Erysimum perovskianum ‘Goldrush’	3 - 4	3 - 4	6 - 7	7 - 8	long period: 5 - 10	long period: 7 - 11	x
F16	Geum coccineum ‘Cooky’	2 - 4	2 - 4	4 - 5	4 - 5	long period: 4 -10	long period: 4 - 13	x
F18	Horminum pyrenaicum	3 - 4	5 - 6	8	8 - 9	9 - 10	14	x
13	Iberis sempervirens ‘Snowflake’	3 - 4	3 - 4	6 - 7	7	7 - 9	long period: 8 - 11	x
14	Lindernia ‘Grandiflora’	1	1	4 - 7	4 - 9	1	4	?
15	Lithodora diffusa ‘Heavenly Blue’	6 - 7	6 - 7	8 - 9	9	9 - 10	10 - 11	x
F21	Papaver miyabeanum ‘Pacino’	3 - 4	3 - 4	6	6 - 7	long period: 4 - 8	no flower until week 14	?
F22	Papaver nudicaule ’Gartenzwerg’	2 - 3	3 - 4	5 - 6	6 - 7	long period: 4 - 9	no flower until week 14	?
24	Phlox divaricata	3 - 4	3 - 4	6 - 7	7 - 8	long period: 5 - 8	11 - 12	x
20	Serissa foetida ‘Pink Mystic’	6 - 7	6 - 7	9 - 10	9 - 10	6 - 8	7 - 9	?
F23	Silene pendula ‘Lausitz’	4 - 5	5 - 6	5 - 6	6 - 8	long period: 6 - 9	long period: 9 - 14	x

Key to terminology: n.t – not tested variant (*) – 72 hours wake up treatment with higher temperatures at 20℃

Growing the plants outdoors or under polythene (unheated) or under glass (frost protected) had sometimes significant effects on species. These effects will be mentioned for each species.

Most species were influenced by the lighting treatments. Supplementary lighting had the greatest effect bringing flowering time forward and improving plant marketability and overall quality

All results, shown as bar charts for all species including the influence of lighting on plant parameters, are included in the DVD annex.

The stages of growth and development are collected in a ULEAD Photo Impact album and in a web browser readable slide show, which are saved on the DVD in the annex.

3.1 Species with no growth regulator treatment

3.1.1 Ajuga pyramidalis 'Metallica Crispa'

This species develops attractive dark robust rosettes of leaves. The blue colour of the flowers is nice and the species looks good in arrangements. The pot size would be better with 9cm. The small ranking branches are not disturbing (Picture 4).The date of flowering was recorded when three open flowers were present on a flowering stem.

Figure 6: Week 5; Ajuga pyramidalis 'Metallica Crispa'

Duration of forcing: All plants exposed to supplementary light were 8 weeks earlier than plants exposed to ambient daylight. The storage had no influence. The plants flowered after 30 to 32 days (H 10.1, 11.1, H 11.2). There were no plants placed in H 10.2 (20h-9℃). The photoperiodic light reacted only on plants from polythene tunnel until week 10 (end of rating). Only plants from polythene tunnel exposed to photoperiodic light were 4 weeks earlier than plants exposed to ambient daylight. In addition, plants exposed to ambient daylight and from polythene tunnel were two weeks earlier compared to plants from frost-free glasshouse .That is a sign that vernalization is necessary for Ajuga. The supplementary light compensates this lack of vernalization. Only plants exposed to supplementary light flowered until Valentine's Day. The plants from start forcing in week 50 were 100% flowering in weeks 2 to 3 and plants from start forcing week 01 were 100% flowering in weeks 5 to 6.

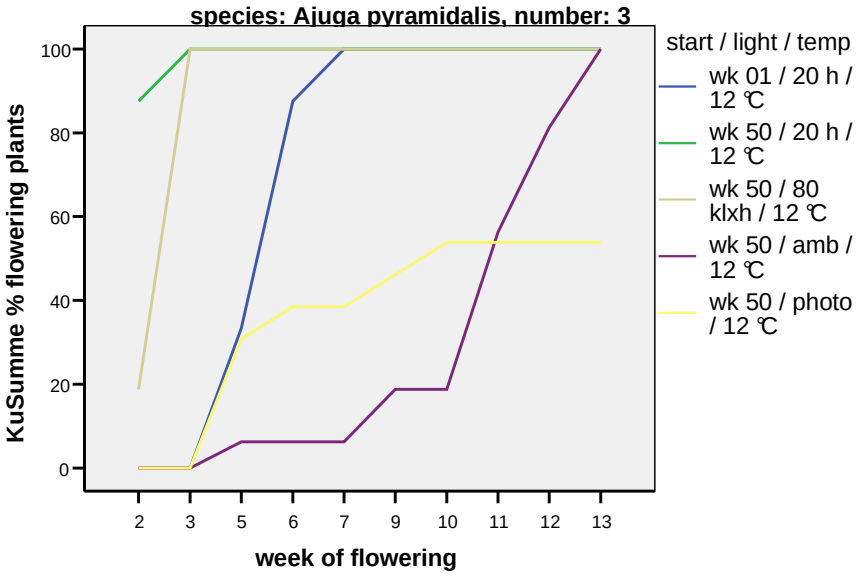


Figure 7: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: There was no influence on height of leaves and no mentionable influence on buds and flowers through lighting or storage. The plants with the start of forcing in week 01 and exposed to supplementary light (especially plants from outdoor) had significant longer flowers (difference in average 2cm) than in the other glasshouse compartments. These plants received a longer cooling period.

General value: Only the plants with supplementary light were marketable. The general value was around 6. The plants did not fill the 10 cm pot.

Shelf life test: The shortest period of time was 19 days whilst the longest time was 39 days. These are in average 31 days. Ajuga reptans 'Metallica Crispa' is suitable for living room conditions.

Recommendation for Ajuga pyramidalis 'Metallica Crispa'

Cuttings root in about three weeks. Potting should be latest week 31 to make sure that one rosette can fill the pot size and the plants are bulked before vernalization. The 9 cm pot is adequate. Ajuga needs well to be fed. The fertilization should be in the higher level of 500 to 700mg N per plant. Make sure that the plants get a cooling period of about 9 weeks. That is important for flowering and flower stretching. The effort for cleaning is low. With higher forcing temperatures of 12℃ and supplementary light, it is possible to sell the Ajuga to Valentine's Day. With ambient daylight and at 10℃ - 12℃ the flowering expected middle of March.

3.1.2 Ajuga reptans 'Braun Hertz'

This variety has nice blue flowers. The disadvantages are the long stem petioles (Figure 10). Therefore, the general value was low for single plant, but in creation of arrangements, this crop could be still interesting. The colour of leaves was different after different storage las the following pictures (Figures 8 and 9) show. The bronze colour disappeared during forcing.

Figure 8 and Figure 9: week 50; Ajuga reptans 'Braun Hertz', storage: right polythene tunnel, left frost-free greenhouse

Figure 10: week 04; Ajuga reptans 'Braun Hertz'

Duration of forcing: All supplementary light treatments with 20hours - 3000lx (H 11.1+10.1+10.2) flowered about the same time (38-41 days). The flowering in glasshouse compartment H 11.1 with the start of forcing in week 50 was earlier than the 80klxh treatment (H 11.2). However, this delay is mainly because of the plants from frost-free greenhouse with less vernalization. Flowers appeared 100% before Valentine's Day in week 4 to 6 with the start of forcing in week 50. Plants with the start of forcing in week 01 did not flower completely in weeks 6 to 7. A reason for that missing flowering could be that developed flowers were damaged because of longer storage and were cleaned off or flowers were not induced. Plants with photoperiodic light and ambient daylight were late (week 10 to 11) and not all plants flowered until week 14 (Figure 11).

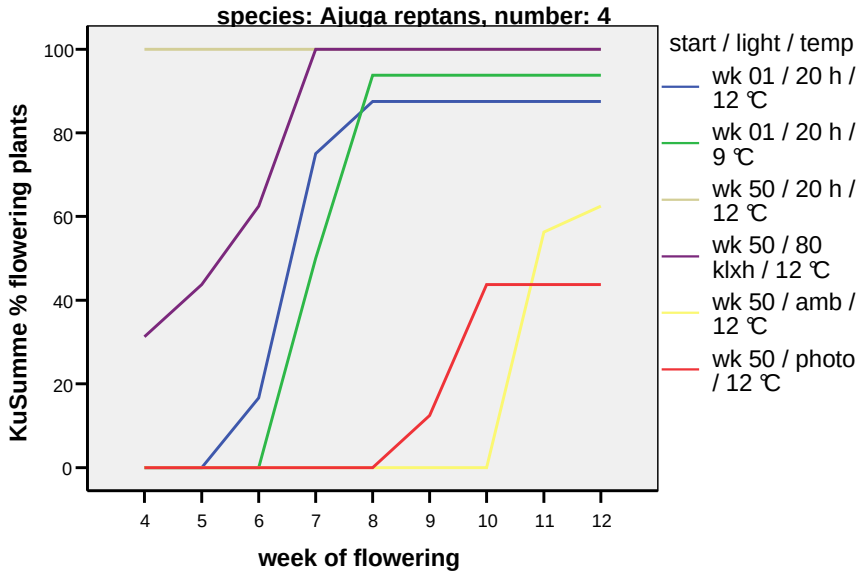


Figure 11: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: The height of leaves was not mentionable influenced by different lighting treatments. A significant difference showed the height of flowers. Flowers stretched 5 to 7 cm higher with the start of forcing in week 01 and supplementary lighting than flowers in other greenhouse compartments. With more vernalization, the flowers stretched more above the leaves. There were no significant differences in amount of buds and flowers. The amount was about 2 to 3. More vernalization would probably cause more flowers and buds. In last year trial, the comparable Ajuga reptans 'Rosea' had more buds because of more vernalization during storage.

General Value: Plants with supplementary lighting were barely marketable (marks 5 to 6) because of long petioles and less flowers per plant. Best scores got plants from the start of forcing in week 01. Plants exposed to ambient daylight and photoperiodic light scored most under 5.

Shelf life test: The shortest period of time was 21 days whilst the longest time was 31 days (average 27 days). Ajuga reptans 'Braun Hertz' is suitable for living room conditions.

Recommendation for Ajuga reptans 'Braun Hertz'

Cuttings root in about three weeks. Potting should be latest week 31 to make sure that one rosette can fill the pot size and the plants are bulked before vernalization. The 9 or 10 cm pot size is adequate. Ajuga needs well to be fed. The fertilization should be in the higher level of 500 to 700mg N per plant. Make sure that the plants get a cooling period of about 9 weeks. That is important for flowering and flower stretching. The effort for cleaning is low. With higher forcing temperatures at 12°C and supplementary light, it is possible to sell the Ajuga to Valentine's Day. With ambient daylight and 10 °C - 12 °C the flowering will be expected in the middle of March.

3.1.3 Ajuga reptans 'Mini Mahagoni'

Lovely blue long lasting flowering and almost no petioles at the time of flowering makes this species to an early spring favourite (Figure 12). Pillnitz discovered this species during a green and structure plant trial. The last year trial took this species first time in testing as an early spring pot plant. The test was with different depot fertilizer and the results were amazing and successful. Ajuga reptans 'Mini Mahagoni' performs well as a single plant and in arrangements. In this year trial, the plants performed not in the same quality like last year. Reasons for that are the plants were not fertilized enough in autumn, the plants could not fill the 10 cm pot and the vernalization was definitely not enough. Not enough flowers were induced. The data of flowering was recorded when three open flowers were visible on a flowering stem. This year trial tested plants from different potting dates.

Plants which were potted in week 34 (number 5) performed better than plants which were potted in week 38 (number 25).

Figure 12: week 04; Early Spring Display –Blue with Ajuga reptans 'Mini Mahagoni'

Duration of forcing: Plants from earlier potting came 100% into flowering but not all plants from later potting date (Figure 13 and 14). Older plants (number 5) exposed to supplementary light and with the start of forcing in weeks 50 and 01 (H 11.1, H 11.2 and H 10.1) flowered after 34 -36 days. With the start of forcing in week 50, the plants flowered in weeks 3 to 4 and with the start of forcing in week 01 in weeks 5 to 6 - both before Valentine's Day. The glasshouse compartment with supplementary lighting and 9℃ (H10.2) had one week delay in flowering (weeks 6 to 7). Plants exposed to supplementary light flowered 4 weeks earlier than plants exposed to photoperiodic light and 5 weeks earlier than plants exposed to ambient daylight. In last year trial this delay was just 2 weeks because the plants were better vernalized. The storage had significant influence in glasshouses exposed to photoperiodic and ambient daylight. Plants from polythene tunnel were 3 weeks earlier in flowering (weeks 7 to 8) than plants from frost-free glasshouse (weeks 10 to 11).
Plants from later potting and exposed to supplementary light were flowering after 36 to 38 days. Plants exposed to 80 klxh (H11.2) had a delay of 1 week. Plants exposed to 9℃ with start forcing week 01 were flowering with a half-week delay. Plants exposed to photoperiodic and ambient daylight were both late and flowered weeks 10 to 11. The storage was not significant.

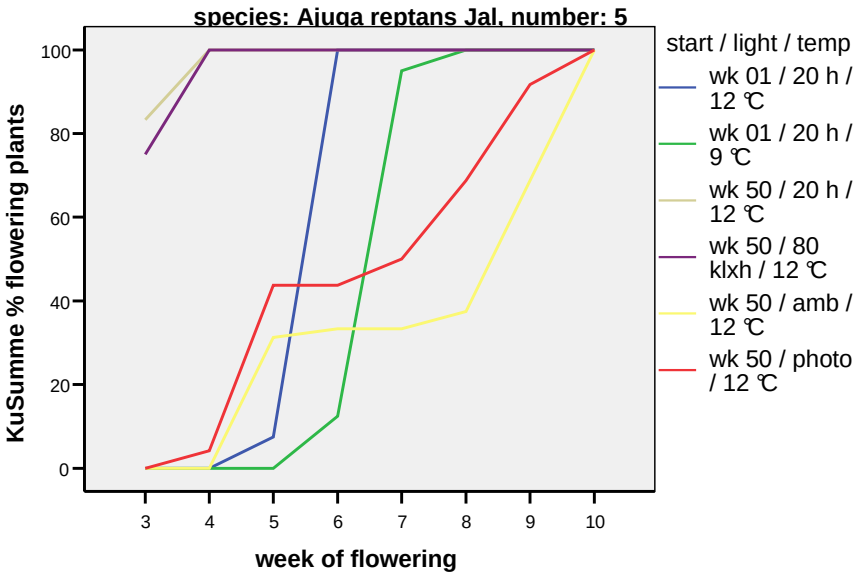


Figure 13: Percentage of flowering plants relative to the light treatments used in the trial (photoperiodic lighting treatment H 11.3 stopped in week 10); Ajuga reptans 'Mini Mahagoni', potting week 34

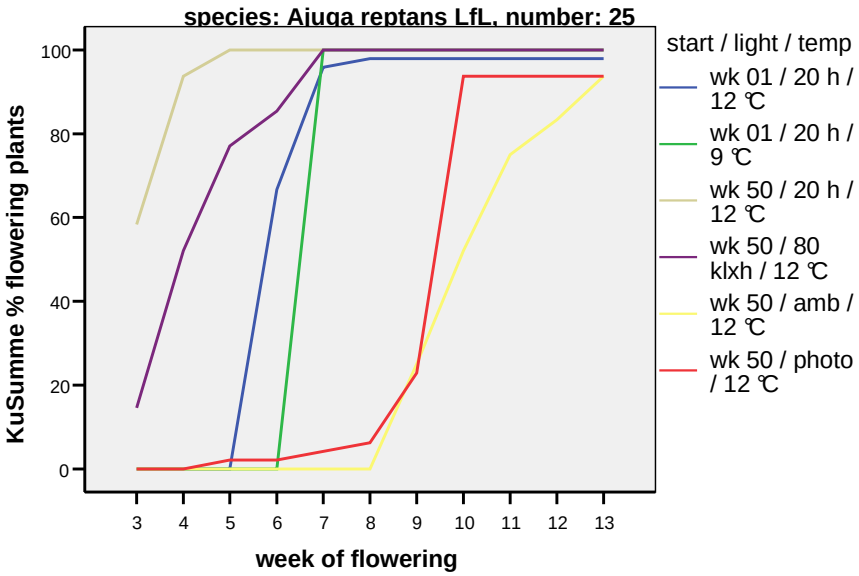


Figure 14: Percentage of flowering plants relative to the light treatments used in the trial. (photoperiodic lighting treatment H 11.3 stopped in week 10) Ajuga reptans 'Mini Mahgoni', potting week 38

Height of leaves, height of flowers and number of buds and flowers: The height of leaves was not mentionable influenced by storage and lighting. However, the height of flowers was different between the glasshouse compartments especially because of the different start of forcing. All plants with more vernalization and with the start of forcing in week 01 stretched their flowers 6 to 7 cm higher (11 to 14 cm, Figure 15) than plants with start of forcing in week 50 (5-7 cm). Plants with start of forcing in week 01 and especially from polythene tunnel and outdoors had more buds and flowers (12-14) compared to the other glasshouse compartments (7 to 8). All plants exposed to supplementary light had in average more flowers and buds than plants exposed to photoperiodic and ambient daylight.

General Value: All plants exposed to supplementary light scored better (6 to 8) than plants exposed to photoperiodic and ambient daylight (4-5). The plants from earlier potting date scored better than plants from later potting date. They were bulked better in autumn.

Shelf life test: The duration of shelf life was always 29 days. Ajuga reptans 'Mini Mahagoni' is absolute suitable for living room conditions.

Recommendation for Ajuga reptans 'Mini Mahagoni'

Cuttings root in about three weeks. Potting should be latest week 33 to make sure that one rosette can fill the pot size and the plants are bulked before vernalization. The 9 cm pot is adequate. Ajuga needs to be fed well. The fertilization should be in the higher level of 500 to 700mg N per plant. Make sure that the plants get a cooling period of about 9 weeks. That is important for flowering and flower stretching. The effort for cleaning is low. With forcing temperatures at 10°C to 12°C and supplementary light, it is possible to sell Ajuga on Valentine's Day. Only effectual vernalized plants got the chance to flower even under ambient daylight and at 12°C until Valentine's Day.

Michigan State University allocates Ajuga to the Early Spring Ephemerals. Plants flower only following a cooling treatment and photoperiod does not regulate flowering (day-neutral). Tested Ajuga reptans 'Bronze Beauty' flowered within two weeks at forcing temperatures at 20°C after 15 weeks constant cooling period at 5°C. Ajuga has to be bulked before forcing otherwise the flower is inconsistent. Ajuga reptans has to be vernalized at least 6 weeks at 5°C.

