Raspberry, blackberry and blueberry off season production

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All year round raspberry production

1. Open field production with different types and cultivars,

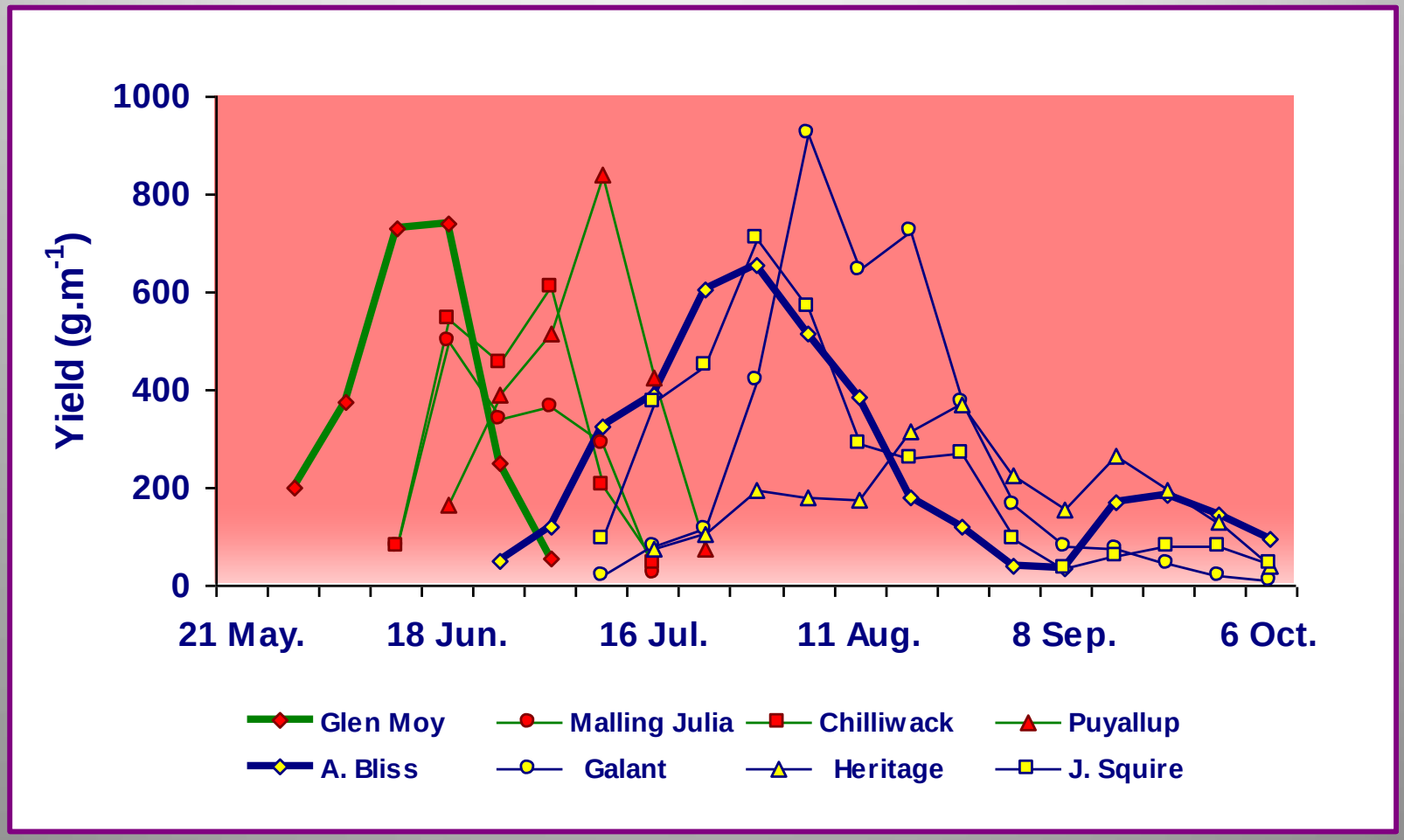
2. Early production with summer-fruiting cultivars,

3. Late production with primocane-fruiting cultivars,

4. Other new growing systems.

1. Open field production

Open field production with different cultivars



Protected cultivation

Substrate

Soil

Planting material
- High altitude nurseries -

- **“Long canes”**
  - This planting material is used for a long time and it was first produced in high altitude nurseries mainly in North European countries. From these nurseries it is possible to buy plants grown in three different ways:
    - 1. Wide bed plants
    - 2. Narrow bed plants
    - 3. In pots

Planting material “long canes”

- High altitude nurseries -

1. Wide bed plants

Plants are grown in wide beds with an high number of plants (high densities). This is the standard way of multiplication that are not often ordered. They can be quickly introduced into an high multiplication rate. However, this plants have a low yield potential.

Planting material “long canes”

- High altitude nurseries -

2. Narrow bed plants

Plants are grown in single rows. Yield potential is very high. In good growing conditions it is possible to achieve more than 500 g per plant.

Planting material “long canes”

- High altitude nurseries -

2.3. Plants in pots

These plants are only supplied to heated glasshouse growers. They present the highest yield potential. However, plants must be ordered with more than 12 months before planting.

Planting material
- Low altitude -

- **“Long canes”**
  - In this case growers use their own planting material. New plants are dig out from the production fields and cold stored for a certain period of time depending on the cultivar used. Depending on digging date and fruiting habit plants can be used for early and late production:
    - 1. Early long-cane production with floricane-fruiting cultivars
    - 2. Winter long-cane production with tip and primocane-fruiting cultivars