Figure 15: week 7; Ajuga reptans 'Mini Mahagoni' from storage outdoor 2006/2007; start of forcing in week 01

3.1.4 Aquilegia F1 Spring Magic Series

Aquilegia performed during last year trial 2005/2007 as an attractive flowering early spring pot plant. This year Aquilegia F1 Spring Magic Series was tested in six different colours like the following pictures (Figures 16 - 21) show. The date of flowering was given with one bud showing colour.

Figure 16: F 03 ‘Blau-Weiß’

Figure 17: F 07 ‘Rosa-Weiß’

Figure 18: F 04 ‘Hellrot-Gelb’

Figure 19: F 04 ‘Hellrot-Weiß’

Figure 20: F 06 'Marine-Weiß'

Figure 21: F 08 'Weiß'

Duration of forcing: All Aquilegia from the F1 Series react almost similar in duration of forcing. There was a 100% flowering. Plants were bulked enough before vernalization. Plants exposed to supplementary light flowered 4 weeks earlier than plants exposed to photoperiodic light and 6 weeks earlier than plants exposed to ambient daylight. The plants flowered 2 weeks earlier under supplementary light than last year because the start of forcing was one week earlier than last year and the glasshouse compartments received not only the higher temperatures at the beginning of forcing but also the supplementary light. All plants with supplementary light came into flowering before Valentine's Day. Storage had significant influence. Plants from frost-free glasshouse and under supplementary light 12℃ (H 11.1, H 10.1) were flowering in average after 31 days compared to plants from polythene tunnel with 37 days. The plants with the start of forcing in week 50 flowered in weeks 3 to 4 and plants with start forcing in week 01 in weeks 5 to 6. The plants exposed to the 80 klxh (H11.2) had a half a week to one week delay in comparison to plants from 20h 3000lx (H11.1). The same effect was with the plants exposed to 20h-3000lx at 9℃ (H 10.2) with almost one week delay compared to 20h-3000lx and at 12℃ (H10.1). That points out the correlations between temperatures and light amounts. It is important that plants exposed to ambient daylight came 100% into flowering but plants performed not very well, the flowers were not stretched above the leaves because of missing vernalization and the low light level (ambient daylight) until week 50. The photoperiodic light was able to compensate that lack of vernalization. Only plants from the frost-free glasshouse with the start of forcing in week 50 and exposed to photoperiodic light flowered on Valentine's Day. The following figure (Figure 22) of the percentage of flowering plants of Aquilegia 'F1 Hellrot -Gelb' was chosen as an example for all tested Aquilegia from this series because their display is similar.

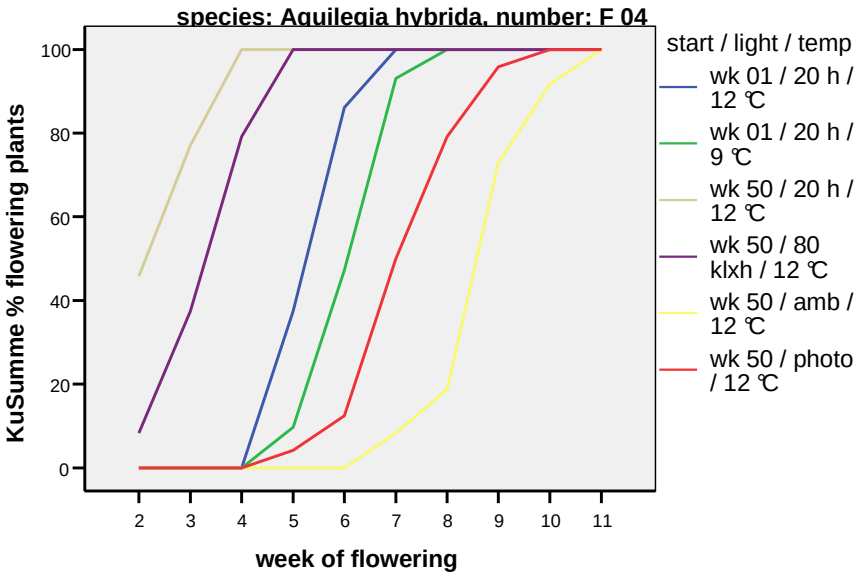


Figure 22: Percentage of flowering plants relative to the light treatments used in the trial.

Aquilegia 'F1 Spring Magic Hellrot-Gelb'

Figure 23 and Figure 24: Aquilegia 'F1 Spring Magic Hellrot-Gelb';

storage left: polythene tunnel, right: frost-free glasshouse, plants cleaned off old foliage

The figures show the differences in foliage after different storage. Plants from frost-free glasshouse (Figures 23 and 24) win by a narrow margin because of a little more foliage.

Height of leaves, height of flowers and number of buds and flowers: The height of leaves was influenced from lighting and storage. All plants under supplementary light were in average 5 to 6 cm taller in foliage than plants under ambient daylight and 3cm higher then plants under photoperiodic light. In most cases plants from frost-free glasshouse stretched their leaves higher than plants from polythene tunnel. The difference between the height of plants exposed to supplementary light and photoperiodic light and from frost-free glasshouse is about 2 cm higher then from polythene tunnel. Even under ambient daylight, the plants from frost-free glasshouse are 1 cm taller then plants from polythene tunnel. Plants from frost-free glasshouses were still better developed in foliage. Half of the Aquilegia series (F03, F04 and F07) showed a significant difference between glasshouse compartments. Plants with 80 klxh (H11.2) kept about 2cm shorter than the plants with supplementary lighting 20h 3000lx (H11.1, H 10.1 and 10.2). The plants from the start of forcing in week 01and at 9°C (H 10.2) were the highest especi ally plants from frost-free glasshouses with 12 to 14 cm compared to other treatments. The height of flowers was influenced from lighting and start of forcing. Flowers with the start of forcing in week 01 and exposed to supplementary light stretched about 4 to 7 cm longer than flowers with the start of forcing in week 50 exposed to supplementary light. Plants were vernalized better. Plants exposed to supplementary light had significant higher flowers than plants exposed to photoperiodic light. Always the shortest flowers had plants exposed to ambient daylight. The flowers were sitting under the foliage because of missing vernalization. Under photoperiodic light, the flowers were in average shortly above the leaves when the first bud showed colour. One week after rating the flower stems under photoperiodic lighting were stretched more above the leaves, the plant performed better but the first flower was already open. This has disadvantages for transport and shelf life. The shortest flowers had the Aquilegia 'F1 Blau-Weiß' exposed to photoperiodic light. The colour showing buds were mainly under the leaves. The photoperiodic lighting could not compensate the lack of vernalization this year by Aquilegia 'F1 Blau-Weiß'. The highest flowers developed Aquilegia 'F1 Marine-Weiß' with a maximum of 29 cm exposed to supplementary light at 9°C with the star t of forcing in week 01. That variety was on the safe side with photoperiodic lighting. The colour showing buds were stretched above the leaves. The other varieties of this series except Aquilegia 'F1 Blau-Weiß' were also successful under photoperiodic light. The amount of buds and flowers was influenced from lighting, start of forcing and in some cases from storage (Figures 25 and 26). In the case of Aquilegia one counted flower and one counted bud means always a flower stem. One flower stem then developed more buds. Plants had in most varieties more buds and flowers with the start of forcing in week 01 and exposed to supplementary light than plants with the start of forcing in week 50 and exposed to supplementary light. The plants had in most cases one flower and 2 to 4 buds. The most developed flowers had the Aquilegia 'F1 Hellrot-Weiß' (F05) and Aquilegia 'F1 Rosa-Weiß'. Plants exposed to ambient daylight often had just the one sitting flower. Plants exposed to photoperiodic light stretched to the time of rating one flower and developed 1 to 2 buds. Aquilegia 'F1 Hellrot-Gelb' and 'F1 Marine-Weiß' had different amounts of flowers and buds because of different storage. Plants from frost-free glasshouses developed 1 to 2 flowers more than plants from polythene tunnel and outdoor. The plants from outdoors had also significant less flowers and buds compared to plants

from frost-free glasshouses and exposed to supplementary light. The outdoor conditions sometimes with degrees under zero set the plants back in development.

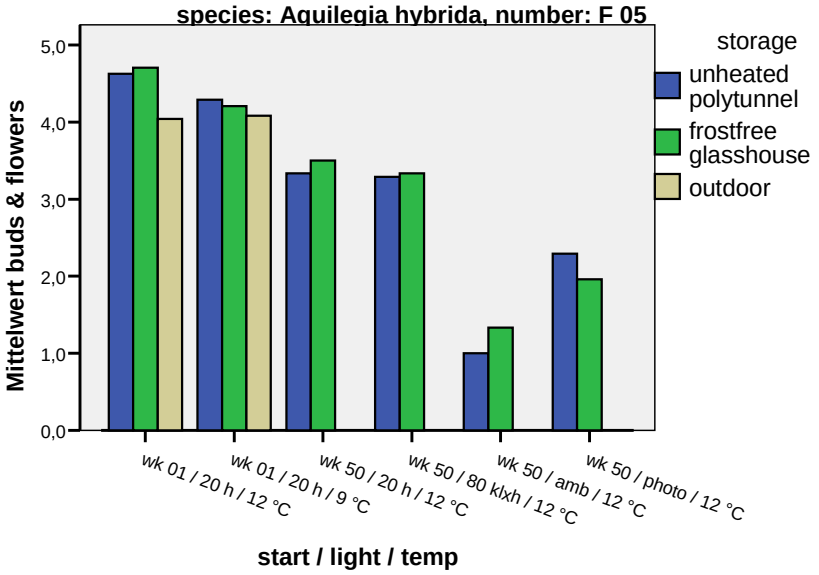


Figure 25: Bar chart of the average number of buds and flowers; Aquilegia 'F1 Spring Magic Hellrot-Weiß'

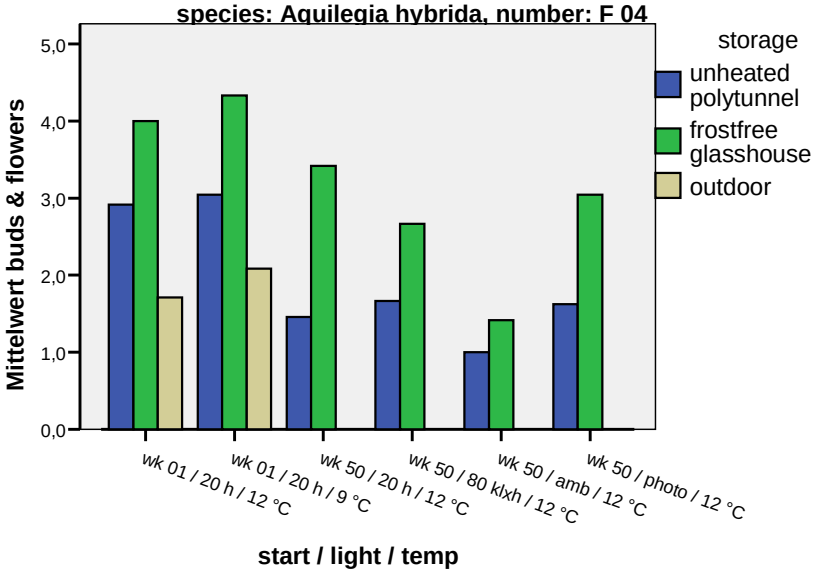


Figure 26: Bar chart of the average of number buds and flowers; Aquilegia 'F1 Spring Magic Hellrot-Gelb'

General Value: Plants exposed to supplementary light scored significantly higher (6 to 7) than plants exposed to photoperiodic light (5 to 6) and ambient daylight (3to 4). The Aquilegia 'F1 Blau-Weiß' scored lower (4-5) because the colour showing bud was often under the leaves. Plants performed significantly better from storage frost-free greenhouse than plants from polythene tunnel or outdoors. The plants developed more foliage.

Shelf life test: The tested Aquilegia received a longer shelf life in this year trial than last year because the plants developed more buds. The shortest time in shelf life was 15 days and the longest 26 days. This makes Aquilegia F1 series suitable for living room conditions

Recommendation for Aquilegia F1 series

Potting should be latest week 36 (better earlier) to get enough bulking before vernalization. The vernalization is necessary to stretch the induced flowers above the leaves. Keep plants for vernalization in frost-free glasshouse as cold as possible about 9 weeks. Plants which are enough vernalized are able to produce quality under photoperiodic light until Valentine's Day. The effort for cleaning is high. Plants will be successful under ambient daylight too but at a later flowering date at the beginning of March. Growing Aquilegia successfully depends on bulking, vernalization and correlations of amounts of light and temperatures.

Michigan State University allocates Aquilegia to the Early Spring Ephemerals. Plants flower only following a cooling treatment and photoperiod does not regulate flowering (day-neutral). The tested Aquilegia flabellata 'Cameo' needs at least 6 weeks for bulking. The weeks of vernalization at constant 5℃ are recommended with 6 to 9 weeks and the tested plants need 4 weeks to flower at 20℃.

3.1.5 Calceolaria biflora 'Goldcap'

Many yellow flowers on wirily flower stems hover above dark green rosettes of leaves (Figure 27). This species was in last year trial first time in testing and attracted attention. Calceolaria biflora 'Goldcap' performs well as a single plant and in arrangements. Calceolaria biflora requires long-day photoperiods. The critical day length seems to be 14 hours as known from other Calceolaria species. It is not known whether Calceolaria needs an obligate vernalization and how long this has to be. The date of flowering was recorded with one open flower on a plant.

Figure 27: week 06; Calceolaria biflora 'Goldcap'; supplementary light

Duration of forcing: The plants exposed to supplementary light came 100% into flowering (Figure 28). Plants exposed to photoperiodic light flowered almost to 100%. Only a couple of plants had no buds at the end of rating. There was no flowering under ambient daylight until week 14. The storage had not a significant influence in all compartments. Only the plants with the start of forcing in week 50, supplementary light and from polythene tunnel were one week earlier than plants from frost-free glasshouse. Plants with the start of forcing in week 50 and exposed to supplementary light 20h-3000lx (H11.1) were one week earlier then the plants exposed to 80 klxh (H11.2). The similar effect was because of the lower temperatures on plants with the start of forcing in week 01. Plants exposed to supplementary light at 12°C (H10.1) were one week earlier than plants exposed to supplementary light and 9°C. Plants exposed to suppl ementary light and 12°C flowered in average after 50 days. The plants in the other light and temperature combinations (H11.2 and 10.2) flowered after 57 days. Plants with supplementary light and the start of forcing in week 50 flowered before Valentine's Day. Plants with the start of forcing in week 50 and exposed to supplementary light flowered in weeks 4 to 5 and plants with the start of forcing in week 01 in weeks 7 to 8. Crop was earlier then last year where plants exposed to supplementary light flowered in weeks 7 to 8. The reasons for this earlier flowering are that plants received light treatment one week earlier and received a higher sum of light and temperatures until Valentine's Day compared to last year. Plants exposed to photoperiodic light flowered in average after 72 days in weeks 8 to 9. The plants with the start of forcing week 01 flowered about the same time weeks 7 to 9.

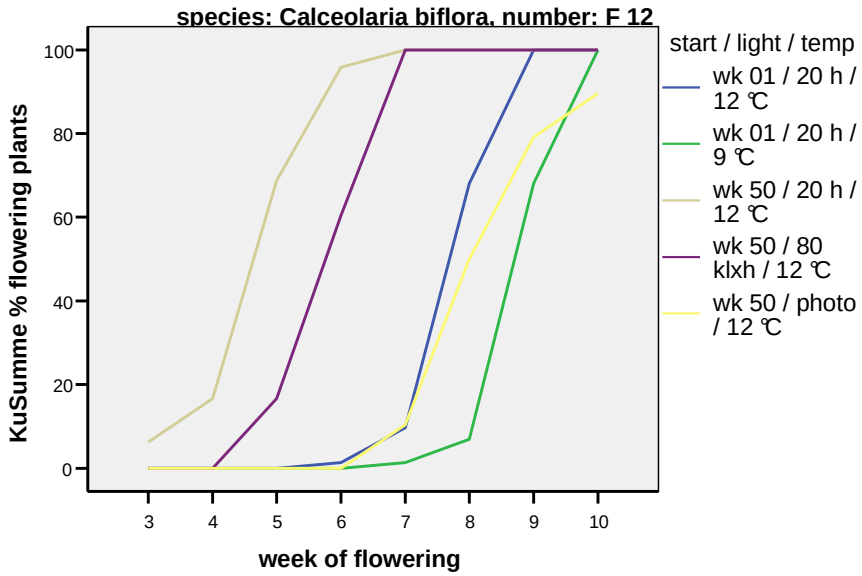


Figure 28: Percentage of flowering plants relative to the light treatments used in the trial (photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: The height of leaves was influenced by storage. Especially plants with the start of forcing in week 50 and from frost-free glasshouse were 2 cm higher than plants from polythene tunnel. Most plants were in average 7 to 8 cm high. The height of flowers was not influenced by lighting and storage. Flowers were in average 17 to 18 cm high. The number of buds was not influenced by storage but by lighting and start of forcing. Plants with the start of forcing in week 01 and exposed to supplementary light developed 2 to 3 buds more (14 to 16) than plants with the start of forcing in week 50 (11-12). Plants received a longer cooling period. Plants under photoperiodic light developed significant fewer flowers and buds (9 to 10).

General Value: The storage had no influence on the general value. Plants under photoperiodic light scored significantly lower (about 6) compared to the other treatments with 7 to 8. The habitus was slacker and flower stems stretched not that equal like under supplementary light.

Shelf life test: The shortest time in shelf life was 21 days and the longest 31 days. This makes Calceolaria suitable for living room conditions.

Recommendation for Calceolaria biflora ‘Goldcap’

Potting should be latest week 35. The 10cm pot is adequate. Storage can take place in frost-free glasshouse or polythene tunnel from week 40 to 50. Calceolaria needs an obligate long day. The effort for cleaning is middle. Under supplementary light (20hours) at 12℃ and the start of forcing in week 50 the Calceolaria biflora ‘Goldcap’ will flower until Valentine’s Day.

3.1.6 Erysimum perovskianum ‘Goldrush’

This species was last year first time in trial and only exposed to supplementary light and attracted attention as an early spring pot plant. The flowers have a fascinating yellow colour (Figure 29) and spread a sweet scent of spring. Not all plants came into flowering during this year trial. The reason is not clear. Some plants flowered already before the forcing started and flowers were removed in week 45 but most plants were able to produce many side flowers. The vernalization seems to be more responsible for the success of flowering. The plants with the start of forcing in week 01 flowered 100% (except a couple of plants from frost-free glasshouse) because of longer vernalization. Only plants with the start of forcing in week 50 and plants from polythene tunnel flowered 100% but not the plants from frost-free glasshouse. That is why the curves are in average under 100% and flowering occurred over a longer period of weeks. The date of flowering was recorded when three open flowers were present at a flowering stem.