Early production with summer-fruiting cultivars

Greenhouse grown plants

Early production with summer-fruiting cultivars

Artificial chilling

Early production with summer-fruiting cultivars

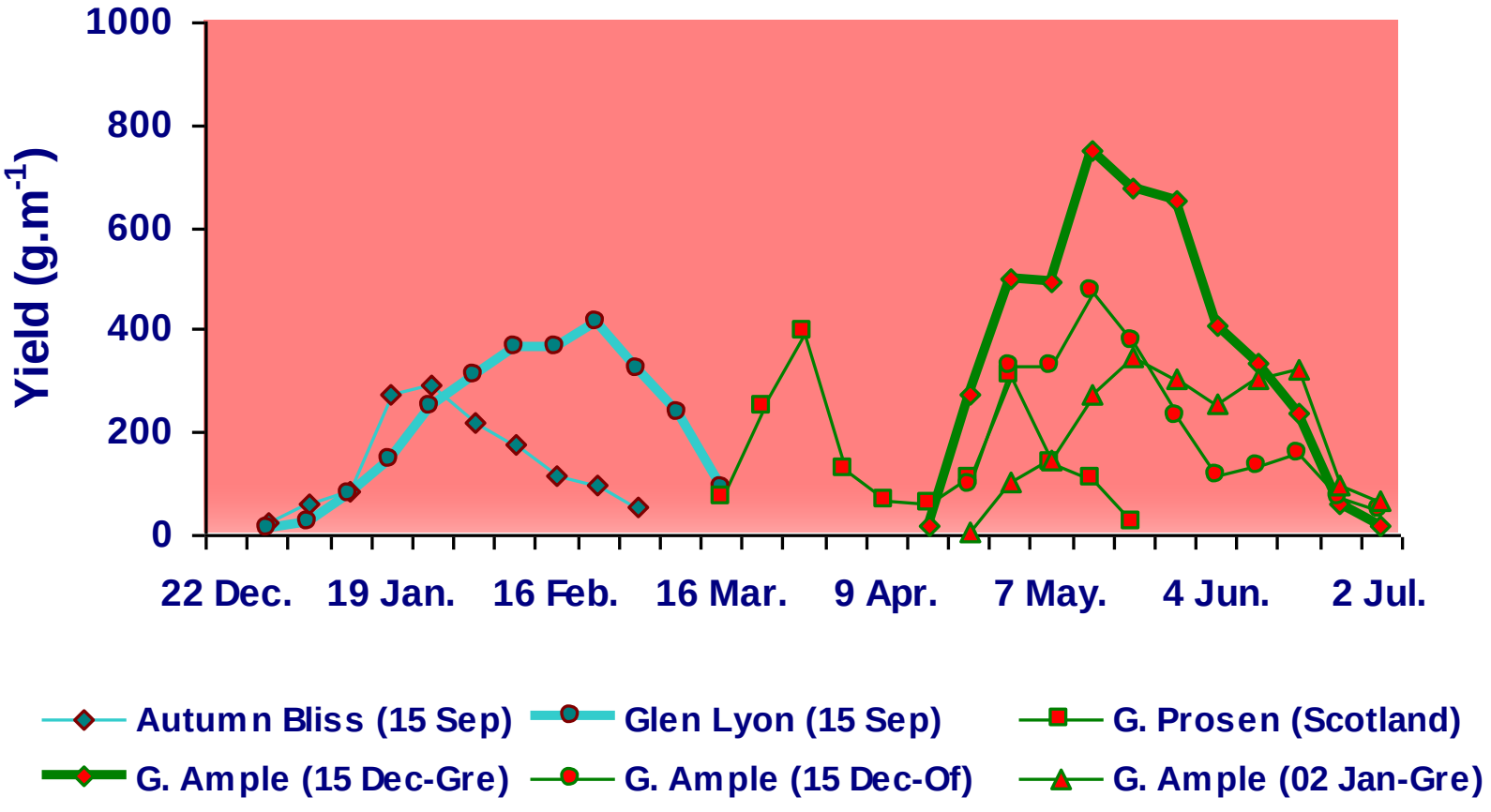
Excellent results

Three different stages

- same day -

- same farm -

Early production

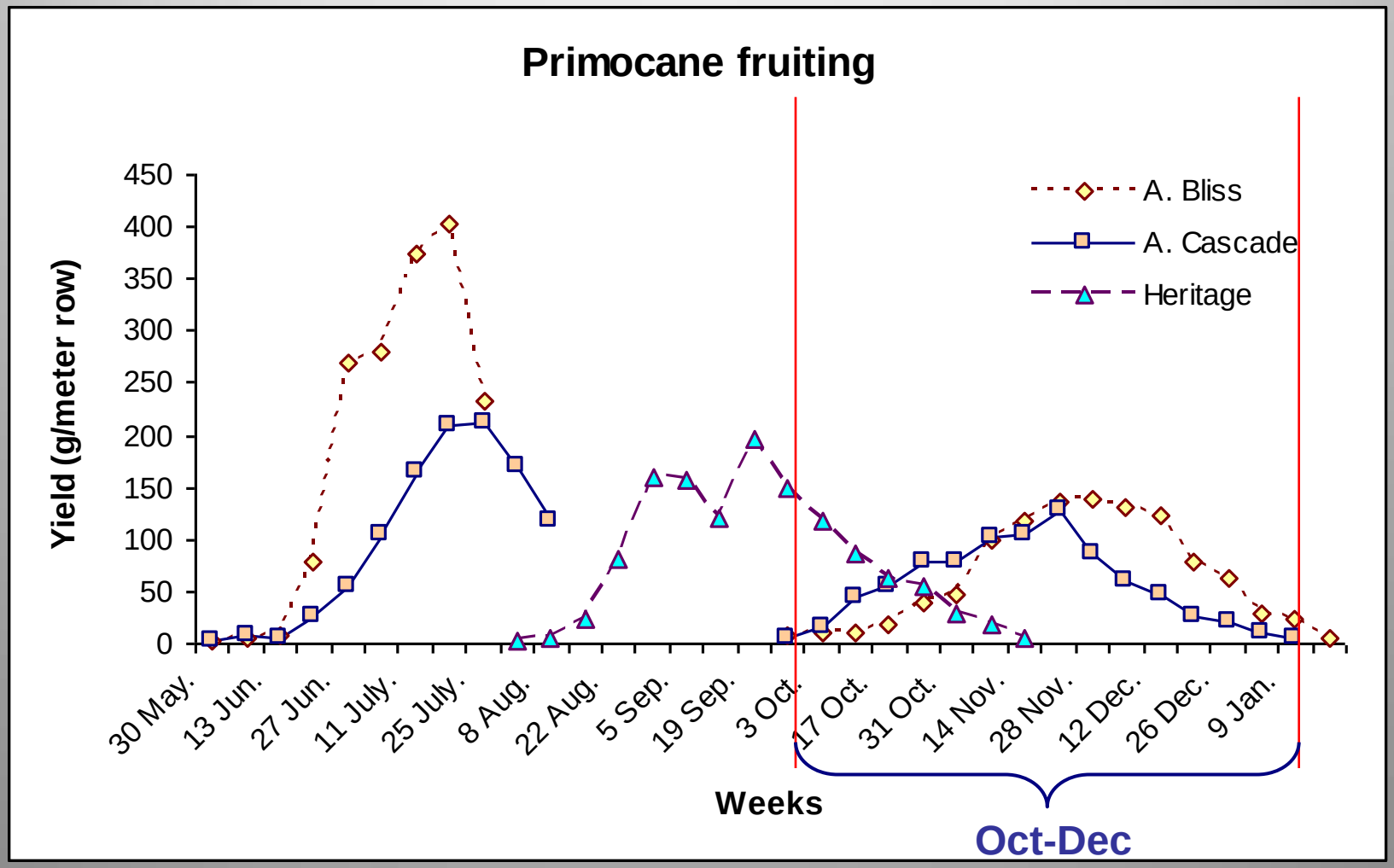


3. Late production

Pruning techniques - early trials

Cutting primocanes at ground level (N_0)

Primocane-fruiting - plastic tunnel



Better pruning techniques

Cutting primocanes at ten nodes (N_{10})

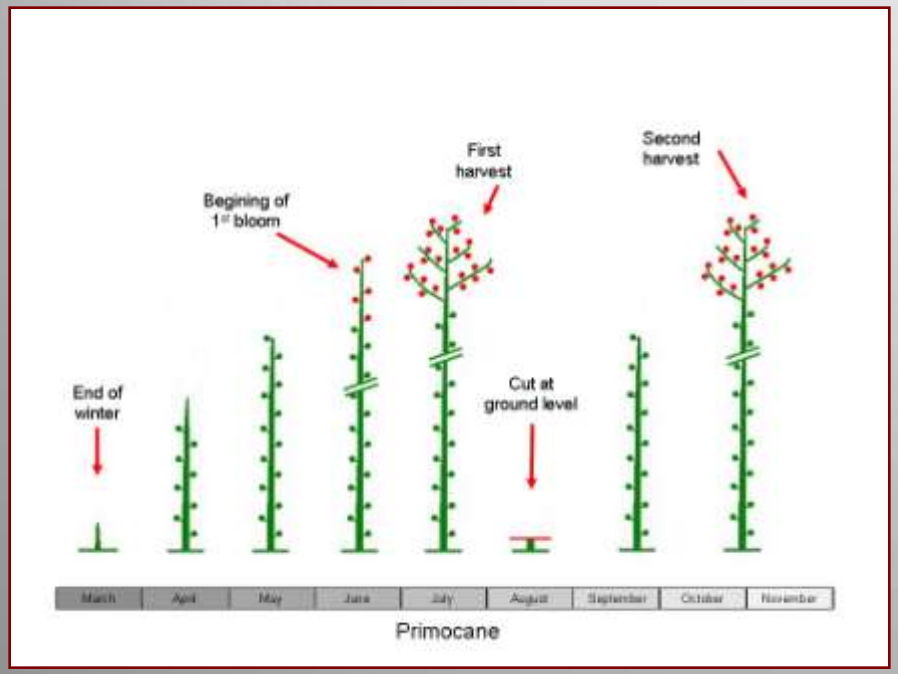
Effect of pruning date

	Growth characteristics					
Cutting date	Cane height (cm)	Nodes (nº)		Cane dry weight (g)	Leaf area per cane (m^2)	Yield per cane (g)
		Total	Fruiting			
2 Jul.	95.0	31.9	8.1	25.0	1.74	63.5
16 Jul.	95.6	32.9	8.0	20.3	1.15	52.8
31 Jul.	88.0	30.0	7.7	16.4	0.99	26.5
15 Aug.	63.3	21.0	3.4	10.5	0.49	4.8
30 Aug.	57.0	18.5	2.7	8.9	0.11	2.1
Significance						
Linear	**	*	**	**	**	**
Quadratic	**	**	**	**	**	**

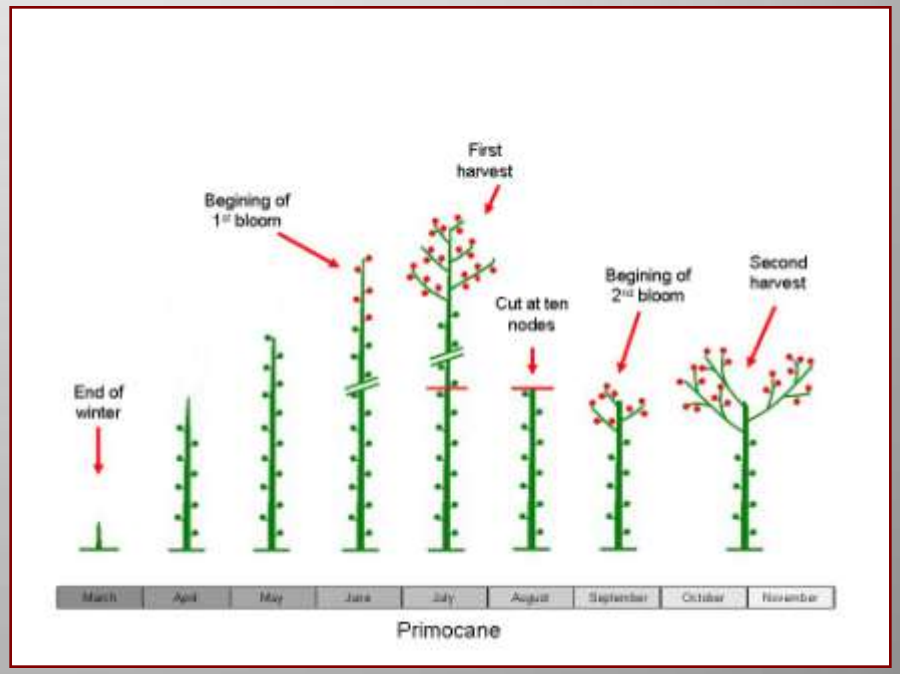
*.**. Significant at $P < 0.05$ and 0.01 respectively.

(-)

Primocane-fruiting
- pruning techniques-



Ground level



Ten nodes

Pruning intensity effect

Cultivar	Cutting date	Pruning intensity[z]	Lateral branches per cane	Characteristics of the lateral branches: Length (cm)	Node number	Fruiting laterals per branch	Yield per cane (g)	Fruit number per cane	Mass per fruit (g)
Autumn Bliss	19 Jul	N_5	2	105	25	9	105	32	3.2
		N_{10}	3	79	20	9	168	54	3.1
		N_{15}	4	62	18	9	167	57	2.9
		Linear[y]	***	***	***	N S	*	*	*
Autumn Cascade	02 Aug	N_{10}	3	46	14	8	174	57	3.0
		N_{15}	4	43	13	8	189	63	3.0
		N_{20}	5	38	12	9	232	78	3.0
		Linear[y]	***	N S	N S	N S	*	*	N S
Heritage	16 Aug	N_{15}	1	72	28	10	33	14	2.4
		N_{20}	2	52	23	10	36	15	2.3
		N_{25}	2	45	19	10	48	20	2.4
		Linear[y]	*	***	***	N S	N S	*	N S

+ +

Autumn Bliss

Five nodes

Ten nodes

Fifteen nodes

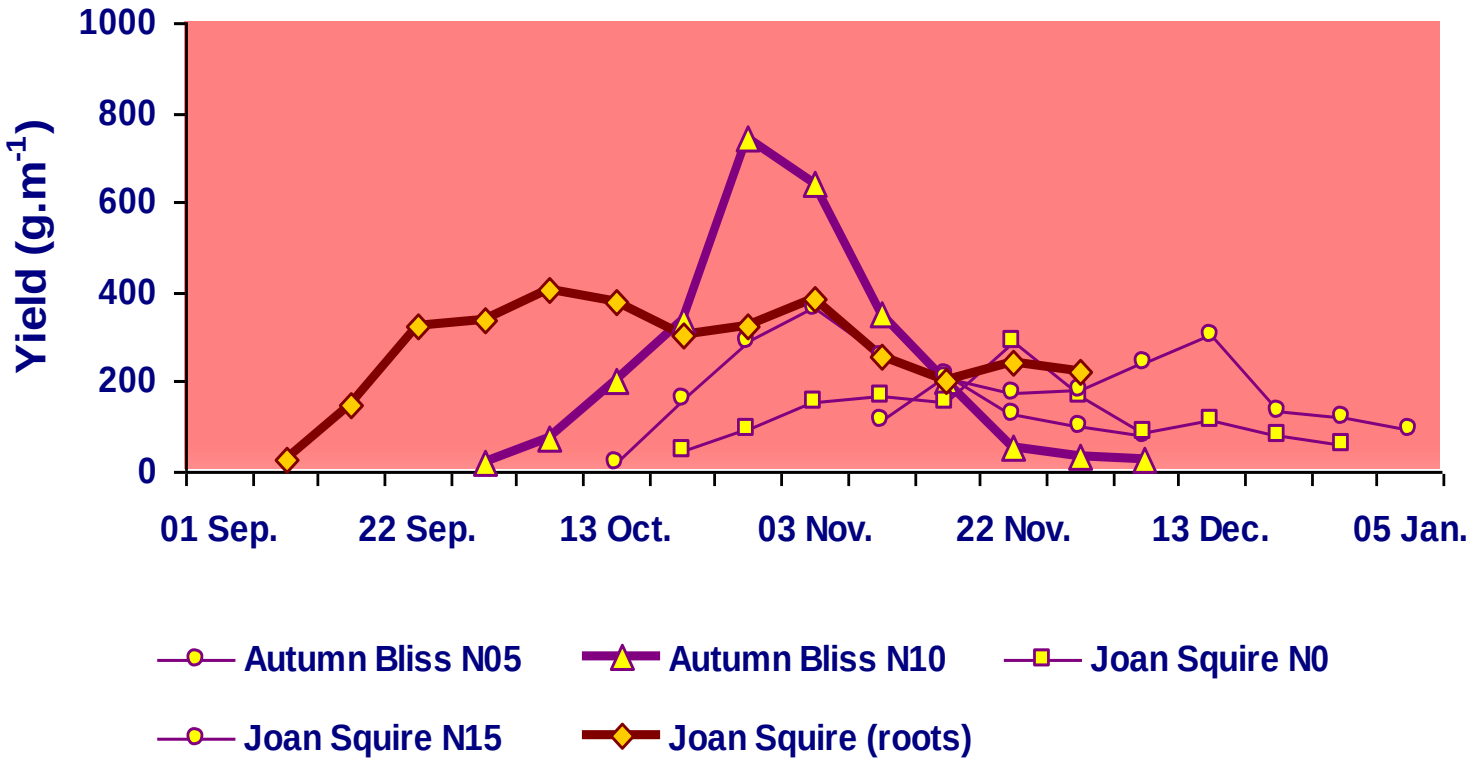
Effect of fruiting-lateral number

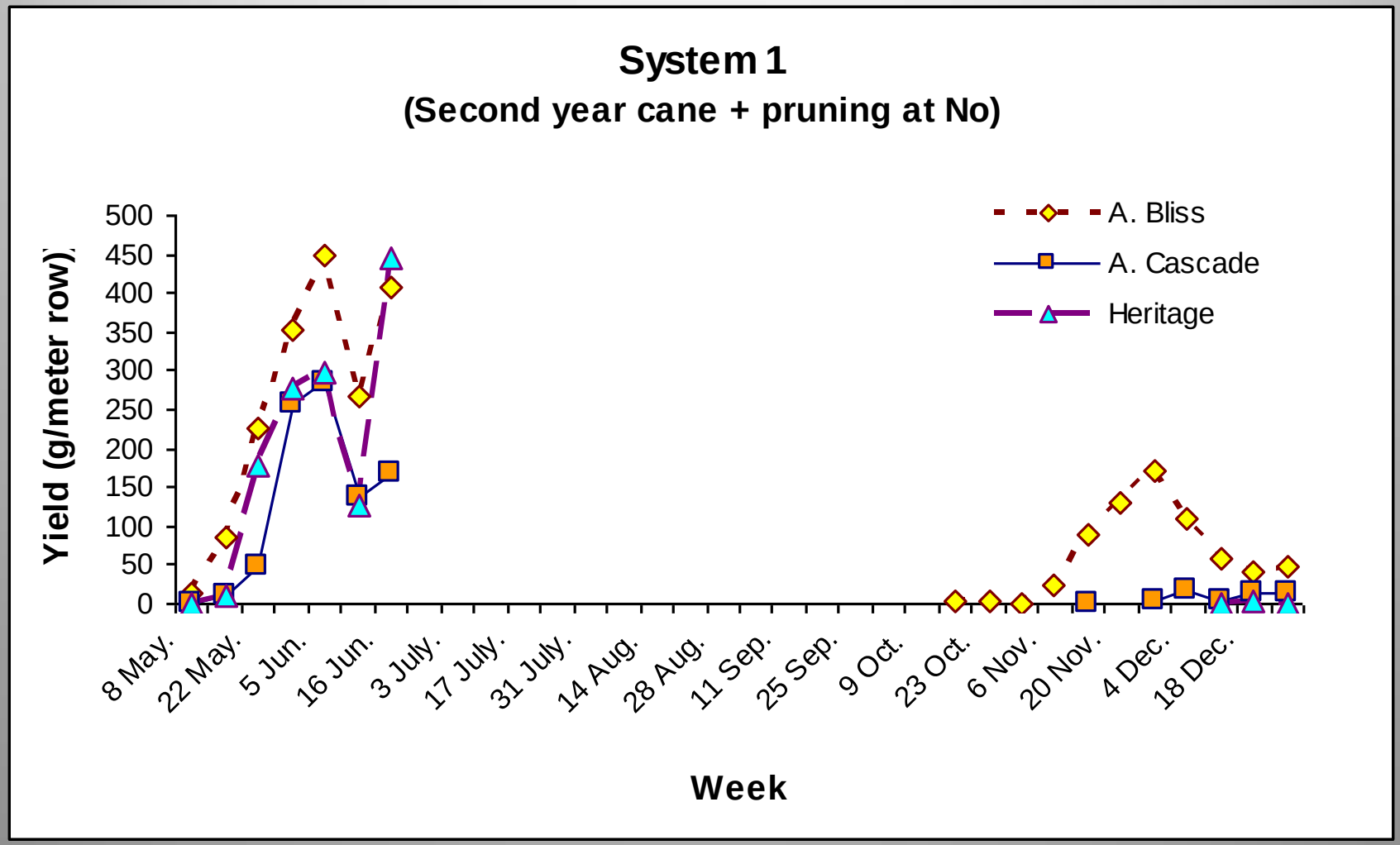
Yield, mean weight of 20 berries and percentage of unmarketable fruit of cultivar Joan Squire, cut at 10 nodes on 9 and 23 August (C_1 and C_2, respectively) with reduction to one and two fruiting laterals per cane (L_1 and L_2, respectively) and standard treatment (without lateral thinning).

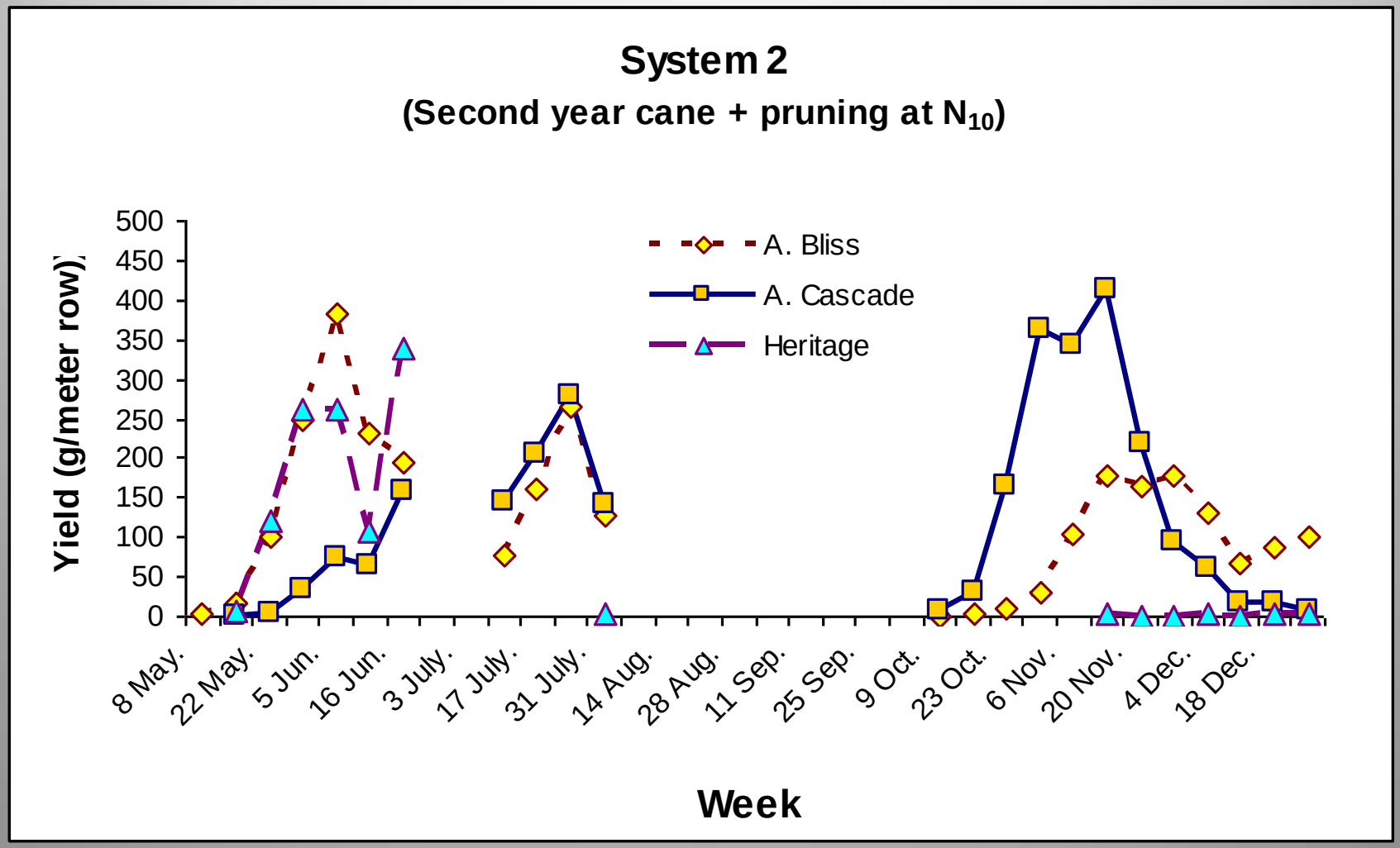
Cultivar	Treatment	Yield[z] ($g \cdot m^{-1}$)	Weight 20 berries[z] (g)	Unmarketable[z] (%)
Joan Squire				
C_1	Standard	1895 a	58 b	3,8 a
	L_2	1398 b	62 ab	2,1 a
	L_1	1477 b	66 a	2,3 a
C_2	Standard	1026 a	58 a	2,2 a
	L_2	880 a	60 a	2,8 a
	L_1	380 b	52 b	1,0 a