Figure 29: week 03; Erysimum perovskianum ‘Goldrush’ ; supplementary light

Duration of forcing: All plants exposed to supplementary light at 12°C needed in average 38 days until flowering. Plants with the start of forcing in week 50 flowered in weeks 3 to 4 and plants with the start of forcing in week 01 flowered in weeks 6 to 7 just before Valentine's Day (Figure 30). Plants with the start of forcing in week 01 and exposed to supplementary light at 9°C flowered almost one week later than at 12°C. Plants exposed to supplementary light were 2 weeks earlier than plants exposed to photoperiodic and 4 weeks earlier than plants exposed to ambient daylight. The flowering was over a long period. There were also early flowers under ambient daylight. Erysimum reacts day-neutral. Storage was significant under photoperiodic light and ambient daylight. Plants from polythene tunnel were 1 to 2 weeks earlier than plants from frost-free glasshouse.

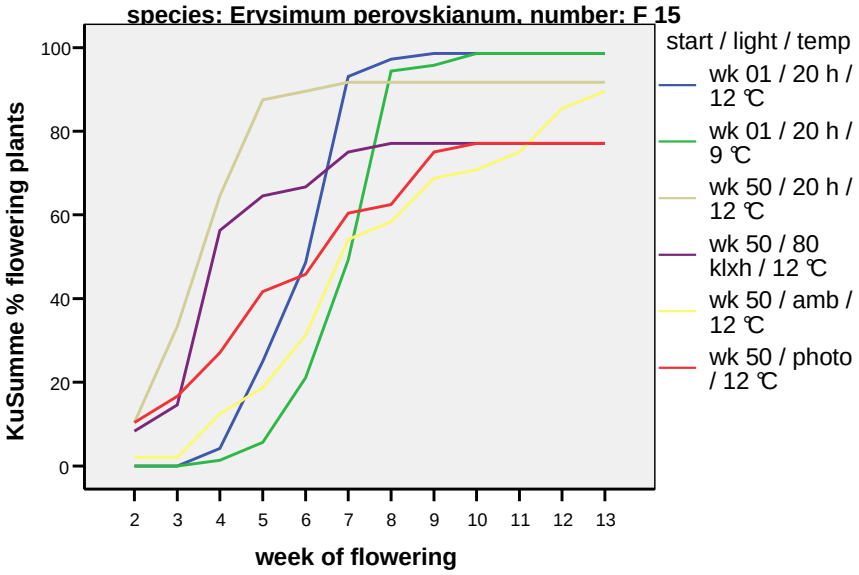


Figure 30: Percentage of flowering plants relative to the light treatments used in the trial. (photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: The height of leaves was not influenced by storage or lighting but the height of flowers. Plants with the start of forcing in week 01 and especially from outdoor stretched their flowers 4 cm higher (17 to 19 cm) than plants with the start of forcing in week 50 (14cm). Plants received a longer cooling period. Flowers exposed to photoperiodic and ambient daylight stretched significantly less (10 to 11cm) than plants exposed to supplementary light. In half of glasshouse compartments, the influence of storage was significant. Plants from polythene tunnel and outdoors stretched taller compared to plants from frost-free

glasshouse. The number of buds was influenced by storage and the start of forcing. Most plants with start of forcing in week 50 and from polythene tunnel had 2 buds more than plants from frost-free glasshouse. Plants with the start of forcing in week 01 developed 2 to 3 buds more (7 to 9) than plants with the start of forcing in week 50 (polythene tunnel; 5 to 7).

General Value: The significant best marks scored plants with the start of forcing in week 01 and exposed to supplementary light at 12°C (6 to 7). The significant lowest marks scored plants exposed to ambient daylight and photoperiodic light (4 to 6). The plants from polythene tunnel scored better marks than plants from frost-free glasshouse. The plants could not fill the 10 cm pot.

Shelf life test: The shortest time in shelf life was 19 days and the longest 39 days. It depended on the number of buds per plant that were present at the beginning of shelf life. Erysimum perovskianum 'Goldrush' is suitable for living room conditions.

Recommendation for Erysimum perovskianum 'Goldrush'

Potting should be latest week 36. The 9 cm pot is adequate. Storage can take place in frost-free glasshouse or polythene tunnel from week 40 to 50. Important is plants receive enough vernalization. Erysimum perovskianum 'Goldrush' belongs to the Early-Spring Ephemerals: species reacts day-neutral and flowers only following a cooling treatment. The effort for cleaning is low. Supplementary light forces flowering and is able to compensate lack of vernalization. Plants flower until Valentine's Day even under ambient daylight.

3.1.7 Iberis sempervirens 'Snowflake'

The bright white flowers of Iberis are attractive in early spring arrangements. This year the Iberis was not so successful in flowering than in former trials (Figure 31). The plants were not bulked enough before cooling. There was not a 100% flowering. The date of flowering was recorded when there were 3 to 4 open flowers per plant.

Figure 31: week 08; Iberis sempervirens 'Snowflake'; ambient daylight; polythene tunnel

Duration of forcing: All plants exposed to supplementary light flowered in average after 36 days. Plants with the start of forcing in week 50 flowered in weeks 3 to 4 and plants with the start of forcing in week 01 flowered in weeks 5 to 7 before Valentine's Day (Figure 32). All supplementary lighting treatments were about 5 weeks earlier than plants exposed to photoperiodic light and 6 weeks earlier than plants exposed to ambient daylight. This delay was because of less vernalization of plants during storage. In former trials, it was possible to receive the flowers until Valentine's Day under ambient daylight. This year the supplementary light compensated the lack of vernalization. The influence of storage was significant under photoperiodic light. Plants from polythene tunnel and with the start of forcing in week 50 flowered earlier (week 7) compared to plants from frost-free glasshouse (week 9).

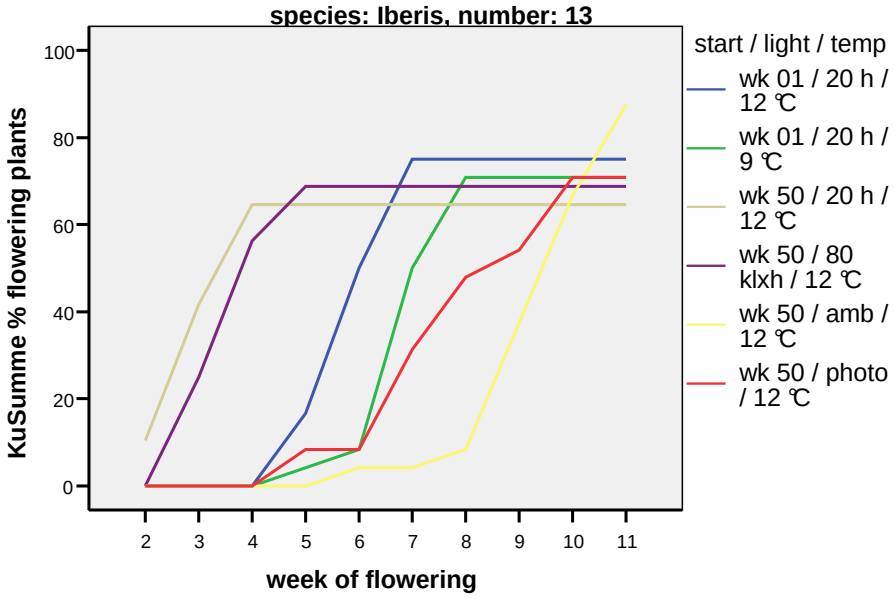


Figure 32: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: The height of leaves was measured in the height were the plant branched. This was always in about 3 to 5 cm. There was no significant influence of lighting and storage. The height of flowers was significant influenced. Plants exposed to supplementary light stretched the flowers 15 to 17 cm high compared to photoperiodic light 10 cm high and ambient daylight 8 cm high. The number of buds and flowers was not influenced by lighting or storage. Only plants with the start of forcing in week 01 and from outdoors were influenced by storage. Plants developed 2 buds more than all other treatments. That points out the relevance of vernalization.

General Value: The plants could not fill the 10 cm pot. The general value was low. Plants under photoperiodic light, ambient daylight and plants with start of forcing in week 01 scored better compared to plants with the start of forcing in week 50 and exposed to supplementary light. Best scored the plants from outdoors with more developed flowers per plant (average 4.8).

Shelf life test: The shortest time in shelf life was 11 days and the longest 14 days (average 13 days). In former trials, the shelf life was 17 days because of more buds per plant. Iberis sempervirens 'Snowflake' is suitable for living room conditions.

Recommendation for Iberis sempervirens 'Snowflake'

Potting should be latest week 32. The 8-9 cm pot size is adequate with one plant per pot. Trim plants after 4 weeks to increase branching. Plants have to be bulked enough with probably up to more than 40 leaves before cooling starts. Storage can take place in a frost-free glasshouse or polythene tunnel from week 40 to 50. It is important that plants receive enough vernalization. The effort for cleaning is zero. Iberis sempervirens 'Snowflake' belongs to the Early-Spring Ephemerals: species reacts day-neutral and flowering only following a cooling treatment. Supplementary light forces flowering and is able to compensate lack of vernalization. Plants flower until Valentine's Day even under ambient daylight.

Michigan State University allocates Iberis sempervirens 'Snowflake' and 'Alexander's White' and others to the Early Spring Ephemerals. Plants flower only following a cooling treatment and photoperiod does not regulate flowering (day-neutral). The bulking before cooling is a must. The weeks of vernalization at constant 5°C are recommended with at least 8 weeks and the tested plants flowered after 2 to 3 weeks at 20°C forcing temperatures.

3.1.8 Lindernia 'Grandiflora'

Amongst its tiny green heart-shaped leaves emerge lots of small dark blue and white flowers that never quit blooming (Figure 33). The creeping foliage is able to cover o pot quickly. It is a newcomer in perennial gardens and could also be a new early spring pot plant attractive as a hanging basket or in arrangements. The species is a Florida native and belongs more to the tropical regions. According to a perennial prospectus Lindernia belongs to Hardy Zone 8b (-7to - 9°C) and more. That species has to be protected against frost. Surprising was the performance in shelf life test. 100% of plants came into flower far before Valentine's Day except plants from polythene tunnel and with the start of forcing in week 01. Plants received a little frost in polythene tunnel and

foliage had to establish again before flowering. The date of flowering was recorded when there were 3 to 4 open flowers per plant.

Figure 33: week 06, Lindernia 'Grandiflora', supplementary light

Duration of forcing: All plants exposed to supplementary light flowered with 3 to 4 open flowers after 23 days except plants from polythene tunnel and start forcing in week 01. They flowered after 40 to 60 days. Plants exposed to ambient daylight flowered after 40 days. Plants with the start of forcing in week 50 and exposed to supplementary and photoperiodic light flowered in week 1 (Figure 34). Plants exposed to ambient daylight and plants with the start of forcing in week 01 and only from frost-free glasshouse flowered in week 4 compared to plants from polythene tunnel (week 9 and week 7).

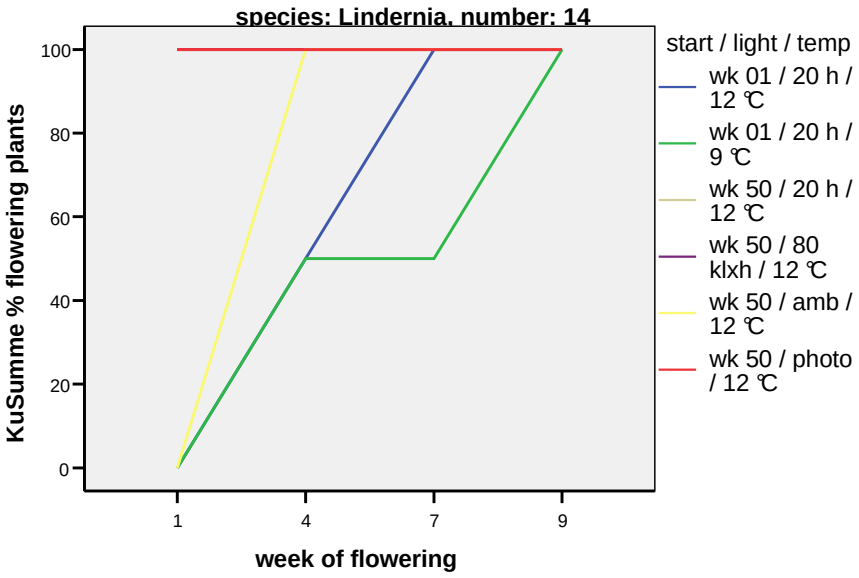


Figure 34: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: The flowers occur at the end of foliage. The measured height for leaves and height of flowers is the same. Plants exposed to supplementary light and start of forcing in week 50 were longer (11-12 cm) compared to plants exposed to supplementary light and start of forcing in week 01 (7- 9 cm) and plants exposed to photoperiodic light (9-10 cm).

General Value: The plants could not fill the 10 cm pot. Plants were not branched enough. The general value was low. Plants from frost-free glasshouse scored best (average 4.8).

Shelf life test: The shortest time in shelf life was 38 days and the longest 47 days (average 43 days). That is amazing. All buds opened up and the plants were covered with flowers. Lindernia loves the higher temperatures. Lindernia is absolutely suitable for living room conditions.

Recommendation for Lindernia 'Grandiflora'

Cuttings root in about three weeks. Potting should be earlier than week 31 to allow trimming that plants branch better and fill 9 cm pots. Alternatively, start with 2 to 3 cuttings in a 10 to 11 cm pot. Lindernia seems to be a plant, which flowers regardless of cooling and photoperiod. There is more dependence on temperatures. The effort for cleaning is low. At forcing temperatures at 12℃ (after a time of frost-free storage), flowers appear after 3 weeks.

3.1.9 Serissa foetida 'Pink Mystic'

That species could have a great future under the new early pot plants. The species is a little shrub and performs like a little Bonsai ready for selling until Valentine's Day (Figures 35 and 36). The small leaves are white and green and the flowers remind on lots of pink and white Stars. The name in German for the species Serissa foetida is Baum der 1000 Sterne (tree of 1000 stars) or Junischnee (snow in June). This species is sold as a Bonsai. 100% of plants came into flower until end of rating except plants from polythene tunnel and with the start of forcing in week 01 at 9℃.
Serissa is not hardy to frost and prefers warmer temperatures. The date of flowering was recorded when one flower was open per pot.

Figure 35 and Figure 36: week 05 left and week 08 right; Serissa foetida 'Pink Mystic'; supplementary light

Duration of forcing: The 100% flowering was received over a longer period of weeks. The storage had significant influence. Plants exposed to supplementary light and photoperiodic light and from frost-free glasshouse flowered about 1 week earlier than plants from polythene tunnel. Plants exposed to ambient daylight react the other way round that plants were 1 week earlier from polythene tunnel than plants from frost-free glasshouse. Plants with the start of forcing in week 50 and exposed to supplementary light flowered until Valentine's Day in weeks 6 to 7 (Figure 37). Plants exposed to photoperiodic and ambient daylight flowered in weeks 6 to 8and 6 to 9. Plants with the start of forcing in week 01 and exposed to supplementary light flowered in week 9 to 10. Only plants from polythene tunnel and exposed to supplementary light at 9℃ did not flower until the end of rating. That's why the curve stops at 50%.

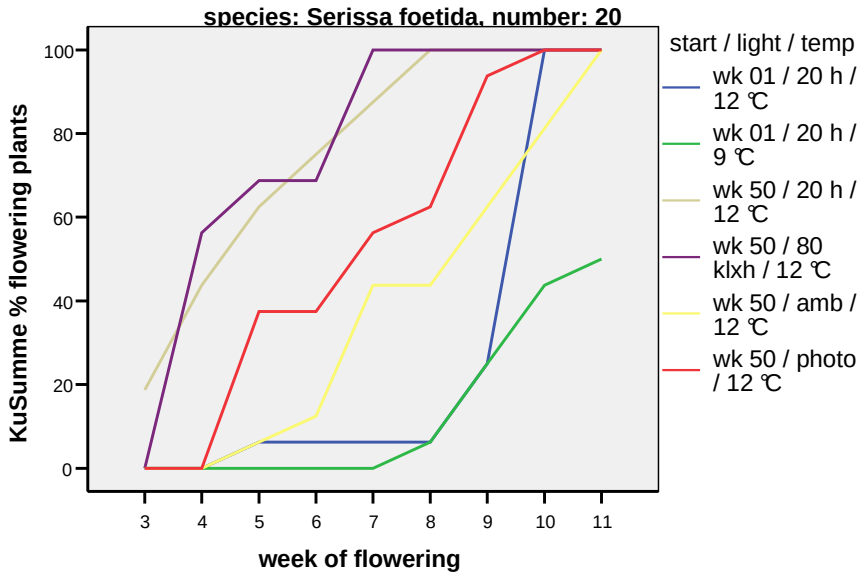


Figure 37: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers: The height of leaves and flowers was not influenced by lighting and storage.

General Value: The plants could not fill the 10 cm pot. The average was about 6. With a suitable pot size and the knowledge that all buds will open up in shelf life the Serissa could have scored much better.

Shelf life test: The shortest time in shelf life was 19 days and the longest 24 days (average 22 days). Serissa loves the higher temperatures. Serissa is absolutely suitable for living room conditions.

Recommendation for Serissa foetida 'Pink Mystic'

Cuttings root in about three weeks. Potting should be latest week 31 in a 9 cm pot. Plants develop branches without trimming. The effort for cleaning is zero. The duration of forcing until flowering depends on amount of light and temperatures. Flowering is possible before Valentine's Day at 12℃ and with the start of forcing in week 50.

3.1.10 Erinus alpinus 'Dr. Hähnle'

This pink flowering plant is actually a recommendable early spring pot plant (Pillnitz trial 2002/2003; Figure 40). However, this year the data were too low to allow an evaluation. The reasons were the

late potting date and the lack of vernalization until week 50 (Figures 38 and 39). Plants with the start of forcing in week 01 received three weeks more vernalization until forcing and the flower stems stretched under supplementary light. However, the number of flowers per plant was still too low.

Figure 38 and Figure 39: week 09; Erinus alpinus 'Dr. Hähnle'; supplementary light 12℃ left: start of forcing in week 50, right: start of forcing in week 01 and plants from outdoor

Figure 40: 2003; week 10; Erinus alpinus 'Dr. Hähnle'; supplementary light at 10℃

3.1.11 Barbarea rupicola ‘Sunnyola’

This species failed this year because the general value scored low. The flowers are very nice compared to the dark leaves rosettes. However, the flowers stretched not enough above the leaves to make this species marketable. The period for vernalization was not long enough during this extreme mild autumn and winter even until week 01 when the second set of forcing started. There was a sign that flowers stretched a bit higher with the start of forcing in week 01 and exposed to supplementary light than plants with the start of forcing in week 50. There has to be more testing about vernalization. Barbarea rupicola ‘Sunnyola’ needs a longer period with temperatures about 5℃. This species should be tested in cooling chamb ers.

3.2 PGR Trial

During this year trial 13 species were tested on reaction to growth regulators treatments. The both Lychnis failed right from the start. Flower stems did not stretch because of the missing vernalization until week 50. The table (Table 9) gives an overview about the inhibition effects of growth regulators on tested species. Then the tested 11 species will be extra explained. At first will the untreated species reaction be mentioned and then the results to its reaction of growth regulators treatments.

Table 9: Early spring pot plants and their reaction to Topflor und Cycocel 720

number	species/variety	Topflor	Cycocel 720
15	Lithodora diffusa ‘Heavenly Blue’	++	+
24	Phlox divaricata	++	+
26	Phlox divaricata (Abvermehrung Pillnitz)	++	+
F01	Anacyclus pyrethrum var. depressus ‘Silberkissen’	+	+
F02	Androsace septentrionalis ‘Star Dust’	+	0
F09	Aquilegia vulgaris ‘Winky Double White-White’	+	+
F13	Erigeron karvinskianus ‘Stallone’	++	+
F16	Geum coccineum ‘Cooky’	0	+
F18	Horminum pyrenaicum	0	+
F19	Lychnis alpina	lack of vernalization no flowers	
F20	Lychnis alpina ‘Snow Furry’		
F21	Papaver miyabeanum ‘Pacino’	+	+
F22	Papaver nudicaule ’Gartenzwerg’	0	0
F23	Silene pendula ‘Lausitz’	+	++

0 = no reaction, + = less inhibition effect, ++ = strong inhibition effect

3.2.1 Anacyclus pyrethrum var. depressus ‘Silberkissen’

Species performed very well in this year trial again. The single flower has white colour at the top and purple colour on the underside of the flower petals (Figure 41). 100% of plants came into flowering. The data of flowering was recorded when there were three open flowers per plant.

Figure 41: week 07; Anacyclus pyrethrum var. depressus ‘Silberkissen’; supplementary light

Anacyclus pyrethrum var. depressus ‘Silberkissen’ and no growth regulator treatment:

Duration of forcing: The supplementary light forces the duration of forcing compared to photoperiodic and ambient daylight. Storage had no influence. Plants with the start of forcing in week 01 at 12℃ were the fastest with an average of 49 days compared to plants with start of forcing in week 01 at 9℃ and plants with start of forcing in week 50 with an average of 55 days. Plants exposed to photoperiodic light were 2 weeks earlier then plants exposed to ambient daylight. The flower was earlier then expected this year because the sum of temperatures and the sum of light were larger until Valentine’s Day than in former trials. It is not clear how far Anacyclus depends on vernalization. Important seems to be the correlation of temperatures and light level. Plants exposed to supplementary light and with the start of forcing in week 50 at 12℃ flowered before Valentine’s Day in weeks 5 to 6 (Figure 42).

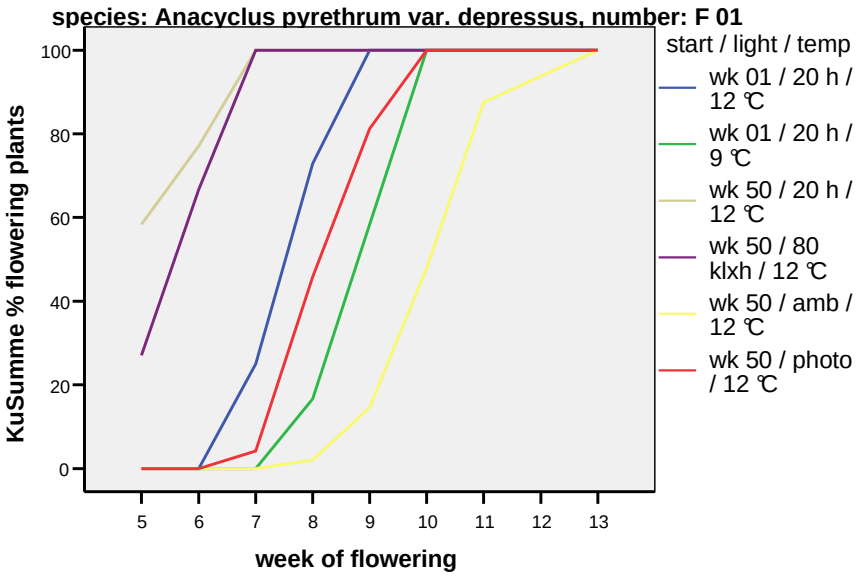


Figure 42: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: The flowers occur at the end of foliage. The measured height for leaves and height of flowers were the same. All plants were about the same height (better long- foliage spreads to the side) about 14 cm. There were two exceptions. Photoperiodic light stretched the plants more than other lighting (22 cm) and plants from the start of forcing in week 01 and from outdoors were about 17 cm. The number of buds and flowers was not influenced by lighting except plants in glasshouse compartment H 11.2 (20-80klxh) had in average 2 to 3 buds more than the others but this seems to be more accidentally. The storage had influence on plants exposed to ambient daylight and photoperiodic light. Plants from polythene tunnel had in average 2 buds more then plants from frost-free glasshouse. It is not sure whether there is a correlation to vernalization. Plants with the start of forcing in week 01 and from outdoor developed less buds because the low temperatures were disadvantageous for development.

General Value: The best scored plants with the start of forcing in week 50 and supplementary light (6-7) compared to all other. The lowest scored plants exposed to photoperiodic light and plants with the start of forcing in week 01 and from outdoors because of the long stretched foliage.

Shelf life test: The shortest time in shelf life was 14 days and the longest 26 days (average 22 days). Anacyclus is suitable for living room conditions.

Anacyclus pyrethrum var. depressus ‘Silberkissen’ and growth regulator treatments:

Height of leaves = Height of flowers: Topflor and CCC 720 had influence with lower application rates (supplementary light). Plants were in average 2 to 3 cm shorter than untreated plants and plants treated with the higher application rate. Plants exposed to ambient daylight were more influenced by the higher application rates and were 2 cm shorter then untreated plants. Plants exposed to photoperiodic light were 5 cm shorter (17 cm) in all growth regulators treatments than untreated plants (22 cm).
Duration of forcing: no influence
Number of buds and flowers: no influence
General Value: no influence

Recommendation for Anacyclus pyrethrum var. depressus ‘Silberkissen’
Potting should be latest week 36 to allow the good covering with foliage before storage. The necessity of vernalization during storage is not clear. However, with the start of forcing in week 50 at 12°C and supplementary light the plants will flo wer before Valentine’s Day. The effort for cleaning is middle. Photoperiodic and ambient daylight will be later in flower. Growth regulator can be useful in combination with photoperiodic light.

3.2.2 Androsace septentrionalis ‘Star Dust’

This species appears with short rosettes of leaves and flowers with many white flowers (Figure 43) like Gypsophila (baby’s breath). Especially in arrangements, Androsace performs very well. Androsace is becoming a little more popular than an early spring pot plant. Growers start to discover Androsace as a simple growing crop. The date of flowering was recorded when three open flowers were presented on a flower stem.

Figure 43: week 03; Androsace septentrionalis 'Star Dust'; supplementary light

Androsace septentrionalis 'Star Dust' and no growth regulator treatments:
100% of plants came into flowering. There was an appearance of buckled flower stems the first time. The reason for that appearance is not clear.

Duration of forcing: Plants exposed to supplementary light were 5 to 7 weeks earlier than plants exposed to photoperiodic and ambient daylight. Plants with the start of forcing in week 01 at 12℃ (supplementary light) and from outdoors were the fastest in forcing with 23 days, one week faster than plants with the start of forcing in week 50 (30 days). Plants from polythene tunnel were always 1 to 2 weeks earlier than plants from frost-free glasshouses. More difference in storage was under ambient daylight and photoperiodic light. Plants from polythene tunnel were 2 to 3 weeks earlier than plants from frost-free glasshouse. Plants with the starts of forcing in week 50 and week 01 flowered before Valentine's Day (Figure 44). The photoperiodic and ambient daylight flowered over a long period of time and late this year because of missing vernalization. That points out the must of vernalization.

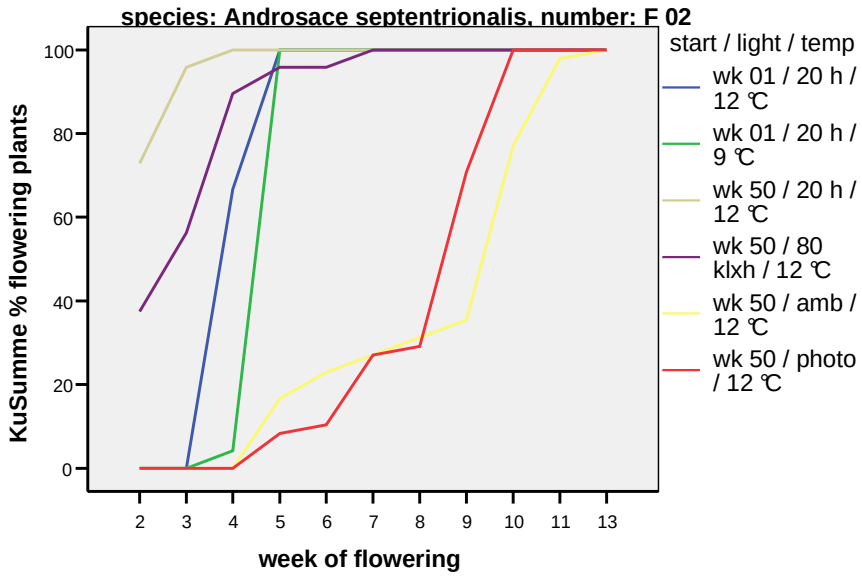


Figure 44: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: There was not a mentionable influence on height of leaves but on height of flowers through lighting or storage. Flowers of plants with start of forcing in week 01 and from outdoor (only tested) stretched 3 to 4 cm higher (23 cm) than flowers with the start of forcing in week 50 (19 cm) and 4 to 5 cm higher than flowers exposed to photoperiodic and ambient daylight (17 cm) . Plants from polythene tunnel stretched the flowers higher than plants from frost-free glasshouse. The more vernalization the more the flowers stretched above the leaves. Androsace develops a whole bunch of buds. This year was one single plant potted per pot. It was surprising that this little rosette was able to fill the 10 cm pot during autumn. However, one rosette develops one main flower in the middle of the plant, which stretches first. That's why this year we often counted only 1 to 2 flowers. The buds were not measured.

General Value: Plants exposed to supplementary light scored better (6 to 7) than plants exposed to photoperiodic light and ambient daylight (5 to 6). These are lower scores than the years before because of the one rosette with its single stretched flower stem. It was hard for flowers and buds to stretch above the leaves especially under photoperiodic light and ambient daylight because of the less vernalization during storage. The storage had no influence on general value.

Shelf life test: The shortest time in shelf life was 23 days and the longest 23 days (average 23 days). Androsace septentrionalis 'Star Dust' is suitable for living room conditions.

Androsace septentrionalis ‘Star Dust’ and growth regulator treatments:

Height of leaves: no influence

Height of flowers: Flowers of plants treated with Topflor were 2cm shorter than untreated plants (Figure 45). The influence of CCC 720 was not significant.

Figure 45: week 05; Androsace septentrionalis ‘Star Dust’ from left to right: untreated, 2x Topflor, 4x Topflor

Duration of forcing: Plants treated with Topflor (2 times and 4 times) had almost one week delay in flowering.

General Value: no influence

Recommendation for Androsace septentrionalis ‘Star Dust’

Sowing should be weeks 29 to 31 and potting week 32 to 33 to allow the good covering with foliage before storage. Three plants (seedlings) per pot perform a better flowering until Valentine’s Day. 9 to 10 cm pot size is adequate. Use liquid fertilizer. Fertilizing should be in the lower level and not above 200mg N per plant. If the vernalization is enough during storage, plants are able to flower until Valentine’s Day even under ambient daylight (start of forcing in week 50 at 12°C). Flowering will be earlier and uniform under supplementary light. Supplementary light is able to compensate the lack of vernalization. The effort for cleaning is almost zero. The growth regulator Topflor was effectual on the height of flowers but plants flowered with delay.

3.2.3 Aquilegia vulgaris 'Winky Double White-White'

This year trial tested only the white colour of this series. The species performs very pretty with the double filled flowers (Figures 46 and 47) and is suitable as a background plant in spring arrangements. 100% of plants came into flowering except three plants exposed to ambient daylight. The flower stem could not stretch because of lack of vernalization. The date of flowering was recorded with one opening bud on a flower stem.

Figure 46 and Figure 47: week 05; Aquilegia vulgaris 'Winky Double White-White'; supplementary light Aquilegia vulgaris 'Winky Double White-White' and no growth regulator treatments

Duration of forcing: Plants exposed to supplementary light were 4 to 5 weeks earlier in flowering than plants exposed to photoperiodic light and 8 to 9 weeks earlier than plants exposed to ambient daylight. Plants with the start of forcing in week 50 (20h-3000lx) were one week earlier than plants exposed to 80klxh. Plants from frost-free glasshouse were one week earlier than plants from polythene tunnel. Plants with the start of forcing in week 50 and supplementary light flowered in weeks 4 to 6 before Valentine's Day (Figure 48).

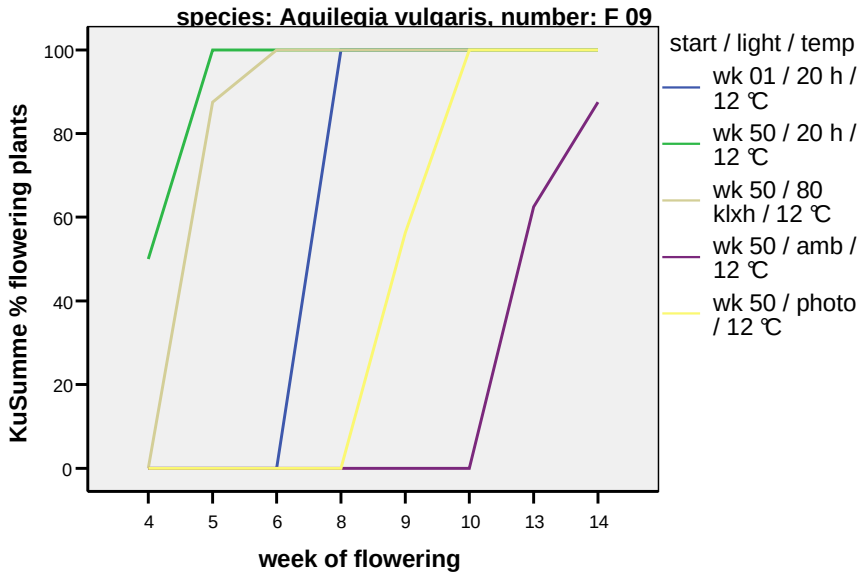


Figure 48: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers: Plants exposed to supplementary and photoperiodic light were higher in leaves than plants exposed to ambient daylight. Storage had no influence on height of leaves. Plants from start forcing in week 01 and from outdoor (only tested) stretched highest with 30 cm. All other plants were shorter about 25 cm and the plants exposed to ambient daylight were the shortest in flower with about 13 cm. The flowers could not stretch enough because of lack of vernalization. Supplementary light and photoperiodic light compensates this lack of vernalization. Storage had not a mentionable influence on height of flowers. The measured flowers and buds were actually flower stems. One flower stem developed many more flowers (Figure 47). There were always one flower stem and some times a second flower stem visible.

General Value: Plants exposed to supplementary light and photoperiodic light scored better (6 to 7) than plants exposed to ambient daylight (4 to 6). Plants from frost-free glasshouse scored better than plants from polythene tunnel. The reason is again the missing vernalization that plants could not stretch the flower stems above the leaves.

Shelf life test: The shortest time in shelf life was 19 days and the longest 26 days (average 20 days). Aquilegia vulgaris 'Winky Double White-White' is suitable for living room conditions.

Aquilegia vulgaris 'Winky Double White-White' and growth regulator treatments:
There were only the higher application rates in testing.

Height of leaves: Topflor (2x) and CCC 720 (2x) had a little influence on height of leaves. Plants were about 2 cm shorter than untreated plants.
Height of flowers: Plants treated with CCC (2x) were about 3 cm shorter than the untreated plants.
Duration of forcing: no influence
General Value: no influence

Recommendation for Aquilegia vulgaris 'Winky Double White-White'
Potting should be latest week 36 better earlier to get the chance of good bulking before vernalization and to improve the flowering. The 10 cm pot is adequate. The vernalization is a must before forcing and with forcing under ambient daylight. Supplementary and photoperiodic light can compensate the lack of vernalization. The effort for cleaning is high. With start of forcing in week 50 and under supplementary light plants will flower before Valentine's Day.
The test with growth regulators was not so conclusive this year to give a recommendation on it.

3.2.4 Erigeron karvinskianus 'Stallone'

This species has a more creeping than upright growth. The flowers are like little daisies and are white and pink coloured (Figure 49). The date of flowering was recorded when three open flowers were presented on a plant. This chapter evaluates only the trimmed Erigeron karvinskianus 'Stallone' (F13 gest) because the untrimmed scored to low general values.

Figure 49: week 06; Erigeron karvinskianus 'Stallone'; supplementary light and no growth regulator treatment

Erigeron karvinskianus ‘Stallone’ and no growth regulator treatments:

Duration of forcing: 100% of plants came into flowering. Plants exposed to supplementary light and with start of forcing in week 50 flowered in weeks 4 to 5 before Valentine’s Day (Figure 50). Plants exposed to photoperiodic light flowered three weeks later and plants exposed to ambient daylight flowered 5 weeks later. The plants with the start of forcing in week 01 had to establish themselves especially plants from outdoor (received frost) and had a delay in flowering. Plants exposed to photoperiodic light and ambient daylight and with the start of forcing in week 50 had significance in storage. Plants from polythene tunnel were 1 week earlier than plants from frost-free glasshouse. During the last year trial 2005/2006 the plants exposed to supplementary light were 2 weeks later in flowering and only plants from polythene tunnel could reach the Valentine’s Day. The reason for the earlier flowering is the earlier start of forcing during this year trial and the larger sum of light and temperatures over the period of time. Vernalization seems to have an influence on Erigeron karvinskianus ‘Stallone’.