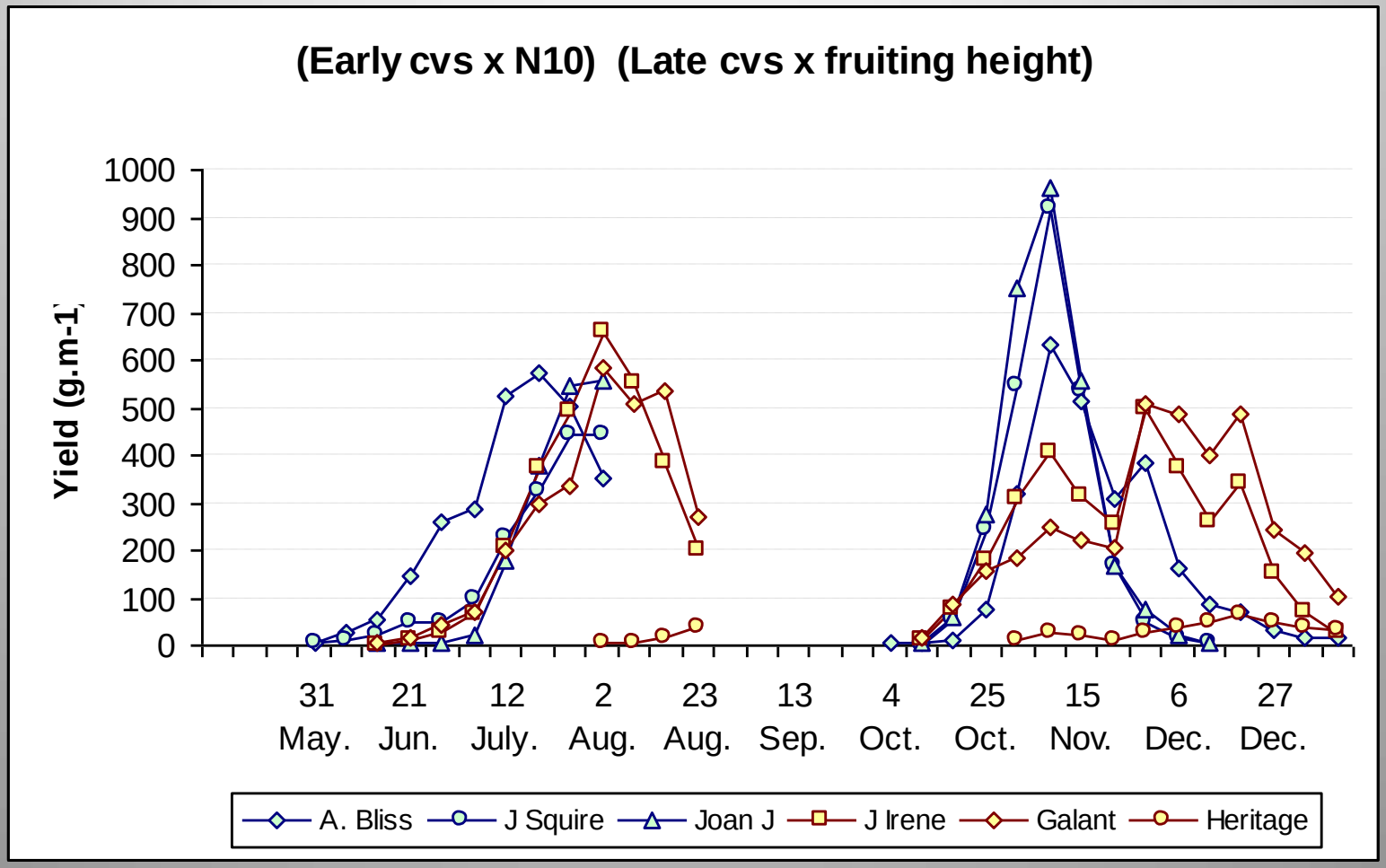
[z]Mean separation within parameters by LSD, $P < 0,05$.

Late production




System 1
(Second year cane + pruning at No)
Yield (g/meter row)
500
450
400
350
300
250
200
150
100
50
0
A. Bliss
A. Cascade
Heritage
8 May.
22 May.
5 Jun.
16 Jun.
3 July.
17 July.
31 July.
14 Aug.
28 Aug.
11 Sep.
25 Sep.
9 Oct.
23 Oct.
6 Nov.
20 Nov.
4 Dec.
18 Dec.
Week


System 2
(Second year cane + pruning at N_{10})
Yield (g/meter row)
500
450
400
350
300
250
200
150
100
50
0
A. Bliss
A. Cascade
Heritage
8 May.
22 May.
5 Jun.
16 Jun.
3 July.
17 July.
31 July.
14 Aug.
28 Aug.
11 Sep.
25 Sep.
9 Oct.
23 Oct.
6 Nov.
20 Nov.
4 Dec.
18 Dec.
Week


(Early cvs x N10) (Late cvs x fruiting height)
Yield (g.m-1)
1000
900
800
700
600
500
400
300
200
100
0
31 May.
21 Jun.
12 July.
2 Aug.
23 Aug.
13 Sep.
4 Oct.
25 Oct.
15 Nov.
6 Dec.
27 Dec.
A. Bliss
J Squire
Joan J
J Irene
Galant
Heritage

Early cultivars - N_{10} (01 Aug.)
Late cultivars – fruiting height (24 Aug.)

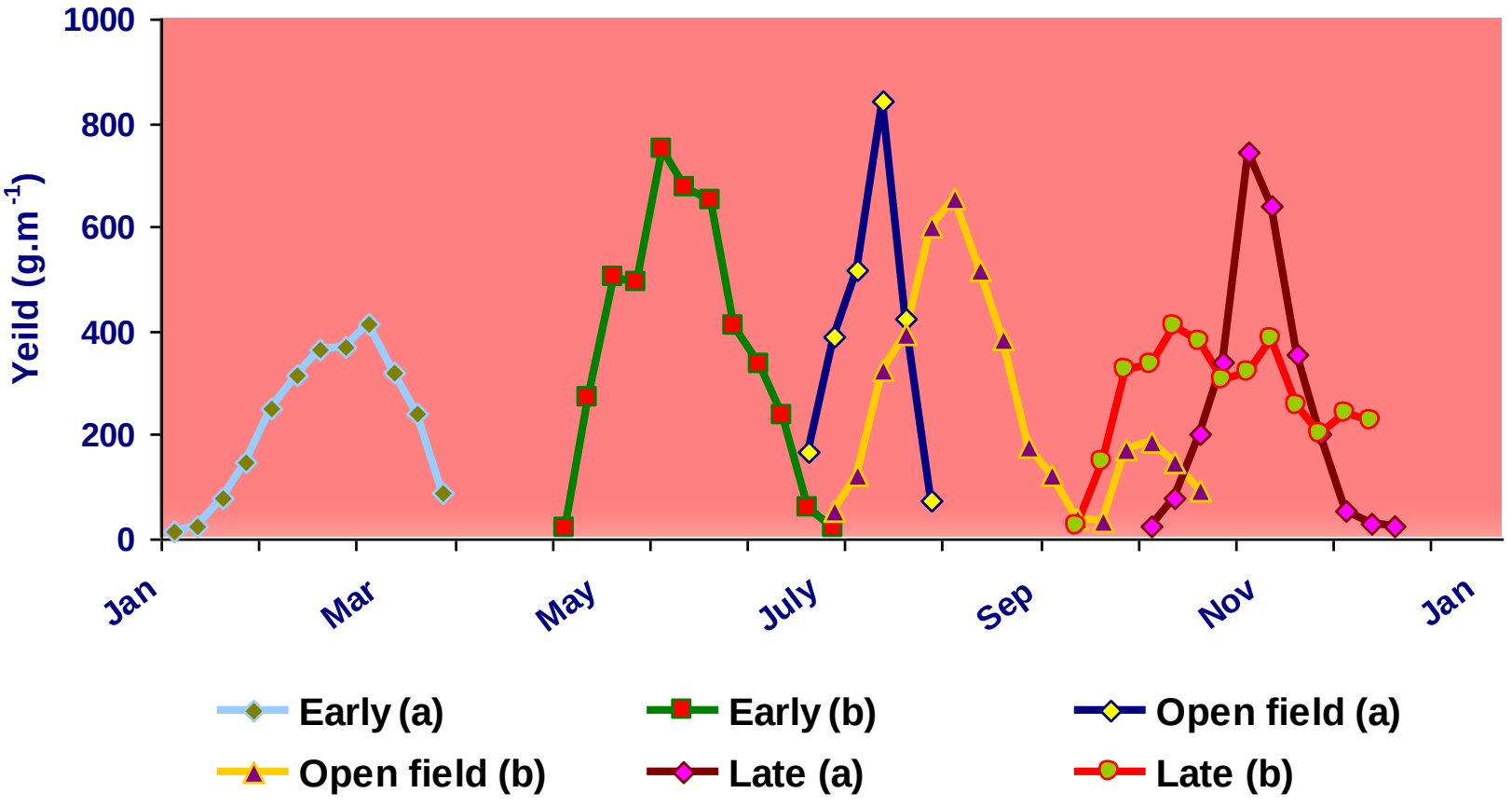
Yield g.m^{-1}

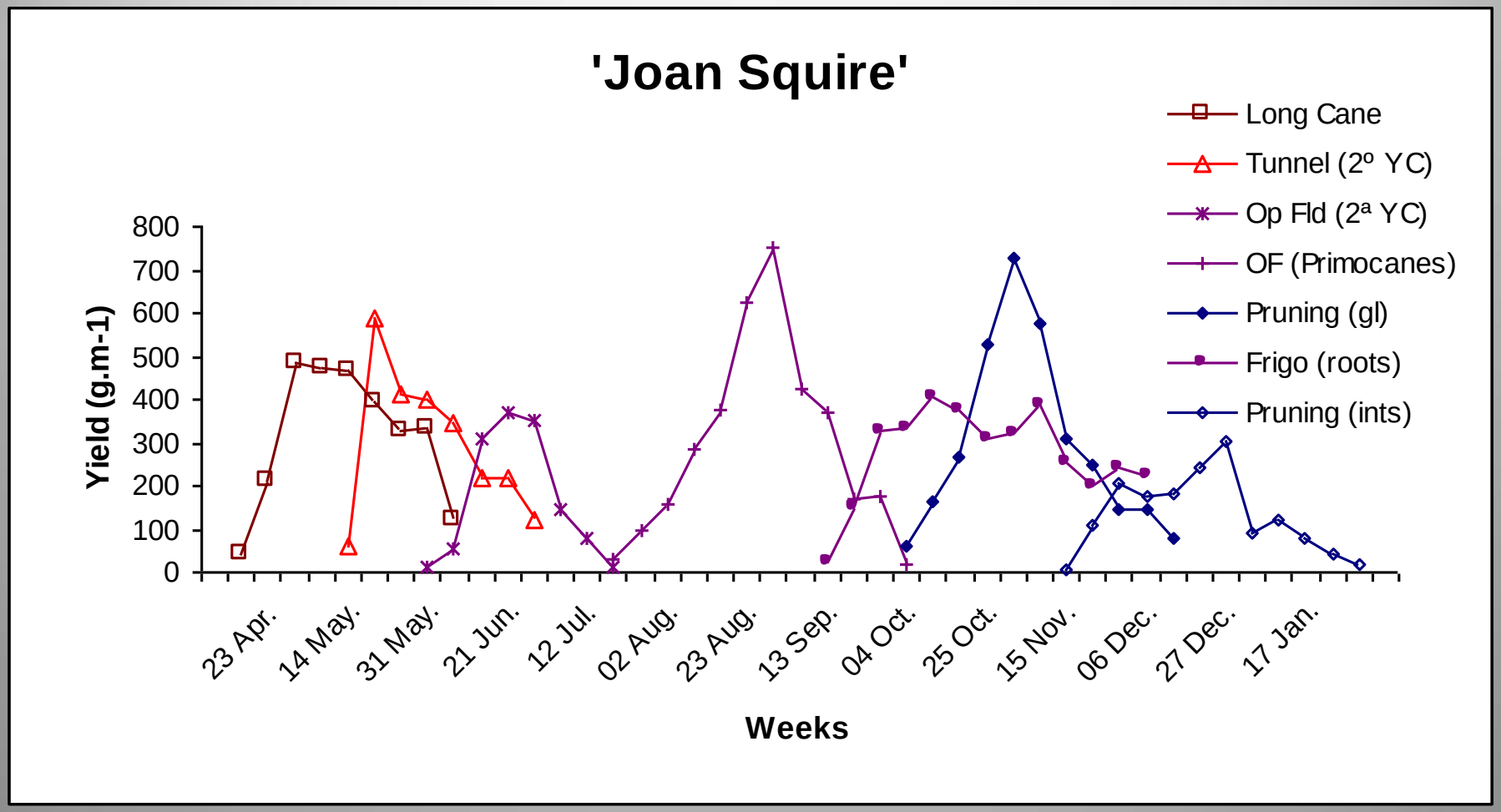
	Spring	Autumn
Autum Bliss	**3796**	3765
Joan J	2471	**4659**
Joan Squire	1832	3478
Joan Irene	2765	3330
Galante	2717	3218
Heritage	61	424

N_{10}

Frt_{hgt}

Combining different systems




'Joan Squire'
Long Cane
Tunnel (2º YC)
Op Fld (2ª YC)
OF (Primocanes)
Pruning (gl)
Frigo (roots)
Pruning (ints)
Yield (g.m-1)
800
700
600
500
400
300
200
100
0
23 Apr.
14 May.
31 May.
21 Jun.
12 Jul.
02 Aug.
23 Aug.
13 Sep.
04 Oct.
25 Oct.
15 Nov.
06 Dec.
27 Dec.
17 Jan.
Weeks

4. Other new growing systems

Root planting

Potted plants

May planting

Autumn harvest

Trial with ‘Polka’ tray plants (summer planting - July)

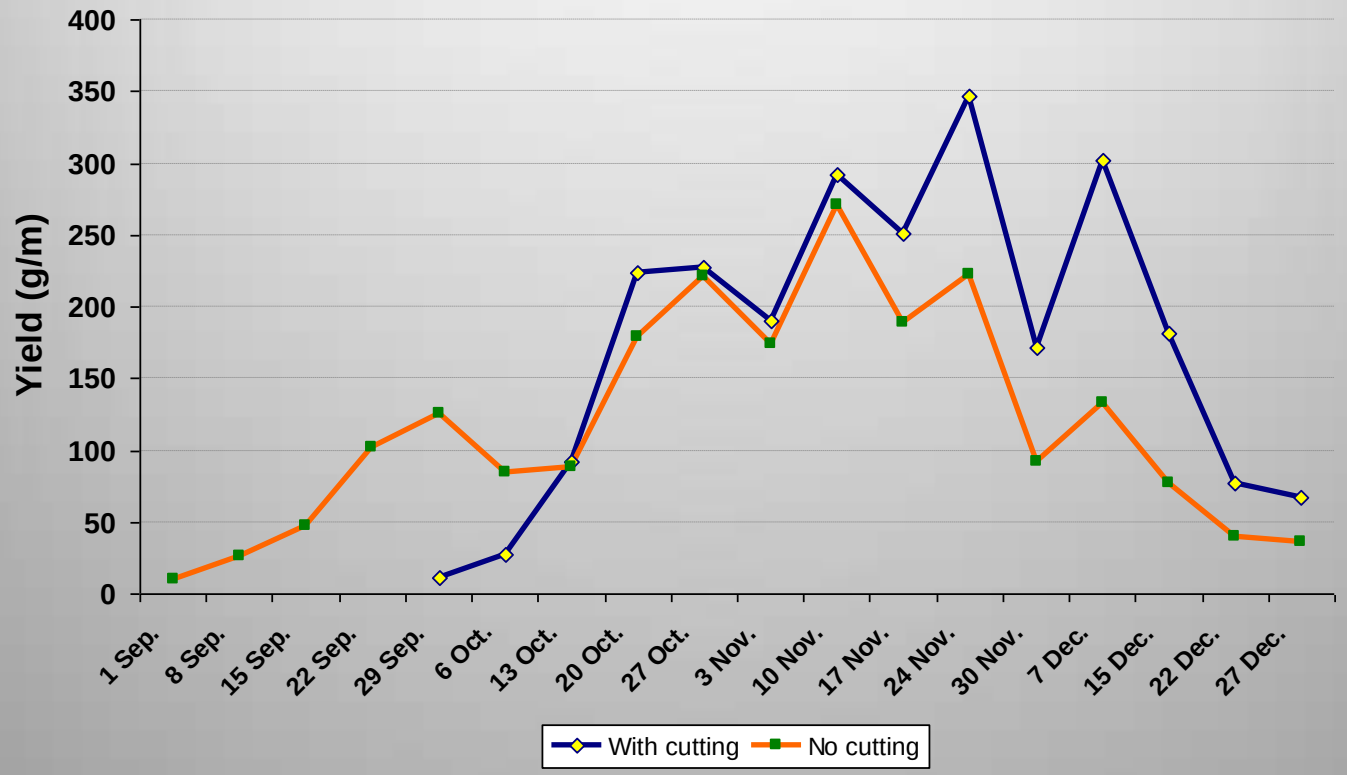
2005	Yield ($kg.m^{-2}$)		Unmark	Fruit weight	Harvest period (% of total yield)		
	Total	Commerc.	(%)	(g)	5%	50%	95%
Tipped							
8 plt/m	**2.0**	**1.7**	**13.8**	**4.3**	**03 Oct.**	**02 Nov.**	**30 Nov.**
10 plt/m	**1.8**	**1.5**	**15.8**	**4.6**	**05 Oct.**	**31 Oct.**	**09 Dec.**
12 plt/m	**1.9**	**1.7**	**11.0**	**4.7**	**05 Oct.**	**31 Oct.**	**09 Dec.**
Not tipped							
8 plt/m	**1.8**	**1.5**	**17.3**	**4.3**	**10 Oct.**	**31 Oct.**	**29 Nov.**

Rock wool – hydroponic culture

July planting - Autumn harvest

Rock wool – hydroponic culture

Rock wool – potted plants – July planting



Yield g.m^{-1}

	With cut	Without cut
Polka	**1484**	1633

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High intensive systems

Two crops a year in the same tunnel

Tray plants

Strawberry Raspberry

Strawberry: Jan. to June

Raspberry: June to Dec.

Frigo plants

Raspberry Strawberry

Raspberry: Jan. to June

Strawberry: June to Dec.

Spring and Autumn production

Early

Late

January to June

June to December

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Blackberry double cropping

The purpose is to develop a double cropping system for fruit production in early spring and late autumn, using the same plant material (floricanes + long-canes) and same tunnels.

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What we know

- Blackberry is a biennial fruiting plant, this fruiting habit strongly influences the how and when fruit is produced,

- Mild winter climatic regions have a long vegetative growth period, starting in March and ending in November,

- Blackberry vegetative growth management is difficult since primocanes can grow more than 6m long, so much hardwood is wasted with pruning.

The idea !