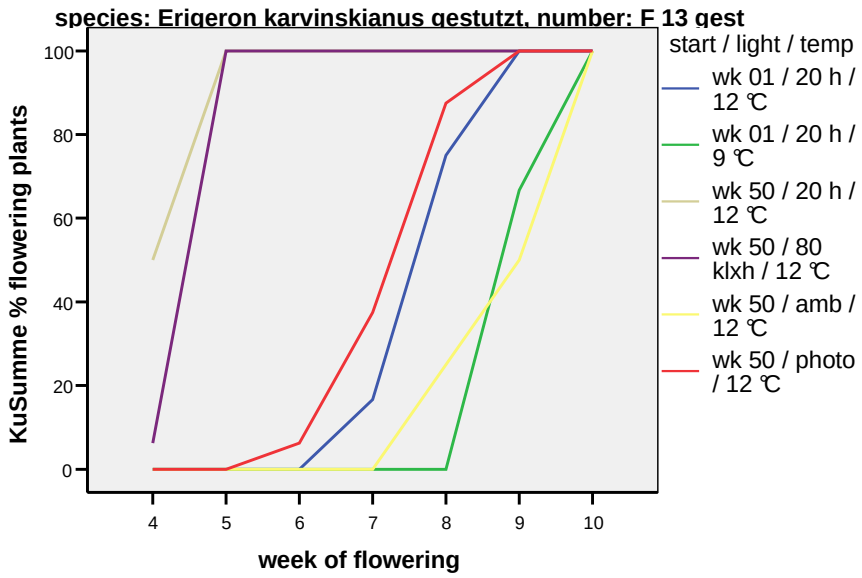


Figure 50: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers: The flowers occurred at the end of branches so that the height of leaves was similar the height of flowers. Plants were about the same height (better long in branches and flower) 18 to 20 cm excepted plants with the start of forcing in week 50 under 80 klxh and under photoperiodic light were 5 to 7 cm longer stretched especially through plants from frost-free glasshouse.

General Value: All plants with the start of forcing in week 50 scored higher (6 to 7) than plants with the start of forcing in week 01. The longer period of lower temperatures was not advantageous for foliage. Plants perform much better when they are kept in a frost-free glasshouse.

Shelf life test: The shortest time in shelf life was 25 days and the longest 32 days (average 29 days). Erigeron karvinskianus 'Stallone' is absolutly suitable for living room conditions.

Erigeron karvinskianus 'Stallone' and growth regulator treatments:
This species reacts on growth regulator treatments in all application rates.

Height of leaves = Height of flowers: Plants treated with Topflor were 8 to 9 cm shorter than untreated plants and plants treated with CCC 720 were 6 to 8 cm shorter than untreated plants (Figures 51 and 52).

Figure 51: week 05; Erigeron karvinskianus 'Stallone' left to right: 2x Topflor, 4x Topflor; 2x CCC 720, 4x CCC 720

Figure 52: week 05; Erigeron karvinskianus 'Stallone' left to right: untreated, 2x Topflor; 4x Topflor

Duration of forcing: Plants treated with the higher application rate (2 x Topflor and 2 x CCC 720) had in average one week delay in flowering compared to the untreated plants. Plants treated with the lower application rates (4 x Topflor and 4x CCC 720) had two weeks delay in flowering compared to the untreated plants.
General Value: The application of growth regulators improved the general value compared to untreated plants.

Recommendation for Erigeron karvinskianus 'Stallone'
Potting should be latest week 36. Trimming is necessary for better performance. It is better to keep Erigeron karvinskianus 'Stallone' in a frost-free glasshouse. Frost damages the leaves too much. The need of vernalization is not clear but seems to be advantageously. The effort for cleaning is low. Start forcing in week 50 at 10℃ to 12℃ and e xpose plants to supplementary light and the plants will flower before Valentine's Day. The application of growth regulators (Topflor; CCC 720) is recommendable. Plants stay more compact.

3.2.5 Geum coccineum 'Cooky'

This species has striking orange coloured flowers (Figure 53). The species is both attractive as a single plant and in arrangements. At the end of trial 2005/2006 was recommended that it is better to pot plants earlier to reach a higher flowering percentage. However, plants were potted 6 weeks earlier than last year and there were still a lot of plants, which looked well in foliage but developed no flowers. That raises questions. There was always one single plant per pot, which branched in

autumn into many side branches at the bottom of the plant. Is there an exact number of leaves per branches necessary so that the plants are able to induce flowers? The vernalization can be an important reason. Plants received not enough vernalization during storage in both years. Supplementary light is able to compensate the lack of vernalization but not to all plants. Plants under supplementary light had a higher flowering percentage. Plants with start of forcing in week 01, exposed to supplementary light and from polythene tunnel and outdoors flowered with 100%. The date of flowering was recorded when there was one open flower per plant.

Figure 53: week 02; Geum coccineum 'Cooky'; supplementary light; polythene tunnel

Geum coccineum 'Cooky' and no growth regulator treatments:

Duration of forcing: Plants exposed to supplementary light flowered in average after 31 days. Plants with start of forcing in week 50 and exposed to supplementary light flowered in weeks 2 to 4 and with start of forcing in week 01 in weeks 4 to 5 before Valentine's Day. Plants exposed to photoperiodic light and ambient daylight flowered over a long period. Only some plants flowered before Valentine's Day (Figure 54).

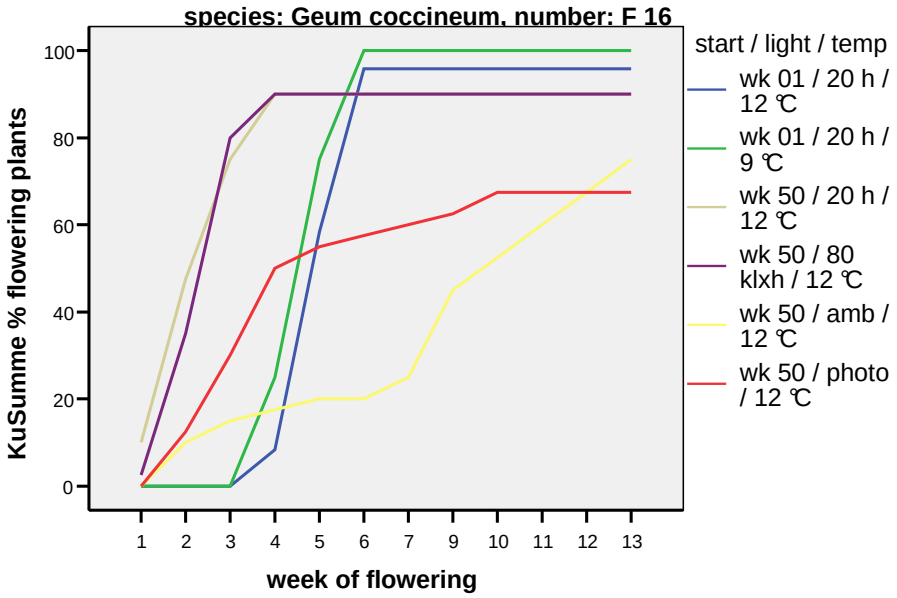


Figure 54: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: Plants exposed to supplementary light stretched their leaves 1 to 2 cm higher compared to plants exposed to ambient daylight and photoperiodic light. The storage had no influence. The height of flowers was about the same with 18 cm except plants exposed to ambient daylight with about 5 cm shorter flowers. Storage had no influence. Plants with the start of forcing in week 01 had in average 2 to 5 buds more per plant than plants with the start of forcing in week 50 and exposed to supplementary , photoperiodic and ambient daylight. Especially plants with start of forcing week 01 and 9℃ and from polythene tunnel (only tested storage in H 10.2) had the most flowers and buds. Plants developed more buds when they were from polythene tunnel and then exposed to supplementary light. Supplementary light compensated the lack of vernalization with a better effect on plants from polythene tunnel. That marks the must of vernalization.

General Value: Plants exposed to supplementary light scored better (6 to 7) than plants exposed to ambient and photoperiodic light (5 To 6). Storage was only significant in the glasshouse H 11.1. Plants from polythene tunnel scored better (7) compared to plants from the frost-free glasshouse (6).

Shelf life test: The shortest time in shelf life was 11 days and the longest 15 days (average 11 days). Geum coccineum ‘Cooky’ is suitable for living room conditions.

Geum coccineum ‘Cooky’ and growth regulator treatments:

Height of leaves: Plants treated with 2 x CCC 720 were in average a little shorter (1 cm) than untreated plants

Height of flowers: Plants treated 2 times and 4 times with CCC 720 had in average 3 to 4 cm shorter flower stems than untreated plants. Topflor was not significant (Figure 55).

Duration of forcing: no influence

General Value: no influence

Figure 55: week 05; Geum coccineum ‘Cooky’ left to right: 2x Topflor; 4x Topflor; 2x CCC 720; 4 x CCC 720; supplementary light (H 11.1)

Michigan State University tested Geum chiloense ‘Mrs Bradshaw’. This species belongs to the Early- Spring Ephemerals, it is day-neutral, and vernalization is required. No plants flowered without vernalization. The only tested vernalization was 15 weeks at 5℃ under controlled conditions. The plants flowered after 8 weeks at 20℃.

Recommendation for Geum coccineum ‘Cooky’

Potting should be not later than week 36. The plant has to be bulked enough before vernalization. Store the plants at least 10 weeks as cool as possible. Vernalization is a must to be successful even under ambient daylight before Valentine’s Day. The effort for cleaning is low. Supplementary light is able to compensate the lack of vernalization. There has to be more testing on growth regulators to get the flower stems shorter.

3.2.6 Horminum pyrenaicum

This species occurs with green rosettes of leaves and lovely blue-violet flowers on a flower stem (Figure 56). This species attracted attention in former trials and tested this year to force the flower earlier and its reaction on growth regulators treatments. Pre-cultivation was not so sucessful this year. The rosettes were potted to deep and that forced fungus diseases. Vernalization was not enough during storage. However, supplementary light was able to compensate the lack of vernalization and many plants flowered surprisingly before Valentine's Day. Many plants had no visible buds at the end of rating. That's why the curves are under 100% flowering. The species Horminum pyrenaicum 'Rubrum' is more violet coloured flower. There were not enough data collected this year to give a recommendation for it. The date of flowering was recorded when there were three open flowers per one flower stem.

Figure 56: week 07; Horminum pyrenaicum ; supplementary light; start of forcing week 01; outdoor

Horminum pyrenaicum and no growth regulator treatments

Duration of forcing: Plants exposed to supplementary light were 4 to 5 weeks earlier than plants exposed to photoperiodic light and 7 to 8 weeks earlier than plants exposed to ambient daylight (Figure 57). Storage had no influence. Plants with the start of forcing in week 50 at 12℃ were the fastest with 40 to 43 days compared to the plants exposed to 80 klxh and plants with supplementary light and start of forcing in week 01 with about 50 days. There is a correlation between temperature and light. The higher the sum of temperature and light the faster the flowers occur.

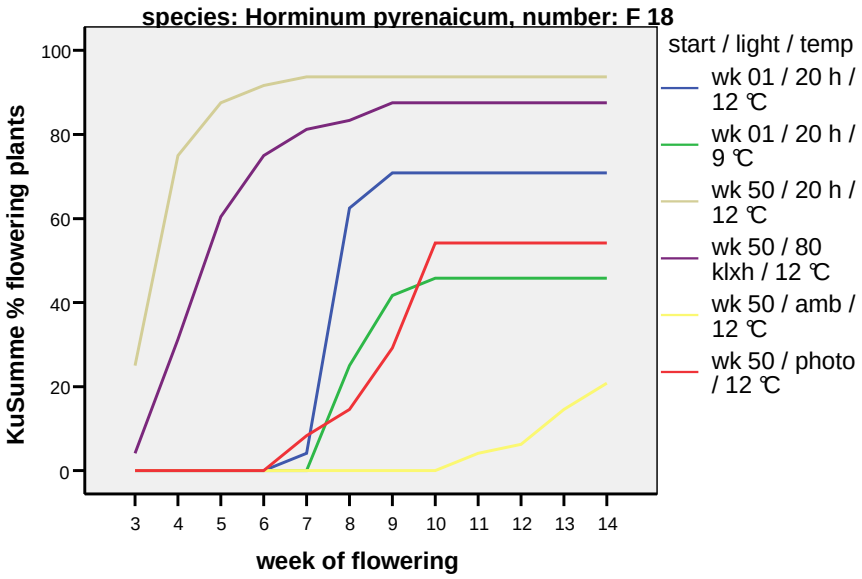


Figure 57: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: There was no mentionable influence on height of leaves. Plants from ambient daylight were a little (2 cm) shorter than plants exposed to supplementary light. Storage had no influence. The flowers were definitely higher and stretched up to 22 cm with the start of forcing in week 01 (outdoor) and supplementary light compared to plants with the start of forcing in week 50 (14 to 16 cm). More vernalization stretches the flower stems higher. Plants with the start of forcing in week 50 and exposed to ambient daylight had the shortest flower stems often sitting between the leaves. Storage had no influence on height of flowers. In most cases, there was one flower and sometimes one bud visible.

General Value: The plants scored about the same (5 to 6). The lowest general value scored the plants with start of forcing week 01 at 12℃ becaus e the flower stems were too high in correlation to the small leave rosettes.

Shelf life test: The shortest time in shelf life was 11 days and the longest 22 days (average 14 days). Horminum pyrenaicum is suitable for living room conditions.

Horminum pyrenaicum and growth regulator treatments:

Height of leaves: Plants treated with 2 x CCC 720 were 1 to 2 cm shorter than other treatments and untreated plants.
Height of flowers: There is no influence of growth regulators in average over all glasshouse compartments. Plants with the start of forcing week 50 and exposed to supplementary light reacted on Topflor and CCC 720 and were shorter than untreated plants. Because of the lack of vernalization during storage, it is not possible to get a conclusive result. There has to be more testing with growth regulators.
Duration of forcing: no influence
General Value: no influence

Recommendation for Horminum pyrenaicum
Potting should be week 28 that plants can bulk enough before vernalization. 3 plants per pot are better for performance and later percentage of flowering. One plant is able to fill a 9 cm pot size; three plants fill a 12 cm pot size. Vernalization is required. Horminum reacts day –neutral. Good vernalized plants are able to flower in the middle of March. Vernalization should be at least 10 weeks as cool as possible (5°C). Supplementary light compensates the lack of vernalization and forces the flowering. The correlation between sum of light and temperature can steer the crop. The effort for cleaning is middle. With the start of forcing in week 50 at least at 12°C, flowering is possible before Valentine's Day. There might be a possibility to shorten the length of flower stems with growth regulators. There has to be more testing in the future.

3.2.7 Lithodora diffusa 'Heavenly Blue'

This species is an eye catcher because of its clear blue coloured flowers (Figures 59 and 60). The species was in testing over several years. The trial 2005/2006 tested different amounts of depot fertilizer. The rooting of cutting took a long period during this year Early-Spring trial. The plants were potted late (week 38) and could not fill the pot size (Figure 58). 100% of plants came into flowering except some plants exposed to photoperiodic light and from frost-free glasshouse because the rating finished week 9 in this glasshouse compartment. The data of flowering was recorded with three open flowers per plant.

Figure 58: week 50; Lithodora diffusa 'Heavenly Blue'; polythene tunnel

Figure 59: week 08; Lithodora diffusa 'Heavenly Blue'

Figure 60: fascinating blue colour of 'Lithodora diffusa 'Heavenly Blue'

Lithodora diffusa ‘Heavenly Blue’ and no growth regulator treatments:

Duration of forcing: Plants with the start of forcing in week 01 and supplementary light were 1 week faster (needed about 52 days) than plants with the start of forcing in week 50 and exposed to supplementary light (needed about 62 days). A good vernalization forces the earlier flowering. Plants with start forcing in week 50 and exposed to supplementary light and from polythene tunnel reached the Valentine’s Day (Figure 61). Plants exposed to photoperiodic light were almost one week earlier (flowered weeks 9-10) than plants exposed to ambient daylight (flowered weeks 10 to 11). The storage was significant in glasshouse H 11.2 (80klxh) and H 11.3 (photoperiodic). Plants from polythene tunnel were one week faster than plants from frost-free glasshouse.

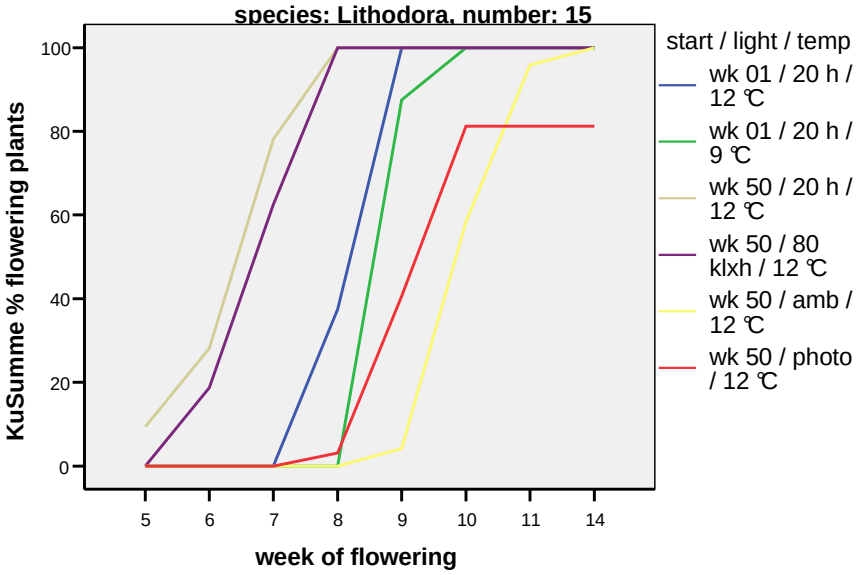


Figure 61: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves = Height of flowers: The flowers occur at the end of branches that’s why the height of leaves and height of flowers are measured in the same height. All plants exposed to photoperiodic light and supplementary light were higher stretched than plants exposed to ambient daylight.

Number of branches: Plants with the start of forcing in week 01 were better branched (10 to 11 branches) than plants with the start of forcing in week 50 (8 to 9 branches). Plants with start forcing in week 50 and exposed to supplementary light were better branched from polythene tunnel than from the frost-free glasshouse. That marks the importance of vernalization during storage.

General Value: All plants scored about the same (5 to 6). Only plants exposed to photoperiodic light scored a little lower (4-5). The plants were slacker in growth. Plants with the start of forcing in week 50 and from polythene tunnel scored better than plants from frost-free glasshouse.
Shelf life test: The shortest time in shelf life was 14 days and the longest 19 days (average 18 days). Lithodora diffusa 'Heavenly Blue' is suitable for living room conditions.

Lithodora diffusa 'Heavenly Blue' and growth regulator treatments:

Height of leaves = Height of flowers: The growth regulators treatments had influence on plants exposed to supplementary and photoperiodic light (Figure 62). Plants treated with Topflor were 2 to 3 cm shorter than untreated plants (Figure 64). Plants treated with CCC 720 were 1 to 2 cm shorter than untreated plants (Figure 63).The lower application rate was a little more successful with Topflor and CCC 720 than the higher application rate.

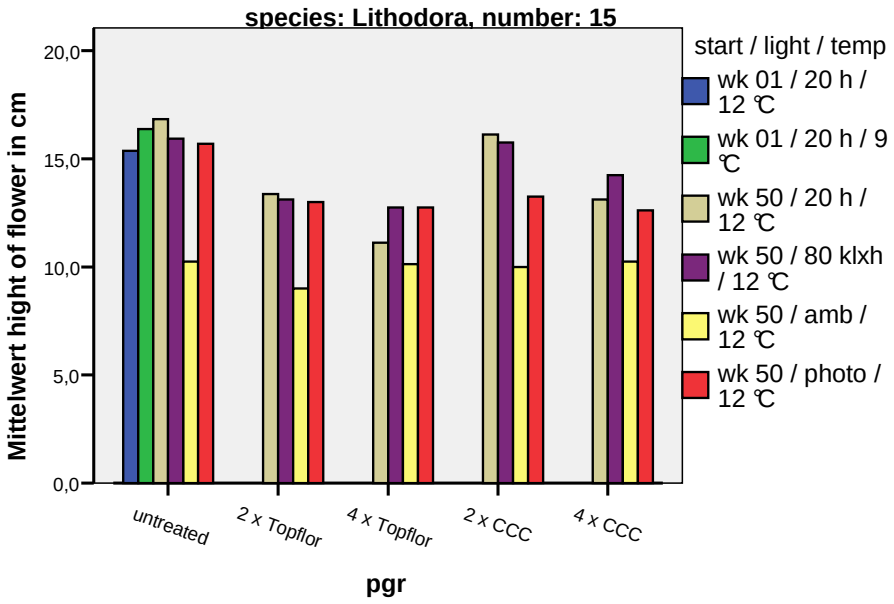


Figure 62: Bar chart of the average of height of flowers in cm; Lithodora diffusa 'Heavenly Blue'

Figure 63: week 07; Lithodora diffusa 'Heavenly Blue'; supplementary light;

left to right: 2x Topflor; 4x Topflor; 2x CCC 720; 4x CCC 720

Figure 64: week 07; Lithodora diffusa 'Heavenly Blue'; supplementary light;

left to right: untreated; 2x Topflor; 4x Topflor

Duration of forcing: All plants treated with growth regulators had a half to one week delay in flowering.
General Value: no influence

Recommendation for Lithodora diffusa 'Heavenly Blue'
Potting should be latest week 30 to allow a two times trimming. Plants will be better branched and fill a 9 to 10 cm pot size. Three rooted cuttings are possible in a 12 cm pot size. The substrate should be with a lower pH (4.5 to 5.5). In case of lack of iron, which shows yellow intercostal fields, a special iron fertilizer can eliminate that appearance (Fetrilon 1g/ 10l water). The fertilization should not be above 200 mg N per plant. The vernalization is a must. Keep Lithodora for 9 to 10 weeks as cool as possible but not under -5℃. Better vernalization forces more branching and flowering during forcing. Lithodora is day-neutral. Lithodora reacts on the sum of light and

temperatures during forcing. The effort for cleaning is zero. With the start forcing in week 50 and higher temperatures for about 72 hours (wake up at 20°C) and following 12°C and supplementary light, the plants will flower until Valentine's Day. It is possible to keep the plants more compact with growth regulators (Topflor, CCC 720) under supplementary light. Plants exposed to ambient daylight at 12°C will flower in the middle of March .

3.2.8 Papaver miyabeanum 'Pacino'

This species has light yellow lemon flowers (Figure 65). It is one of the compact growing species of Papaver and that makes it interesting as an early spring pot plant. It performs well as a single plant and in arrangements. When flowers are withered, the seed vessels look still interesting. Papaver requires the long day. All plants flowered except the plants exposed to ambient daylight. The date of flowering was recorded when there was one opening flower per plant.

Figure 65: week 04; Papaver miyabeanum 'Pacino'; supplementary light

Papaver miyabeanum 'Pacino' and no growth regulator treatments:

Duration of forcing: All plants exposed to supplementary light (20h-3000lx) at 12°C flowered after 35 days. Plants exposed to 80 klxh at 12°C and plant s exposed to 20h- 3000lx at 9°C had almost one week delay in flowering. Plants exposed to photoperiodic light flowered with two weeks delay. Plants exposed to supplementary light flowered before Valentine's Day (Figure 66). The photoperiodic light had a longer period to finish the crop and not all plants flowered until Valentine's Day. Plants exposed to supplementary light with the start of forcing in week 50 flowered earlier than

in former trials. That is because of the higher collected sum of temperatures and light until flowering.

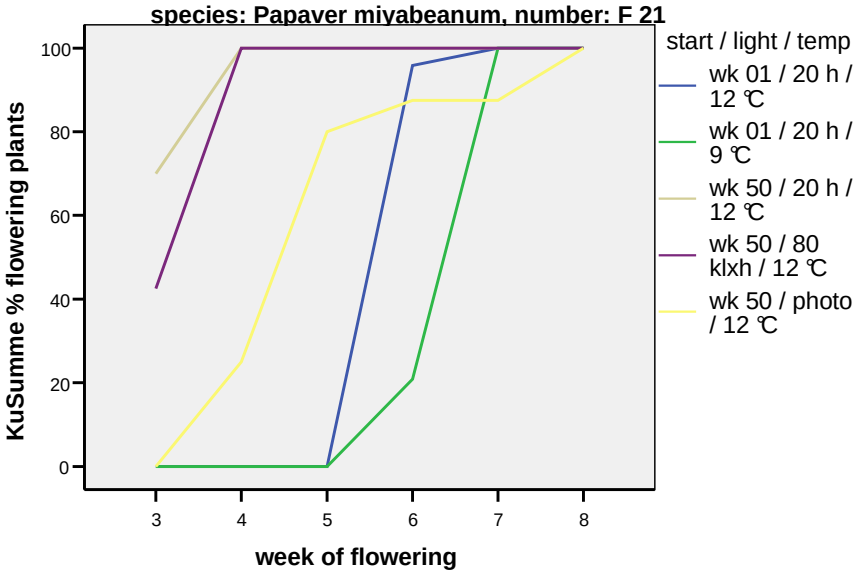


Figure 66: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: The height of leaves (about 9 cm) and the height of flowers (about 18 cm) were about the same height, except plants exposed to photoperiodic light. They stretched the leaves 3 cm higher and the flowers 4 cm higher compared to all others. The number of buds and flowers was about the same except plants exposed to photoperiodic light. They had in average 2 buds less than all others. The storage had no mentionable influence on the height of leaves. The plants from polythene tunnel with the start of forcing in week 50 were 2 cm shorter than plants from frost-free glasshouse.

General Value: All plants scored about 6 to 7 except plants exposed to photoperiodic light scored in average 5. The plants were slacker in growth under photoperiodic light.

Shelf life test: The shortest time in shelf life was 7 days and the longest 15 days (average 14 days). The duration of shelf life depended on the number of buds, which were able to open up in shelf life room. Papaver miyabeanum ‘Pacino’ is suitable for living room conditions.

Papaver miyabeanum ‘Pacino’ and growth regulator treatments:

Height of leaves: no influence
Height of flowers: Plants treated with the higher application rate of Topflor were about 3 cm shorter and treated with CCC 720 about 2 cm shorter than the untreated plants.
Duration of forcing: no influence
General Value: no influence

Recommendation for Papaver miyabeanum ‘Pacino’
Potting should be latest week 32 to allow the plants to fill the 10cm pot size. A group of plants in 1 pot could produce a better amount of flowers and buds. It is not sure how important a cooling period is for Papaver. Keep plants frost-protected. That results in less cleaning. However, the effort for cleaning is high. Plants exposed to supplementary light at 12℃ and with the start of forcing in week 52 at the latest will flower before Valentine’s Day.

3.2.9 Papaver nudicaule ‘Garden Gnome’

The clear vibrant colours of these species were striking, although single plants were not so attractive because of the high flower stems above the leaves. However, in arrangements as a background plant or as a cut flower, the crop could be interesting (Figures 67 and 68). During the Early Spring trial 2006/2007 this species was tested again especially with the attention on reaction on growths regulators treatments. Papaver needs the long day. All plants flowered except the plants exposed to ambient daylight until week 14.

Figure 67 and Figure 68: left: week 03; Papaver nudicaule 'Garden Gnome'; supplementary light; right: February 2007; Papaver nudicaule 'Garden Gnome' in arrangement at fairy floriga Leipzig 2007

Papaver nudicaule 'Garden Gnome' and no growth regulator treatments:

Duration of forcing: Plants exposed to supplementary light (20h-3000lx) at 12℃ flowered after 32 to 35 days. Plants exposed to 80klxh at 12℃ and plants with 20h-3000lx at 9℃ flowered with delay after 40 days. That demonstrates the correlation between temperatures and light and the duration of forcing. Plants exposed to photoperiodic light flowered 3 to 4 weeks later and the rating was over a longer period of time. All plants with supplementary light with the start of forcing week 50 and week 01 at 12℃ flowered completely until Valentine's Day (Figure 69). The crop was earlier than last year because of more light and temperatures until flowering.

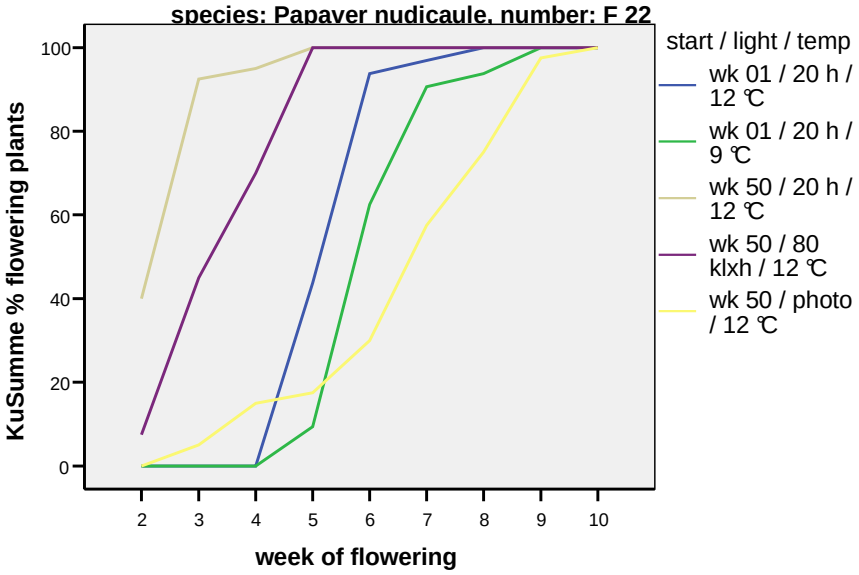


Figure 69: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves, height of flowers and number of buds and flowers: There was no influence on the height of leaves. They were all about 14 cm. The plants exposed to photoperiodic light stretched their flowers 5 to 7 cm higher (~38 cm) than plants exposed to supplementary light (~32 cm). The storage had no influence. There was influence on the number of buds and flowers. Plants exposed to photoperiodic light developed about 2 buds less than all others with about 5 to 7 buds.

General Value: Plants scored about the same (5 to 6) except plants exposed to photoperiodic light scored 4 to 5 because of the long stretched flower stems.

Shelf life test: The shortest time in shelf life was 11 days and the longest 15 days (average 13 days). The duration of shelf life depended on the number of buds, which were able to open up in shelf life room. Papaver nudicaule 'Garden Gnome' is suitable for living room conditions.

Papaver nudicaule 'Garden Gnome' and growth regulator treatments:
There was a hope to keep the flower stems shorter with Topflor or CCC 720 but there was no consequent reaction during this year trial.

Height of leaves: no influence
Height of flowers: no mentionable influence
Duration of forcing: no influence
General Value: no influence

Recommendation for Papaver nudicaule 'Garden Gnome'
Potting should be latest week 32 that the plants can fill the 10 cm pot size. More plants in a bigger pot have advantage to more flowering and there is a better correlation between pot size and height of flowers. The storage is better under frost-free conditions. The need of vernalization is not clear. Papaver is a long-day plant. There will be no flowering under ambient daylight until week 14. The effort for cleaning is high. Plants exposed to supplementary light at 12℃ and a start of forcing in week 52 at the latest will flower before Valentine's Day. There is no recommendation for growth regulators now.

3.2.10 Phlox divaricata

This species occurs with many sky-blue flowers (Figures 70 and 71). It spreads a sweet spring smell. This species could be an attractive early spring pot plant. The disadvantage is the height of flowers. The plants need something to hold on and not to tip over. This species was successful in former trials. During this year trial was the first testing with growth regulators to shorten the height of plants. Plants exposed to supplementary light flowered before Valentine's Day. The number 24 were tiny divided plants propagated in multi cell palettes in week 27 until potting. The number 26 were cuttings from the divided stock plants and were propagated in week 27, too. Plants developed comparable to the same level and the results were about the same. The following facts associate both Phlox divaricata (24) and Phlox divaricata (26).

Figure 70 and Figure 71: week 03, Phlox divaricata (24); supplementary light;

left: 1 plant per pot; right: 2 plants per pot

Phlox divaricata and no growth regulator treatments:

Duration of forcing: All pants exposed to supplementary light at 12℃ flowered in average after 38 days. Plants with the start of forcing in week 50 and exposed to supplementary light flowered early in weeks 3 to 4. Plants with the start of forcing in week 01 at 12℃ flowered just before Valentine's Day in weeks 5 to 7 (Figure 72). Plants with start of forcing week 01 at 9℃ had one week delay. Plants exposed to photoperiodic light flowered in average 2 weeks later than plants exposed to supplementary light and the rating was over a longer period. Plants exposed to ambient daylight and only the plants from polythene tunnel were in average 7 weeks later and flowered in weeks 11 to 12 much later than in former trials. Because of the not flowering plants from frost-free glasshouse, the curve in diagram finishes after 50% in week 14. An explanation for that could be the lack of vernalization during storage. The supplementary and photoperiodic lighting is able to compensate this lack of vernalization. There were a couple of plants with no visible buds. These plants were not bulked enough before storage to induce flowers.

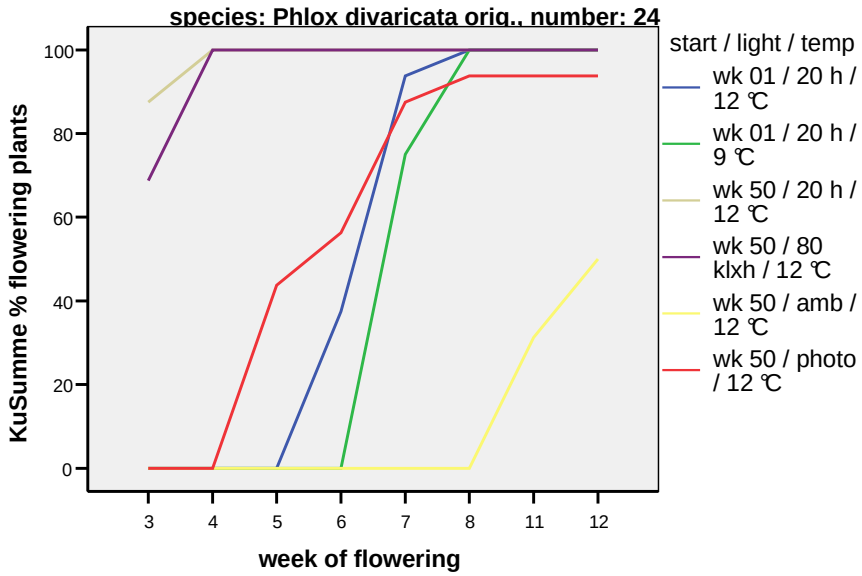


Figure 72: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves=height of flowers: The flowers occur at the end of branches that's why the height was the same. The plants with the start of forcing in week 50 and exposed to supplementary light and photoperiodic light were about the same height (~ 32 to 34 cm). Plants with the start of forcing in week 01 stretched 6 to 8 cm higher (37 to 38cm) than plants with the start of forcing in week 50. Plants were more vernalized and stretched higher. Plants exposed to ambient daylight with the start of forcing in week 50 were 15 cm shorter than plants exposed to supplementary light (Figure 73).

Figure 73: week 11, Phlox divaricata (24), ambient daylight from polythene tunnel

General Value: Plants scored lower than in other years because plants did not have a hold, the branches tipped over, and there was not enough branching per plant. Plants exposed to ambient daylight scored better (5 to 6) because of the compact growth than all others (4 to 5).
Shelf life test: The shortest time in shelf life was 19 days and the longest 24 days (average 19 days). Phlox divaricata is absolutely suitable for living room conditions.

Phlox divaricata and growth regulator treatments:

Height of leaves = Height of flowers: Plants treated with 2x and 4x Topflor and exposed to supplementary light were 8 cm shorter in average than untreated plants (Figure 74). Plants treated with 2x CCC and 4x CCC and exposed to supplementary light were about 4 to 6 cm shorter than untreated plants. Plants exposed to ambient daylight were not influenced by growth regulations.

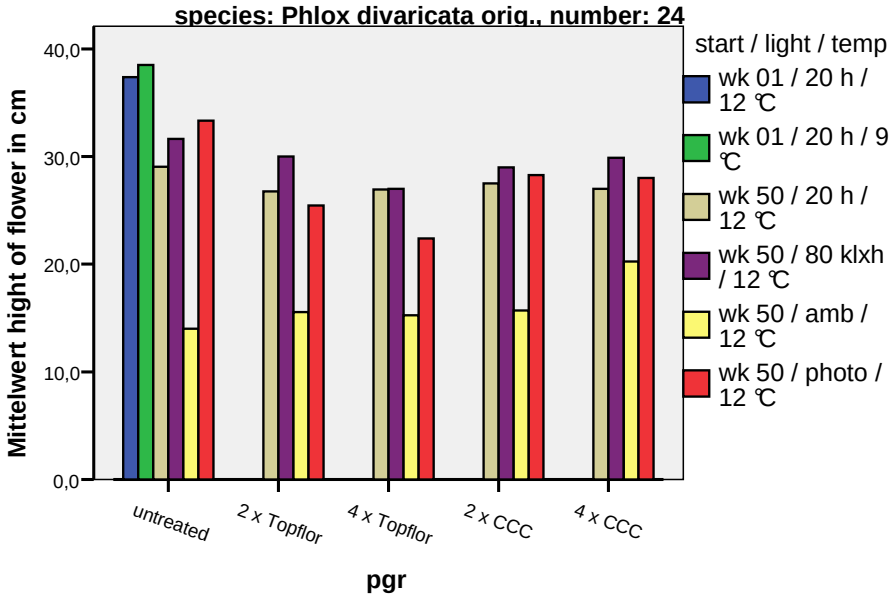


Figure 74: Bar chart of the average of height of flowers in cm; Phlox divaricata

Duration of forcing: no influence
General Value: no influence

Michigan State University tested Phlox divaricata 'Laphammi', 'London Grove' and 'May Breeze'. This species belongs to the Early- Spring Ephemerals, it is day-neutral, and vernalization is required. The only tested vernalization was 15 weeks at 5℃ under controlled conditions. The plants flowered after 3 weeks at 20℃. The recommendation is a prolonged bulking to overcome juvenility prior to cooling.