Double cropping…

Floricane (Spring)

Rooted primocanes (Autumn)

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The trial

(Gonçalves, 2011)

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Materials and methods

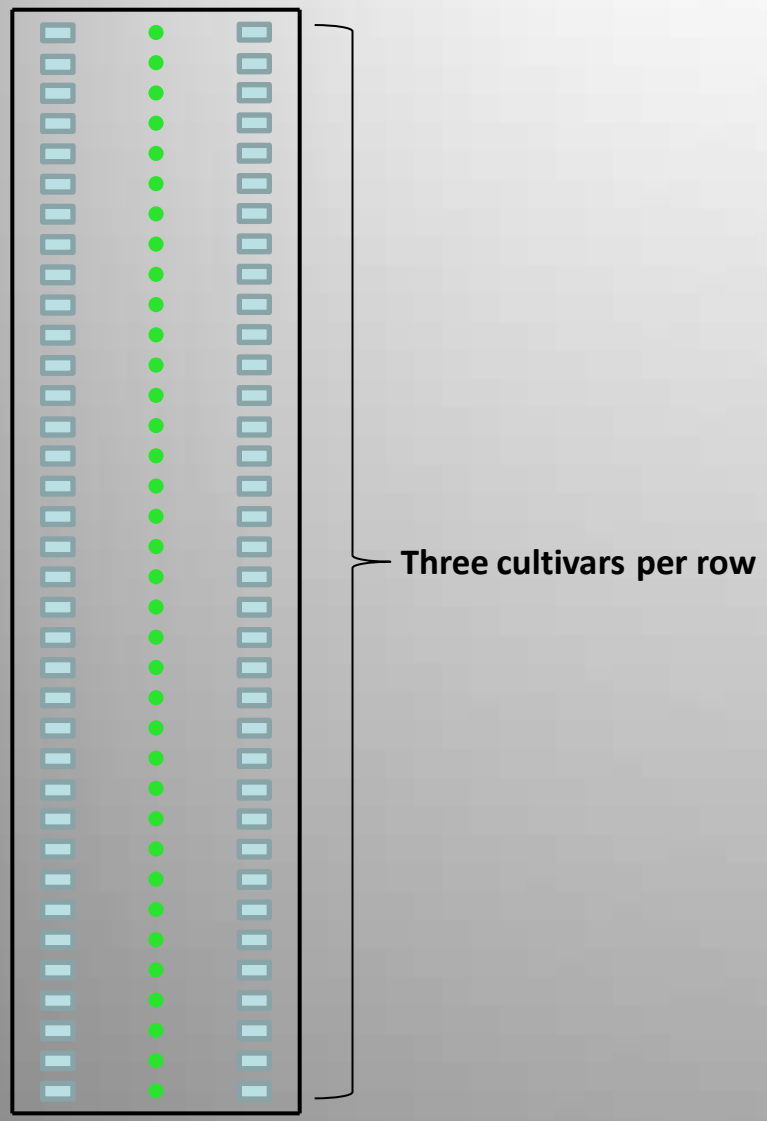
- Fataca, Odemira, located at Lat. 37 N, (average temperature: January 11.2 C; July 19.4 C),

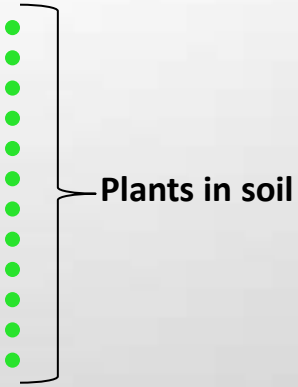
- "Spanish tunnels", 9 cultivars (12 plants per cultivar) planted in the soil spring 2010,

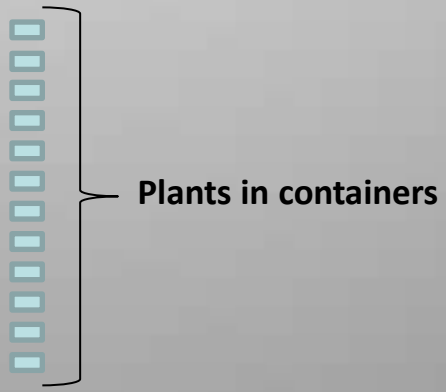
- 1 row planted two rows for pots,

- Tip layering (TL); Tip layering with 15 days in cold storage after cutting (TL cold); Tip layering after cutting top 20 cm (TL 20 cm) e simple layering (SL)

Tunnel view







Cultivars:

- `Olallie
- `Silvan
- `Kotata
- `Karaka
- `Ouachita
- `Logan (hybrid)
- `Chester
- `Boysen (hybrid)
- `Loch Tay


LICOR REIRÃO

Results

Mother plant primocane characteristics for all cultivar tested.

Cultivar	Cane number	length (cm)	Base diameter (mm)	Node number
Olallie	3.1	404.2 B	10.4 C	65.4 B
Karaka Black	3.1	419.9 B	9.8 C	77.7 A
Logan Thornless	3.7	401.4 B	9.5 C	59.6 C
Boysenberry	3.5	512.7 A	10.2 C	67.9 B
Ouachita	3.8	412.7 B	18.4 A	47.0 E
Loch Tay	2.6	318.1 B	11.1 C	51.5 DE
Chester Thornless	2.9	431.4 B	15.5 B	55.4 CD
Error	0.4	14.8	0.5	2.0
Significance level	NS	P<0.001	P<0.001	P<0.001

Means followed by different letters are significantly different according to Tukey test (p<0.05).

Results

Primocanes characteristics after rooting treatment for ‘Karaka Black’ and ‘Loch Ness’

Cultivar	Type	Treatment	Cane number	Length (cm)	Base diameter (mm)	Node number
Karaka	dewberry	SL	6	392.2 19.4	7.95 0.32	85 3
Loch Tay	Semi-erect	SL	3	476.3 101.5	8.66 1.31	68 17

Means and standard errors

Primocanes characteristics after rooting treatments for ‘Ouachita.

Cultivar	Length (cm)	Base diameter (mm)	Node number
Tip layering	218.7 B	11.9 AB	29.1
Tip layering 20 cm	312.3 A	13.8 A	34.1
Simple layering	252.9 AB	9.6 B	34.0
Significance level	0.019	0.007	NS

Means followed by different letters are significantly different according to Tukey test (p<0.05).

Primocanes characteristics after rooting treatments for ‘Chester thornless’.

Cultivar	Length (cm)	Base diameter (mm)	Node number
Tip layering	221.5 B	17.6 A	35.5 B
Tip layering 20 cm	293.3 AB	15.0 A	39.0 B
Simple layering	479.3 A	11.4 B	61.0 A
Significance level	0.028	P<0.001	0.02

Means followed by different letters are significantly different according to Tukey test (p<0.05).

Key questions answered:

- Vegetative growth is enough (time and vigor) to form two shoots (more than 2 m each) in the same year,
- Simple layering is the best technique for the production of a new shoot in July,
- New shoots must be separated from the mother plant in August,
- Layering did not affected shoot production of the mother plant,
- In the end of the season (December) a new long cane is produced ready for cold storage.

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Can wild *Rubus* sp. *become a new crop?*

Portugal has a large number of wild *Rubus* species which are extremely rich in nutraceutical compounds.

(Trindade, 2013)

Wild *Rubus* sp.

Wild Rubus sp.

Total and commercial yield (g), waist percentage and berry weight (g), in five of the species studied.

Specie	Yield (g/plant)		Waist (%)	Berry weight (g)
	Total	Commercial		
R.vigoi	150 b	34 b	77 a	1,8 ab
R.radula	1516 a	911 a	40 b	1,7 ab
R.henriquesii	1543 a	928 a	40 b	1,9 ab
R.sampaioanus	1467 a	845 a	43 b	2,1 a
R.brigantinus	1232 a	657 a	49 b	1,6 b
Level of Significance	<0,000	<0,000	<0,000	0,018

Means followed by different letters are significantly different according to Tukey test (p<0.05).

(Trindade, 2013)

Wild Rubus sp.

Sensorial analysis for the different species, showing *R. henriquesi* and *R. brigantinus* as the better performing species.

Wild Rubus sp.

Marketing is mandatory to differentiate sales

Blueberry

Blueberries are mainly produced in open field

Main cultivars

Northern Highbush (NHB)

- Berkley
- Goldtraub
- Bluecrop
- Bluetta
- Brigitta
- Patriot
- Duke
- Elisabeth
- Elliot
- Legacy
- Aurora

Southern Highbush (SHB)

- Sharpblue
- Misty
- O' Neal
- Ozarkablue
- Reveille
- Star
- Paloma
- Camelia

Rabbiteye

- Powderblue
- Tifblue
- Columbus
- Brightwell
- Ochlockonee
- Centra Blue

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Early and late blueberry production under tunnels

Early trials

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1 – Early blueberry production with Southern Highbush Blueberry under tunnels. Oliveira *et al*., 2004.

2 – Can we use autumn flowering habit of ‘Sharpblue’ to Increase early blueberry production? Oliveira *et al*., 2004.

Early blueberry production with Southern Highbush Blueberry under tunnels.

Oliveira *et al.*, 2004

Actas do II Colóquio Nacional da Produção de Morango e Outros Pequenos Frutos.

Early blueberry production with Southern Highbush Blueberry under tunnels.

- The main objective was to evaluate harvest date and productivity of four SHB cultivars (O'Neal, Cape Fear, Georgiagem and Reveille) in order to know the best adapted to the Portuguese climatic conditions.

- Plants were grown in tunnels (6.5 x 30 x 3 m), with two rows,

- Tunnels were covered only in January and plastic was removed in March.