Recommendation for Phlox divaricata

Potting should be in week 32 at the latest. Make sure plants are well developed (bulked) to fill the 10 cm pot size before vernalization. Three rooted cuttings can fill a 12 cm pot size, perform better and develop more flowers at the end of crop. The plants with no height control need a holding. The use of growth regulators like Topflor and CCC 720 is recommendable. However, there has to be more testing with growth regulators on this species in future. Phlox needs vernalization for at least 9 weeks and as low as possible (about 5 °C). The effo rt for cleaning is low. With the start the forcing in week 52 at 12°C at the latest and with supplemen tary light the plants will flower before Valentine's Day. Plants exposed to ambient daylight will flower at the beginning of March.

3.2.11 Silene pendula 'Lausitz'

This species was recommended as an early spring pot plant in former years 2000 to 2003. The pink colour of flowers is very pleasing (Figure 75). This species is attractive as a single plant or in spring arrangements. Silene pendula 'Lausitz' reacts day-neutral and requires vernalization. All plants flowered with 100% except plants exposed to ambient daylight. Plants did not receive enough vernalization during storage. The date of flowering was recorded when there were three open flowers per plant.

Figure 75: week 04; Silene pendula 'Lausitz'; supplementary light; 2x CCC 720

Silene pendula 'Lausitz' and no growth regulator treatments:

Duration of forcing: Plants exposed to supplementary light at 12℃ flowered after 44 to 49 days. The fastest were plants from outdoors followed from plants from polythene tunnel and then frost-free glasshouse. These plants flowered until Valentine's Day (Figure 76). Plants with the start of forcing in week 50 and exposed to supplementary light flowered in weeks 4 to 5. Plants exposed to the 80klxh flowered in average with almost one week delay in weeks 5 to 6. Plants with the start of forcing in week 01 at 12℃ and 20h 3000lx flowered in weeks 5 to 6. Plants with the start of forcing in week 01 at 9℃ (20h-3000lx) had also one week delay in average and flowered in weeks 6 to 8 and did not all flower until Valentine's Day. Plants exposed to photoperiodic light flowered in weeks 6 to 9. Therefore plants from polythene tunnel were earlier in weeks 6 to 8 than plants from frost-free glasshouse in weeks 8 to 9. The better vernalized the earlier the flower.

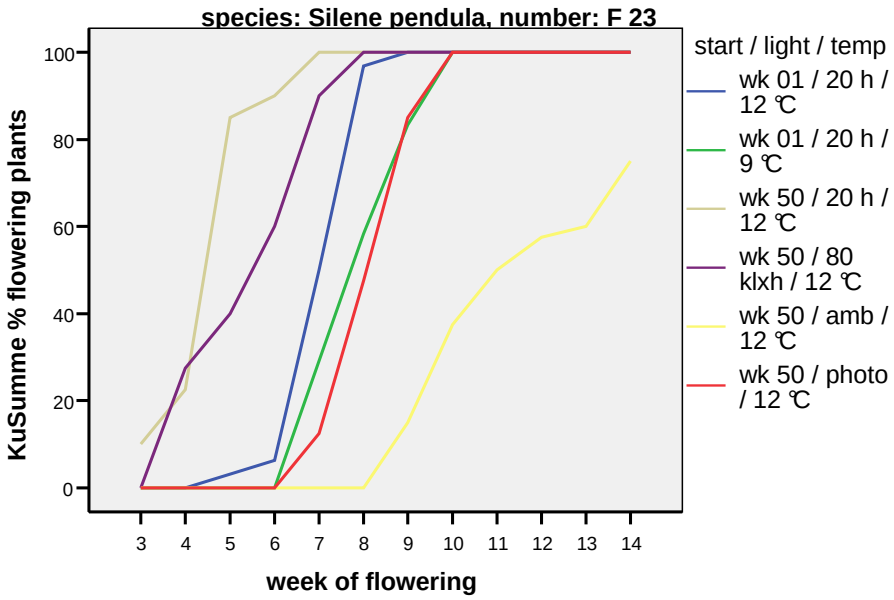


Figure 76: Percentage of flowering plants relative to the light treatments used in the trial.

(photoperiodic lighting treatment H 11.3 stopped in week 10)

Height of leaves =Height of flowers: Flowers occurred at the end of branches that's why the measured heights are the same. Plants exposed to supplementary light were about the same height (15 to 16 cm). Plants with the start of forcing in week 01 (20h-3000lx) at 9 and 12℃ and from outdoors were a little shorter (14 to 15 cm). These 1 to 2 cm were important. Plants stood upright and branches did not tip over. Plants exposed to photoperiodic light stretched about 1 to 2 cm higher than plants exposed to supplementary light. More branches tipped over like the following

picture shows (Figure 77). Plants exposed to ambient daylight were shorter but developed more a creeping than the upright appearance (Figure 78).

Figure 77: week 09; Silene pendula 'Lausitz'; photoperiodic light

Figure 78: week 09; Silene pendula 'Lausitz'; ambient daylight

General Value: Plants exposed to supplementary light scored about the same (6 to 7). Plants with the start of forcing in week 01 and exposed to supplementary light and from outdoor scored in average a little better (6.8). Plants were taut in growth and branches did not tip over. Plants exposed to ambient daylight scored 4 to 5 because of the uneven flowering per plant. Plants

exposed to photoperiodic light scored all around 4 because the branches of plants tipped over (Figure 77).

Shelf life test: The shortest time in shelf life was 11 days and the longest 21 days (average 14 days). Silene pendula 'Lausitz' is suitable for living room conditions. The bright pink colour of flowers keeps better under cooler conditions than in the shelf life room.

Silene pendula 'Lausitz' and growth regulator treatments:

Height of leaves = Height of flowers: Plants exposed to ambient daylight were not influenced by growth regulations treatments. The treatment with Topflor was not so successful. Only plants treated with the higher application rate of Topflor were in average 1 to 2 cm shorter. The 2 x Topflor was more effective in glasshouses H 11.2 (80klxh) and H 11.3 (photoperiodic) than in glasshouse H 11.1 (20h). Plants exposed to supplementary and photoperiodic light react more effective on CCC 720 (Figures 79 - 81). Plants treated with the higher application rate were 3 to 4 cm shorter and plants treated with the lower application rate were 2 cm shorter compared to the untreated plants.

Figure 79: week 05; Silene pendula 'Lausitz'; supplementary light;

left to right: 2xTopflor; 4x Topflor; 2x CCC 720, 4x CCC 720

Figure 80: week 05; Silene pendula 'Lausitz'; supplementary light;

left to right: untreated, 2xTopflor; 4x Topflor

Figure 81: week 05; Silene pendula 'Lausitz'; supplementary light;

left to right: untreated, 2x CCC 720, 4x CCC 720

Duration of forcing: no influence
General Value: no influence

Recommendation for Silene pendula 'Lausitz'

Potting should be latest week 31 that plants can bulk well before storage. A 10 cm pot size is adequate. Silene reacts day-neutral and requires vernalization. Keep the plants for at least 6 weeks as cool as possible (about 5°C) in a frost-free glasshouse or in a polythene tunnel. With higher forcing temperatures, the flowers will be earlier but the plants stretch more and can tip over. In that case, a growth regulation with CCC 720 is recommendable. The effort for cleaning is middle. Start forcing at week 50 at 10°C to 12°C and expose plants to supplementary light, then plants will flower until Valentine's Day. Provided the plants are well vernalized and the ambient daylight is in higher levels in December, January and February the crop can even finish without supplementary light until Valentine's Day.

3.2.12 Lychnis alpina and Lychnis alpina 'Snow Furry'

This pink flowering Lychnis alpina is actually a recommendable early spring pot plant (Pillnitz trial 2002/2003; Figure 84). Lychnis alpine 'Snow Furry' has white flowers. However, this year the data were too insufficient to allow an evaluation. The reason was the lack of vernalization until week 50. Flowers could not appear or stretch enough above the leaves (Figure 82). Supplementary light could not compensate this lack of vernalization. Plants with the start of forcing in week 01 received three weeks more vernalization until forcing and the flower stems stretched under supplementary light (Figure 83).

Figure 82: week 05; Lychnis alpina 'Snow Furry'; left: 2 x supplementary light ; right: 2 x photoperiodic light; start of forcing in week 50

Figure 83: week 07; Lychnis alpina 'Snow Furry'; supplementary light at 12 °C from outdoor; start of forcing in week 01

Figure 84: week 09; Lychnis alpina; supplementary light at 9°C from outdoor; start of forcing in week 01

The experiences from former trials and compared to this year trial allows the conclusion that Lychnis has to be vernalized at least 6 weeks with lower temperatures (about 5℃) before forcing. Provided the plants are vernalized and plants exposed to supplementary light (20h – 3000lx) at 12℃, Lychnis will flower after 43 to 47 days. Plan ts exposed to supplementary light at 9 to 10℃ will flower after 53 to 55 days. The flower stems stretch higher with raising forcing temperatures. There are no results concerning reaction on growth regulators.

3.3 Shelf life under living room conditions and frost hardiness test

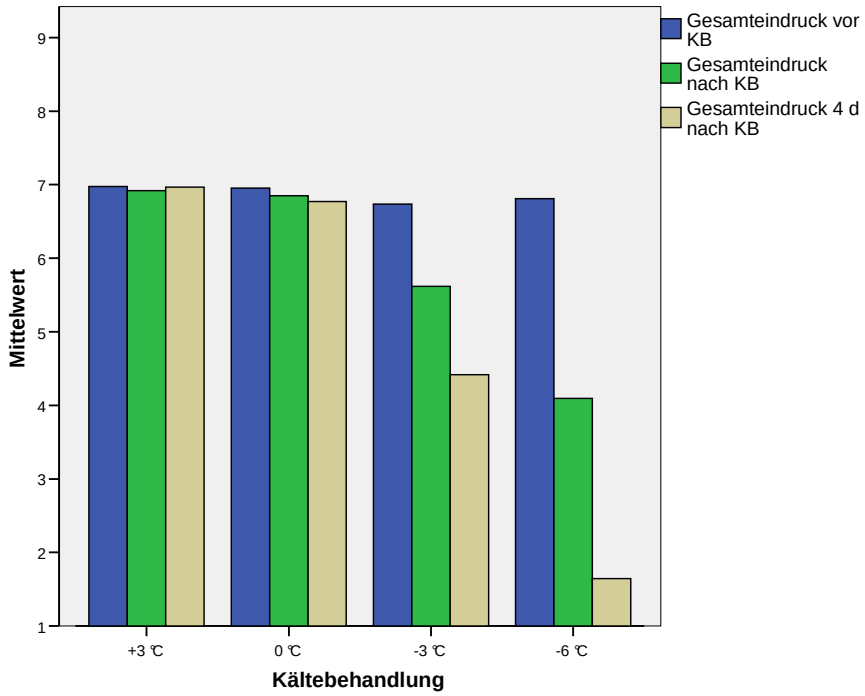
The shelf life test with the 'new' early spring pot plants was successful. The minimum requirement was 7 days and all species stood more days in shelf life test under living room conditions. 14 species reached even above 20 days. The table (Table 10) demonstrates the species, the amount of tested plants (n) and how many days they stood in shelf life test.

Table 10: Early spring pot plants and their shelf under living room conditions

Species / variety	Shelf life in days			
	n	Min.	Max.	average
Ajuga pyramidalis 'Metallica Crispa'	5	19	39	31
Ajuga reptans 'Braun Hertz'	5	21	31	27
Ajuga reptans 'Mini Mahagoni'	5	29	29	29
Anacyclus pyrethrum var. depressus 'Silberkissen'	5	14	26	22
Androsace septentrionalis 'Star Dust'	14	23	23	23
Aquilegia hybrida 'Spring Magic Blau-Weiß'	5	15	15	15
Aquilegia hybrida 'Spring Magic Hellrot-Weiß'	5	23	23	23
Aquilegia hybrida 'Spring Magic Weiß'	5	15	26	22
Aquilegia vulgaris 'Winky Double White-White'	15	19	26	20
Arabis ferdinandi 'Old Gold'	5	19	19	19
Barbarea rupicola 'Sunnyola'	5	11	19	17
Calceolaria biflora 'Goldcap'	4	21	31	26
Cymbalaria 'Muralis'	5	24	24	24
Erigeron karvinskianus 'Stallone'	15	25	32	29
Erinus alpinus 'Dr. Hähnle'	5	13	13	13
Erysimum perovskianum 'Goldrush'	5	19	39	28
Geum coccineum 'Cooky'	15	11	15	11
Horminum pyrenaicum	15	11	22	14
Horminum pyrenaicum 'Rubrum'	5	11	19	17
Iberis sempervirens 'Snow Flake'	5	11	14	13
Lindernia 'Grandiflora'	5	38	47	43
Lithodora diffusa 'Heavenly Blue'	5	14	19	18
Lithodora diffusa 'Pete's Favorite'	5	13	13	13

Species / variety	Shelf life in days			
	n	Min.	Max.	average
Lychnis alpina	10	10	24	19
Lychnis alpina 'Snow Furry'	15	3	24	13
Papaver miyabeanum 'Pacino'	15	7	15	9
Papaver nudicaule 'Gartenzwerg'	15	11	15	13
Phlox divaricata original	15	19	22	19
Phlox divaricata Abvermehrung	15	19	22	19
Serissa foetida 'Pink Mystic'	5	19	24	22
Silene pendula 'Lausitz'	15	11	21	14

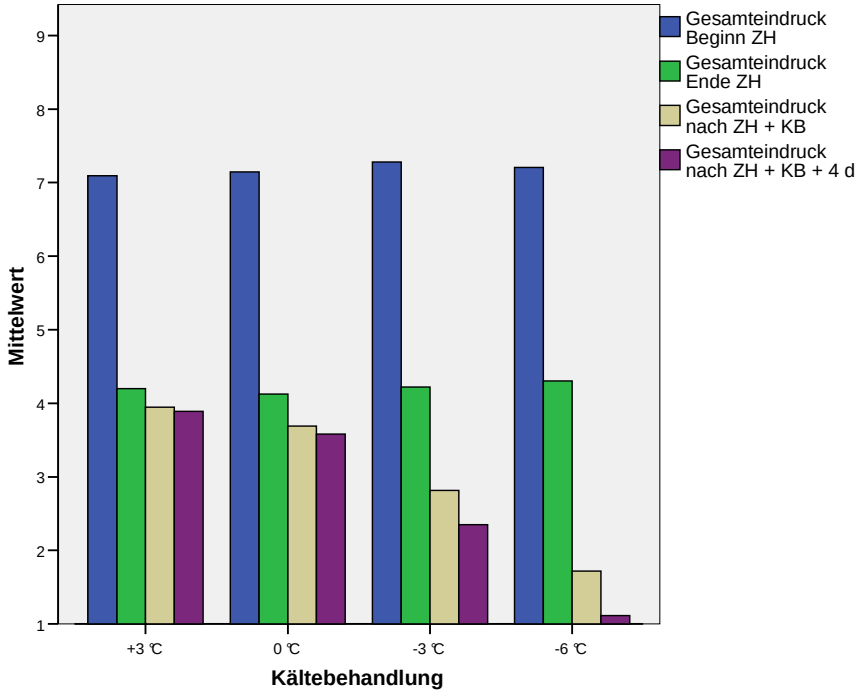
The most tested species are perennials but with the higher forcing temperatures in greenhouse compartments, the plants are not stabil against frost any more. The next diagram (Figure 85) explains that plants which came directly to the frost hardiness test came along with + 3 ℃ and 0 ℃ and had no damage. However, plants exposed to - 3 °C and - 6 ℃ were damaged with the frost temperatures. Those temperatures simulate the case that flowering plants come directly to outdoor conditions a short time after buying.



Mittelwert – average; Kätebehandlung (KB) = cooling treatment; Gesamteindruck vor KB = general value before cooling treatment; Gesamteindruck nach KB = general value after cooling treatment; Gesamteindruck 4d nach KB = general value 4 days after cooling treatment;

Figure 85: Effect of frost hardiness test on general value of early spring species a short time after their forcing treatment in greenhouse (29 species/varieties, general value: 1 = very bad to 9 = perfect)

The following diagram (Figure 86) explains the effect of cooling treatments on plants, which came from shelf life test under living room conditions. That's why the general value is already in the lower level before the cooling treatments started. Many species were damaged at +3 ℃ and 0 ℃ but there was more damage at - 3 ℃ and - 6℃. That wou ld be the situation when plants transferred from the living room directly into the garden.



Mittelwert – average; Kätebehandlung (KB) = cooling treatment; Gesamteindruck Beginn ZH = general value at start of shelf life test; Gesamteindruck Ende ZH = general value at the end of shelf life testt; Gesamteindruck nach ZH + KB = general value after shelf life test and cooling treatment; Gesamteindruck nach ZH + KB + 4d = general value after shelf life test; cooling treatment and after 4 days

Figure 86: Effect of frost hardiness test on general value of early spring species after shelf life test under living room conditions (29 species/varieties, general value: 1 = very bad to 9 = perfect)

The total evaluation involved the average of all tested species. Each species reacts a bit different. Species, which were tough against cooling treatments a short time after greenhouse:

- Barbarea rupicola 'Sunnyola‘
- Ajuga pyramidalis 'Metallica Crispa‘
- Ajuga reptans 'Braun Hertz‘
- Anacyclus pyrethrum var. depressus 'Silberkissen‘
- Androsace septentrionalis 'Star Dust‘
- Geum coccineum 'Cooky‘
- Ajuga reptans 'Mini Mahagoni‘
- Aquilegia vulgaris 'Winky Double White-White‘
- Calceolaria biflora 'Goldcap'

Species, which were tough against cooling treatments a short time after shelf life test under living room conditions:

- Androsace septentrionalis 'Star Dust‘
- Geum coccineum 'Cooky’

4 Consideration of economics

The last calculation for early spring pot plants was made 2003 in Dresden-Pillnitz. It was interesting to know how higher costs for energy changed the situation for early spring pot plants during this year trial. The results give growers an idea about the financial benefits of cultivation of early spring pot plants. The calculations were realized with the help of a database and software for pot plant production by Arbeitskreis Betriebswirtschaft Hannover e.V. The calculations based on the production of 1000 pots for sale. For the new economic calculation, the following basic data were used:

Greenhouse:	1000 m²; single-layer energy screen, 90 % netto area
Marketing charge:	10 %
Costs for transport:	15 %
Payment:	7 Euro per hour
Heating oil:	0.50 Euro/ Liter
Electricity:	0.15 Euro/ kwh
Pot size:	10 cm
Potting:	500 pots per hour, week 32
Moving:	400 pots per hour, week 40
Moving and cleaning:	300 pot per hour, week 50
Burning time of lamps:	forcing periods of 2006/2007
Storage until week 50:	polythene tunnel

The examples 1 to 3 in table (Table 11) base on the purchase of young plants, which were seed propagated like Andosace septentrionalis, Papaver nudicaule, Papaver miyabeanum, Silene pendula, Calceolaria biflora and Lychnis alpine and accepts this year conditions of cultivations. Except Papaver all species are possible to calculate with ambient day light (example 3).

These species were earlier 2007 than the years before because of the higher forcing temperature and the lighting treatment started at the same time with higher temperatures at the beginning of forcing. The 72 hours of higher temperatures were simulated with calculated 15 °C for one week (week 50). The example 2 with the lighting treatment of 80 klxh per day safes electricity but the flowering starts one week later than in example 1 and the costs for oil are higher. That is why the amounts of coverage are about the same. The calculated amount of coverage based on the price of 1 Euro per pot. Plants were sold at wholesaler. There are higher costs through 10 cm pot size. The costs for marketing charge are high. In 2003 the calculation run with 9 cm pot size and the price of 0,80 Euro (wholesale) realized a much higher amount of coverage (~ 350 Euro). The same amount of coverage would be possible with a price of 1,20 Euro per 10 cm pot. The example 3 with the ambient day light makes a higher amount of coverage possible but the selling date is later.

The examples 4 to 6 in table (Table 12) base on the purchase of young plants, which were seed propagated like Anacyclus pyrethrum var. depressus, Horminum pyrenaicum, Erinus alpinus. These species start later with flowering and need more space and lighting during forcing. The amounts of coverage were realized with 1,20 Euro per pot. The amounts of coverage were not very high with the supplementary light. However, the supplementary lighting makes the flowering before Valentine's Day possible.

The examples 7 to 9 in table (Table 13) base on young plants, which have a higher cost price and are vegetative propagated like Ajuga reptans, Lithodoa diffusa or seed propagated like Aquilegia hybrida. The calculated amounts of coverage base on a selling price of 1,30 Euro (wholesale). These species are special and have to be sold as high value plants for Valentine's Day.

These are only examples and the growers have to analyse their own conditions in cultivation. The advantage of supplementary light is the early selling date and the plants flower uniform at the same time. Whoever has supplementary light installed should use it. There should be always the chance to sell the 'news' with the higher prices. The situation of primroses and pansies is getting even harder with the higher costs for energy. This year was a testing in selling. A couple of growers with their own florist tried the 'new' species. The reached retail price was in average 2,30 Euro. The highest price reached the Calceolaria biflora 'Goldcap' with 3,25 Euro. The Aquilegia was successful in selling and reached 2,75 Euro. Androsace was sold with 1,80 Euro to 2,75 Euro. Some florists loved the Androsace very much for arrangements. Many customers, often from older generation, were surprised about the early selling date. There was the association to perennials and their garden. The customers could not imagine that there are new pot plant for the living room. At this point, the right recommendation and advertising is necessary. However, florists mentioned a different group of customers, which were lucky to find something new to that early selling date. These customers accept the 'news' as pot plants for indoors.

Table 11: Economic calculations, examples 1 to 3

examples		**1** 20 h 3000lx	**2** 80 klxh	**3** ambient daylight
start	week	32	32	32
start of sale	week	3	4	6
end of sale	Week	5	6	9
duration of crop	Weeks	26	27	30
plants/m²	start>end	62>49	62>49	62>49
area netto	m² x days	3318	3465	3906
amount for sale	pots	1000	1000	1000
Selling rate at the market	in %	95	95	95
revenue	**€**	**950**	**950**	**950**
oil	litre	499	545	670
oil costs	€	250	272	335
seeds and plants				
seedlings	unit	1050	1050	1050
price	€/unit	0.10	0.10	0.10
costs of seedlings	€	105	105	105
pots and substrates				
size of pots		10 cm	10 cm	10 cm
number of pots	units	1050	1050	1050
costs of pots	€	32	32	32
amount of substrate	litre	431	431	431
costs of substrate	€	20	20	20
fertilisation, plant protection				
water, fertiliser (low level)	€	6	6	6
plant protection (low level)	€	8	9	10
lighting	W/m²	50	50	
lighted area	m²	20	20	
lighting duration	h	1030	840	
costs of lighting	€	155	126	
selling				
package	units	125	125	125
costs of package	€	23	23	23
marketing charge	€	95	95	95
summary of direct costs	€	692	687	625
manpower	hours	12.1	12.2	12.5
costs of manpower	€	85	85	71
output without direct costs	€	258	263	325
- per hour manpower	€/hour	21	22	26
- per area	€/1000 m² x days	78	76	83
amount of coverage	€	173	178	238

Table 12 : Economic calculations, examples 4 to 6

examples		**4** 20 h 3000lx	**5** 80 klxh	**6** ambient daylight
start	week	32	32	32
start of sale	week	5	6	9
end of sale	Week	7	8	12
duration of crop	Weeks	28	29	33
plants/m²	start>end	62>34	62>34	62>34
area netto	m² x days	4442	4452	5292
amount for sale	pots	1000	1000	1000
Selling rate at the market	in %	95	95	95
revenue	**€**	**1140**	**1140**	**1140**
oil	litre	839	903	1083
oil costs	€	420	451	542
seeds and plants				
seedlings	unit	1050	1050	1050
price	€/unit	0.10	0.10	0.10
costs of seedlings	€	105	105	105
pots and substrates				
size of pots		10 cm	10 cm	10 cm
number of pots	units	1050	1050	1050
costs of pots	€	32	32	32
amount of substrate	litre	431	431	431
costs of substrate	€	20	20	20
fertilisation, plant protection				
water, fertiliser (low level)	€	7	7	9
plant protection (low level)	€	11	11	13
lighting	W/m²	50	50	
lighted area	m²	30	30	
lighting duration	h	1277	930	
costs of lighting	€	287	209	
selling				
package	units	125	125	125
costs of package	€	23	23	23
marketing charge	€	114	114	114
summary of direct costs	€	1018	972	857
manpower	hours	12.6	12.8	13.2
costs of manpower	€	89	89	93
output without direct costs	€	122	168	283
- per hour manpower	€/hour	10	13	21
- per area	€/1000 m² x days	29	38	54
amount of coverage	€	34	79	190

Table 13: Economic calculations, examples 7 to 9

examples		**7** 20 h 3000lx	**8** 80 klxh	**9** ambient daylight
start	week	32	32	32
start of sale	week	3	4	7
end of sale	Week	5	6	10
duration of crop	Weeks	26	27	31
plants/m²	start>end	62>34	62>34	62>34
area netto	m² x days	3822	4032	4872
amount for sale	pots	1000	1000	1000
Selling rate at the market	in %	95	95	95
revenue	**€**	**1235**	**1235**	**1235**
oil	litre	713	778	996
oil costs	€	357	389	498
seeds and plants				
seedlings	unit	1050	1050	1050
price	€/unit	0.25	0.25	0.25
costs of seedlings	€	263	263	263
pots and substrates				
size of pots		10 cm	10 cm	10 cm
number of pots	units	1050	1050	1050
costs of pots	€	32	32	32
amount of substrate	litre	431	431	431
costs of substrate	€	20	20	20
fertilisation, plant protection				
water, fertiliser (low level)	€	6	7	8
plant protection (low level)	€	10	10	12
lighting	W/m²	50	50	
lighted area	m²	30	30	
lighting duration	h	1030	840	
costs of lighting	€	232	189	
selling				
package	units	125	125	125
costs of package	€	23	23	23
marketing charge	€	124	124	124
summary of direct costs	€	1064	1055	997
manpower	hours	12.4	12.5	13.0
costs of manpower	€	87	88	91
output without direct costs	€	171	180	256
- per hour manpower	€/hour	14	14	20
- per area	€/1000 m² x days	45	45	53
amount of coverage	€	84	92	165

5 Summary and conclusions

From 34 species/varieties tested during this year early spring trial 2006/2007 in Dresden- Pillnitz 25 species are recommendable for the cultivation as early spring pot plants. The results of the research project give detailed information about the requirements of successful species like vernalization and reaction on different lighting treatments.

The selling date Valentine's Day is attached for most species with supplementary light. Supplementary lighting advances the crop and improves the quality. Some species like Papaver and Calceolaria will only flower with photoperiodic or supplementary lighting. The quantity of light should be at least 80 klxh per day during forcing. But there are species which are able to flower until Valentine's Day exposed to photoperiodic light or even ambient daylight (provided the right precultivation): Ajuga reptans 'Mini Mahagoni', Androsace septentrionalis 'Star Dust', Aquilegia hybrida 'F1 Spring Magic' series, Erysimum perovskianum 'Goldrush', Geum coccineum 'Cooky', Lindernia 'Grandiflora', Papaver miyabeanum 'Pacino' and Phlox divaricata.

The use of growth regulators like Topflor and CCC 720 is possible with the corresponding application rate. The species react differently on growth regulators. It depends also on the development of plants and the forcing conditions at the time of application. There are still open questions about the use of growth regulators in combination treatments and the best time for applications. That could be optimized in future research work.

Many species need to be enough vernalized before forcing otherwise the flowering is less, flower stems do not stretch above leaves, the quality degrades and the period of forcing prolongs. High temperatures during storage in autumn and early winter can become a problem for successful growing. The early spring trial 2006/2007 in Dresden-Pillnitz and Stockbridge (UK) was strongly influenced by the high temperatures during storage 2006. Possibly, for the future work on early spring pot plants could be the controlled storage in climate chambers to satisfy the vernalization.

The cultivation of early spring pot plants can take place between other crops. The pre-cultivation is possible in outdoor terrain, the storage in frost- free glasshouse or in a polythene tunnel and the forcing on qualified space starts relatively late in greenhouses after for instance poinsettias. The required energy for forcing at 10 °C to 12 °C is in an exactable scope.

The changing climate conditions in temperatures and quantity of light from year to year make it difficult to steer the crop to an exact selling date. However, with adapted temperatures and supplementary lighting a steering of the crop is possible.

The costs for the cultivation of new spring plants rose in the same way like all other crops in horticulture. The input for energy got higher. The profitability depends on the conditions of each grower. With the input of supplementary light, the most species flower before Valentine's Day. The installed supplementary light is profitable when the use is all year round. The new pot plants for early season sale can realize a higher prices then primroses and pansies. This is a great chance for growers. The 'new' species will find their way on the market as early pot plants in the future.

The recommended species are 'new' as pot plants. The new species have a high aesthetical value and a good shelf life under living room conditions. Most species are perennials and have natural frost hardiness. However, with the early start of forcing the species become sensitive to frost. That is important for selling. It is not recommendable to use the label perennial as an extra bonus for selling. It is better to present the 'new' species as new pot plants for indoor. Anyway, after staying under warm indoor conditions, the customer can keep the species at a light and cool place and can transfer the plants with a risk of survival to outdoor conditions at the end of April.

The results of the research program PC 267 assist growers in the U.K and Germany to improve their economic returns and develop the market for early season sales of pot plants.

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7 Appendices

Appendix 1

Content of the annex on DVD:

Data files	sheets	contents
UKprojektdatenEndboni020407.xls	3…….F23	data of single varieties
UKDatenEndboni020407.xls	all data	combined data of all varieties
Bigtable06-07PC267.xls	with pgr	Overview of the number of plants and average values for all variants of the species with pgr treatments
	no pgr	Overview of the number of plants and average values for all variants of the species without pgr treatments
Fruehjahr.ab3		ULEAD PhotoImpact album of all picture with the option of automatic search (needs special ULEAD software)
LightUKPC267.xls	Diag2	diagram: amount of light in klxh
	evaluations	Light summaries of the different treatments in klxh
	burning time lamps	greenhouse compartments and the real burning time of lamps per day
	Diag mol m²	diagram: sum of PAR mol/m²
	mol m²	data
TemperaturesUKPC267.xls	temp storage	temperature during storage
	temp humidity	temperature and air humidity during forcing period
	average temp per day	real average temperature during forcing period
	wm	accumulated heating energy per glasshouse in MWh
Stockbridge170507.ppt		Powerpoint presentation from the meeting at stockbridge, May 17th2007
Report PC 267.doc		this technical report as pdf file

Appendix 2: Germination and Cropping Details Early Spring Trial 2006/2007

Nr.	UK No	species	variety	source	amount	prop-week	saw-week	germ-date	pr-date	pr-week	pr-amount	po-date	po-week	po-amount	trimm-week
3		Ajuga pyramidalis	'Metallica Crispa'	Jal	100	**27**						31	**31**	99	
4		Ajuga reptans	'Braun Hertz'	Jal	100	**27**						31	**31**	112	
5	1	Ajuga reptans	'Mini Mahagoni'	Jal	500	**27**						34	**34**	539	
6		Arabis ferdinandi	'Coburgii Variegata'	Jal	115	**27**						34	**34**	94	
7	2	Arabis ferdinandi	'Old Gold'	Jal	100	**27**						34	**34**	84	
10	3	Cymbalaria	'Muralis'	Jal	100	**27**						34	**34**	99	**45**
13	4	Iberis	'Snow Flake'	Jal	500	**27**						12.9.06	**37**	486	**45**
14	5	Lindernia	'Grandiflora'	Jal	100	**27**						31	**31**	114	
15	6	Lithodora	'Heavenly Blue'	Jal	500	**27**						20.9.06	**38**	427	**45**
16		Lithodora	'Pete's Favorite'	Jal	100	**27**						20.9.06	**38**	50	**45**
20	7	Serissa foetida	'Pink Mystic'	Jal	100	**27**						31	**31**	99	
F 01	14	Anacyclus pyrethrum var. depressus	'Silberkissen'	Je	2 g		**29**	27.7.06	1.8.06	**31**	770	4.9.06	**36**	763	
F 02	12	Andosace septentrionalis	'Star Dust'	LfL			**29**	27.7.06	4.8.06	**31**	770	4.9.06	**36**	760	
F 03	18	Aquilegia hybrida	'Spring Magic Blau-Weiß'	Be	1000 K		**29**	31.7.06	15.8.06	**33**	616	12.9.06	**37**	598	
F 04		Aquilegia hybrida	'Spring Magic Hellrot-Gelb'	Be	1000		**29**	31.7.06	16.8.06	**33**	770	5.9.06	**36**	756	
F 05		Aquilegia hybrida	'Spring Magic Hellrot-Weiß'	Be	1000		**29**	31.7.06	14.8.06	**33**	770	5.9.06	**36**	765	
F 06		Aquilegia hybrida	'Spring Magic Marine-Weiß'	Be	1000		**29**	28.7.06	10.8.06	**32**	770	5.9.06	**36**	762	
F 07		Aquilegia hybrida	'Spring Magic Rosa-Weiß'	Be	1000		**29**	31.7.06	15.8.06	**33**	770	11.9.06	**37**	765	
F 08		Aquilegia hybrida	'Spring Magic Weiß'	Be	1000		**29**	31.7.06	15.8.06	**33**	770	11.9.06	**37**	763	
F 09	11	Aquilegia vulgaris	'Winky Double White-White'	Kieft	300 K		**29**	27.7.06	16.8.06	**33**	231	11.9.06	**37**	239	
F 11	8	Barbarea rupicola	'Sunnyola'	Kieft	1500 K		**29**	31.7.06	14.8.06	**33**	616	5.9.06	**36**	616	
F 12		Calceolaria biflora	'Goldcup'	Kieft	2000 K		**29**	27.7.06	16.8.06	**33**	770	11.9.06	**37**	766	
F 13	10	Erigeron karvinskianus	'Stallone'	Kieft	2000 K		**29**	27.7.06	15.8.06	**33**	770	5.9.06	**36**	763	**45**
F 14		Erinus alpinus	'Dr. Hähnle'	Je	1 g		**29**	28.7.06	14.8.06	**33**	770	12.9.06	**37**	620	
F 15	9	Erysimum perovskianum	'Goldrush'	Kieft	2000 K		**29**	27.7.06	1.8.06	**31**	770	4.9.06	**36**	747	
F 16	17	Geum coccineum	'Cooky'	Be	1000 K		**29**	28.7.06	16.8.06	**33**	616	5.9.06	**36**	591	
F 17	15	Horminum pyrenaicum	'Rubrum'	Je	1 g		**29**	28.7.06	16.8.06	**33**	308	12.9.06	**37**	314	
F 18		Horminum pyrenaicum		Je	1 g		**29**	28.7.06	16.8.06	**33**	770	11.9.06	**37**	752	
F 19		Lychnis alpina		Je	1 g		**29**	27.7.06	15.8.06	**33**	770	12.9.06	**37**	695	

Nr.	UK No	species	variety	source	amount	**prop-week**	**saw-week**	germ-date	pr-date	**pr-week**	pr-amount	po-date	**po-week**	po-amount	**trimm-week**
F 20	16	Lychnis alpina	'Snow Furry'	Je	1 g		**29**	28.7.06	11.8.06	**32**	770	12.9.06	**37**	714	
F 21	19	Papaver miyabeanum	'Pacino'	Be	0,5 g		**29**	31.7.06	16.8.06	**33**	770	12.9.06	**37**	709	
F 22	20	Papaver nudicaule	'Gartenzwerg'	Be	0,5 g		**29**	27.7.06	8.8.06	**32**	770	4.9.06	**36**	733	
F 23	13	Silene pendula		LfL			**29**	27.7.06	1.8.06	**31**	770	4.9.06	**36**	736	
24	21	Phlox divaricata original		bGD	400	**27**					432	5.9.06	**36**	408	**45**
26	21	Phlox divaricata propagation		bGD	400	**27**					415	5.9.06	**36**	486	
25		Ajuga reptans Eigenv.	'Mini Mahagoni'	LfL		**35**						20.9.06	**38**	598	

Impressum

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Redaktionsschluss / editorial deadline: 30.06.07