Results

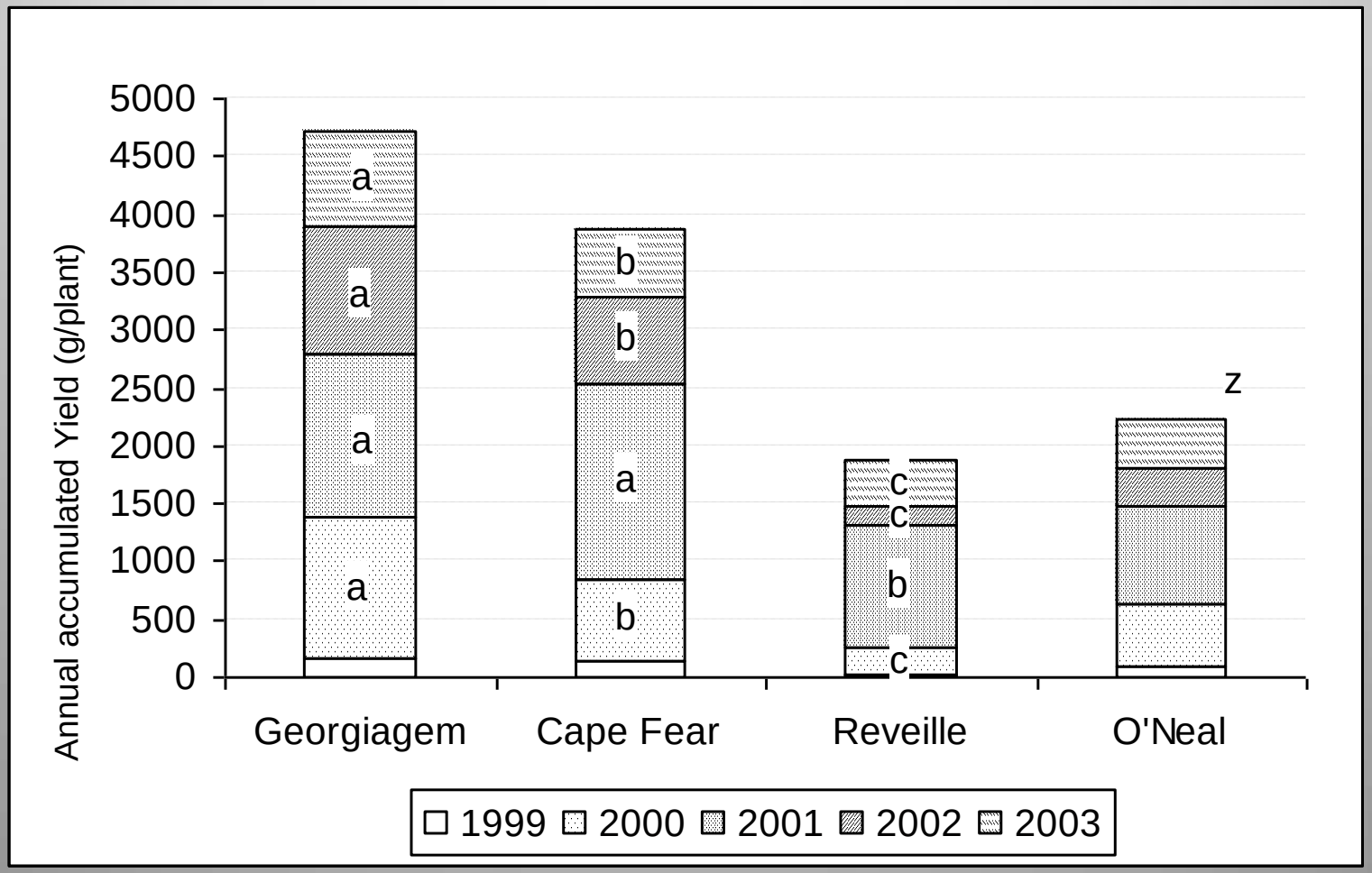
Cultivar	Nº days to 50% harvest	Harvest dates			Nº days in harvest
		5%	50%	95%	
Georgiagem	15	30-Apr	14-May	28-May	29
SD	*(6)*	*(9)*	*(+6)*	*(+6)*	*(9)*
Cape Fear	8	30-Apr	07-May	24-May	25
SD	*(6)*	*(+8)*	*(+7)*	*(+7)*	*(-7)*
Reveille	15	30-Apr	14-May	28-May	29
SD	*(4)*	*(+8)*	*(+6)*	*(+7)*	*(4)*
O'Neal	11	19-Apr	30-Apr	17-May	17
SD	*(4)*	*(10)*	*(+9)*	*(+5)*	*(8)*

Results

Harvest period, yield per plant and berry weight for the three harvest times in 2002.

Cultivares	Harvest time	Harvest period	Yield (g/plant)	Berry weight (g)
Georgiagem	1.º	17 Abr - 7 Jun	1089	1,1
	2.º	23 Ago - 20 Set	215	1,5
	3.º	27 Nov - 18Dez	62	0,9
Cape Fear	1.º	19 Abr - 7 Jun	736	1,7
	2.º	23 Ago - 20 Set	407	1,6
	3.º	27 Nov - 18Dez	36	1,0
Reveille	1.º	19 Abr - 7 Jun	180	1,2
	2.º	23 Ago - 20 Set	88	1,2
	3.º	27 Nov - 18Dez	11	1,0
O'Neal	1.º	17 Abr - 2 Jun	505	1,2
	2.º	26 Ago - 20 Set	45	1,5
	3.º	27 Nov - 18Dez	16	0,9

Results


Annual accumulated Yield (g/plant)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
a
a
a
a
b
b
a
b
c
c
b
c
z
Georgiagem
Cape Fear
Reveille
O'Neal
1999
2000
2001
2002
2003

First conclusions in 2003

- All SHB cultivars studied had three different harvest periods in 2002 which led to a decrease in yield in 2003,

- The low productivity of O'Neal and Reveille suggests that their chilling requirements were not completed fulfilled,

- The five years accumulated yield was considerably low for a commercial profitable industry,

- New SHB cultivars are needed more adapted to mild winter climatic regions.

Can we use autumn flowering habit of ‘Sharpblue’ to increase early blueberry production?

Oliveira *et al.*, 2004

Actas do II Colóquio Nacional da Produção de Morango e Outros Pequenos Frutos.

Can we use autumn flowering habit of ‘Sharpblue’ to increase early blueberry production?

- The main objective was to evaluate the possibility to have an early crop with the autumn flowers of cultivar Sharpblue,

- Plants were grown in tunnels (6.5 x 30 x 3 m), with two rows,

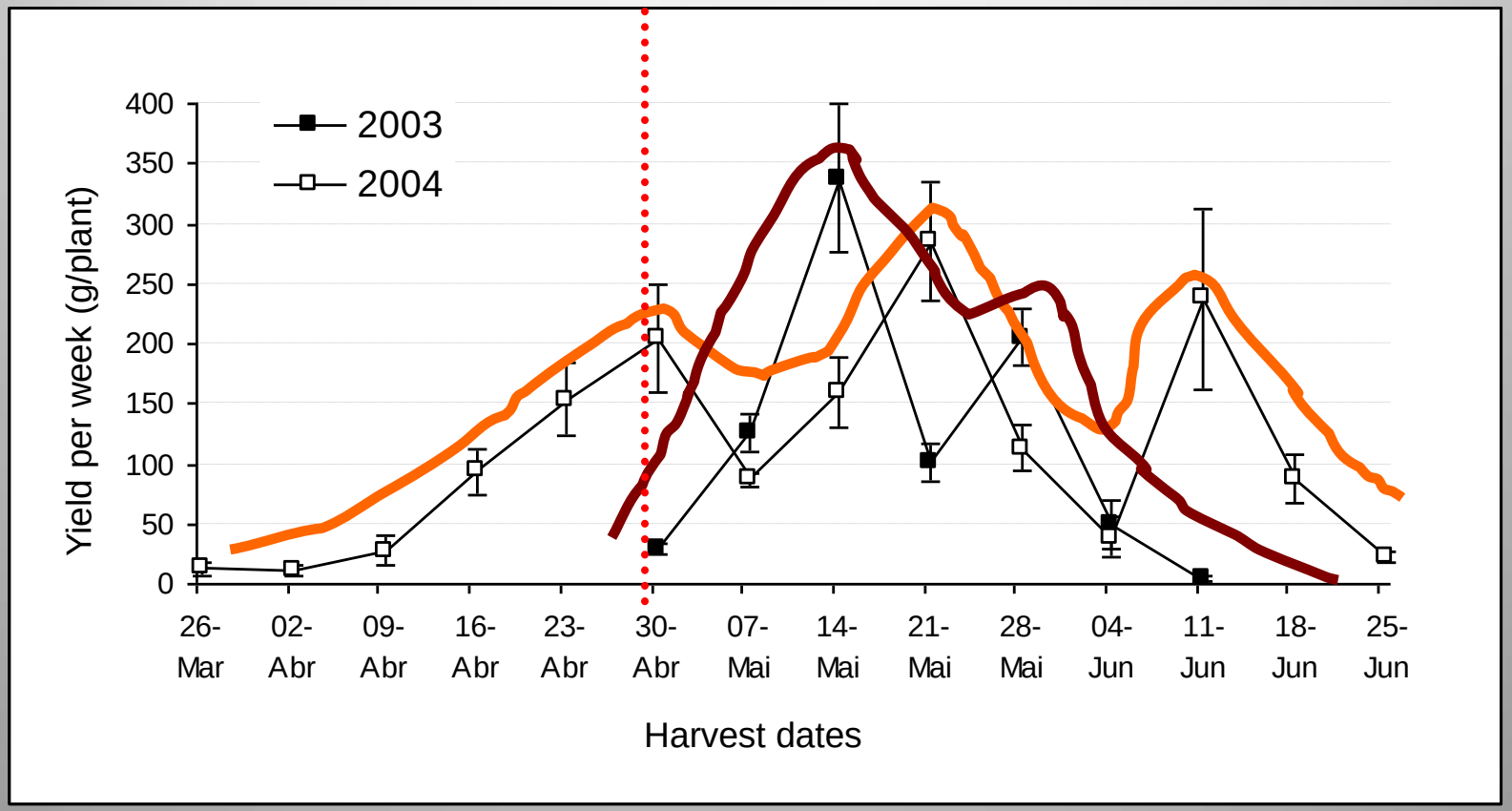
- Tunnels were covered only in January and October 2003 and plastic was removed in March 2003 and 2004.

- A standard was established in open field.

Results

System	year	Nº days to 50% harvest	Dates			Nº days in harvest
			5%	50%	95%	
Open field	2003	11	14-May	28-May	11-Jun	27
	2004	14	7-May	21-May	11-Jun	33
Tunnel	2003	11	7-May	14-May	28-May	22
	2004	37	16-Apr	21-May	18-Jun	44

Results



Yield per week and per plant for ‘Sharpblue’ in tunnel in the two years trial.

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Early and late blueberry production under tunnels

Present trials

GOVERNO DE PORTUGAL

MINISTÉRIO DA AGRICULTURA, DO MAR, DO AMBIENTE E DO ORDENAMENTO DO TERRITÓRIO

Received plants in 2011

Change for larger pot size in Spring 2012

Plants enter the greenhouse

Beggining of plant growth

General view of the greenhouse during the first year vegetative growth - 2012 -

Plants were placed in cold storage for the different treatments

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Early production

- Southern Highbush -

Parente, 2013

GOVERNO DE PORTUGAL

MINISTÉRIO DA AGRICULTURA, DO MAR, DO AMBIENTE E DO ORDENAMENTO DO TERRITÓRIO

Objective

- Determine the effect of cold storage on harvest date and productivity in three SHB cultivars.

Materials and methods

- Three SHB cultivars: O'Neal, Star and Paloma,

- Substrate culture in 12 liter pots,

- Two standard treatments (open field and greenhouse) and two cold storage periods at 2 C; E1 (13 Dec / 9 Jan); E2 (10 Jan / 30 Jan),

Vegetative and floral length (cm), diameter (mm), number of fruits per trust, number of vegetative and floral buds for each cultivar.

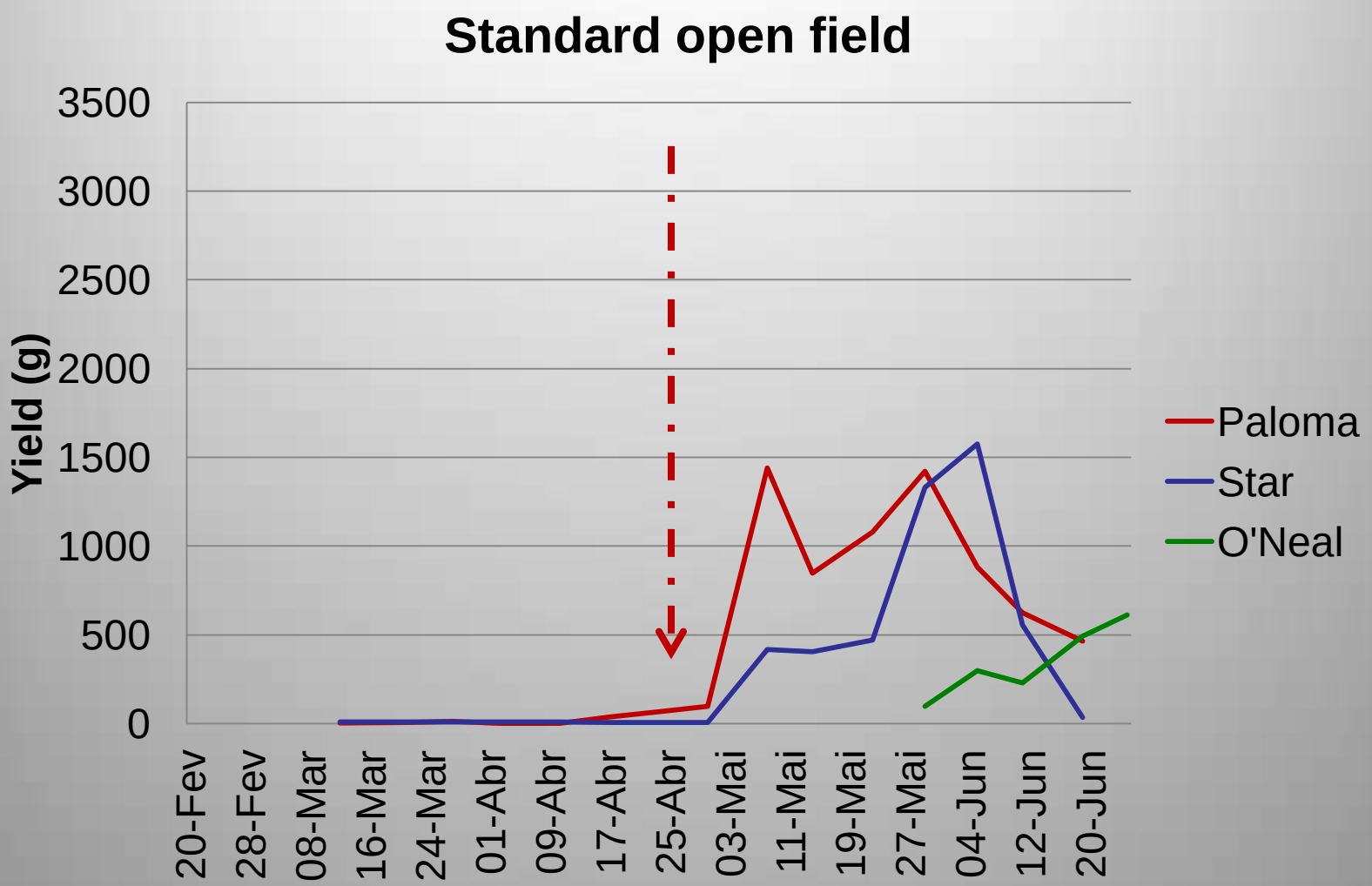
Cultivar	length		Diameter (mm)	Nº buds		Nº fruits
	Vegetative (cm)	Floral (cm)		Vegetative	Floral	
Star	10,6 AB	13,0 A	3,5	6,4	7,4 A	4,8 B
Paloma	14,8 A	8,0 B	3,4	5,5	5,4 B	5,7 A
O'Neal	7,3 B	6,8 B	2,5	5,0	4,7 B	5,1 B
Prob (F)	0,0011	P<0,001	NS	NS	P<0,001	P<0,001
EP	1,92	1,37	0,47	1,1	0,57	0,23

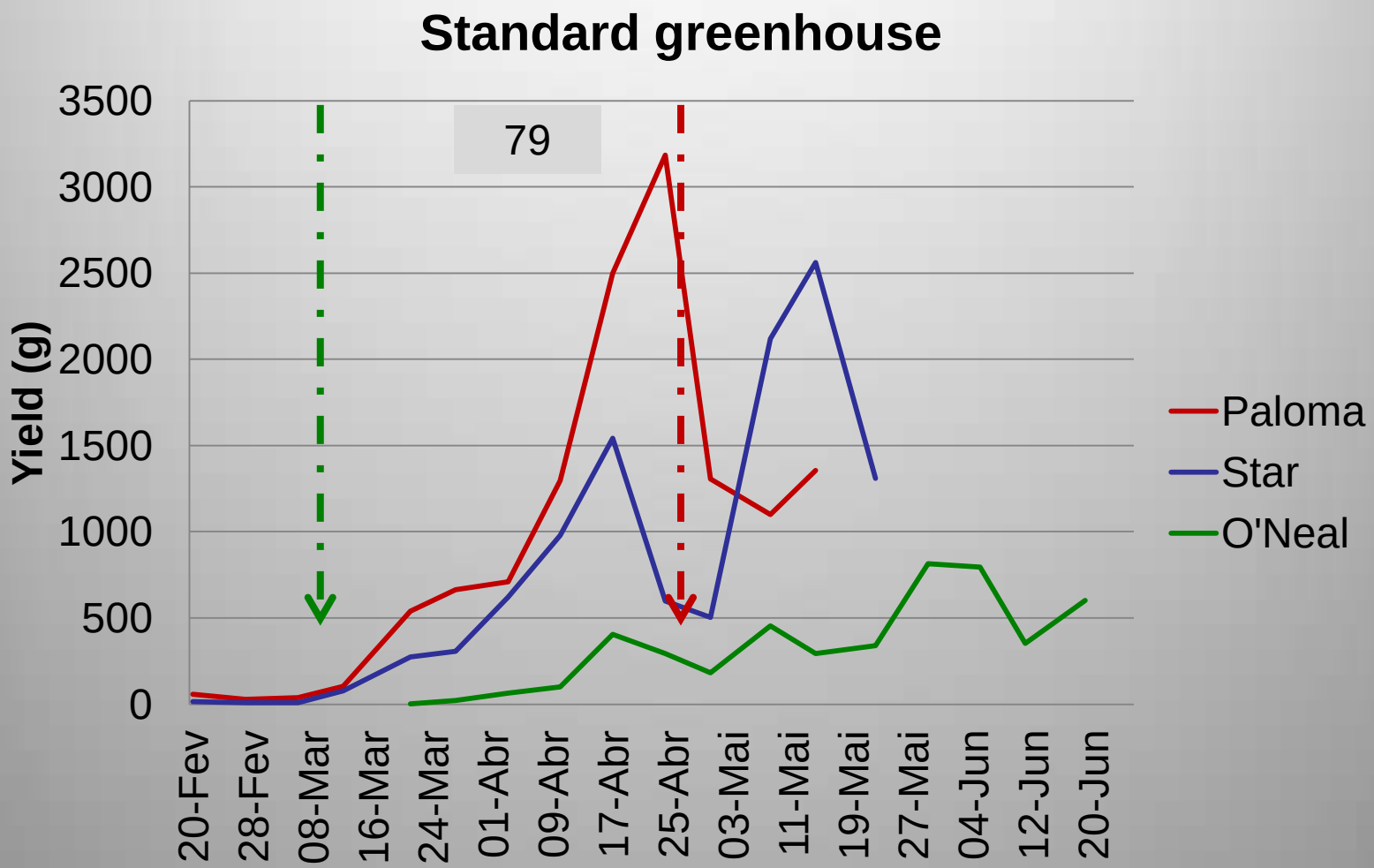
Means followed by different letters are significantly different according to Tukey test (p<0.05).

Total yield per plant (g) and berry weight. Standard opem field (S_open field); standard greenhouse (S_greenhouse); Entrance 1 (E_1) – natural cold + 690h; and Entrance 2 (E_2) – natural cold + 480h.

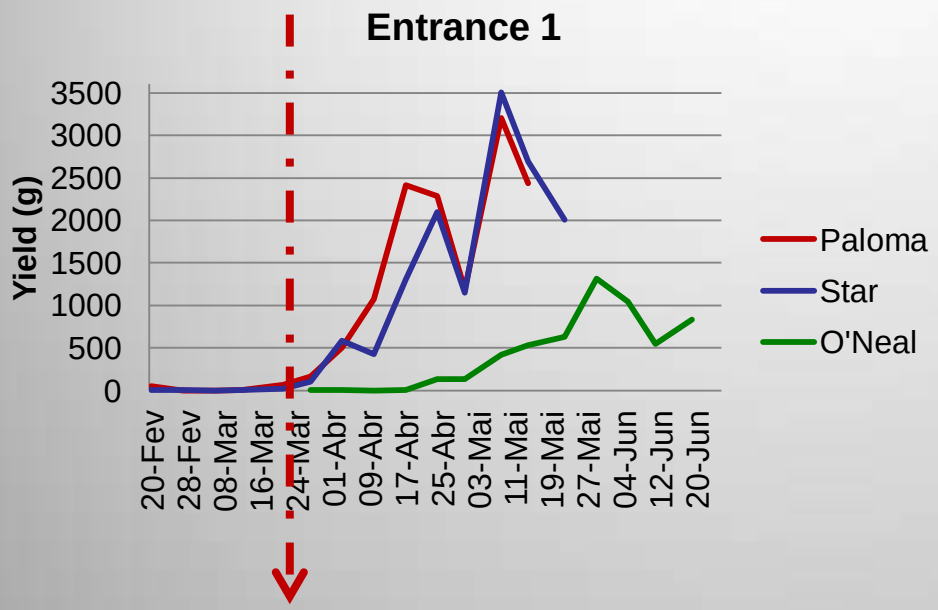
Treatament	Cultivar	Yield (g/plant)	Berry weight (g)
S_open field	Star	2853 A	1,35 ABCD
	Paloma	1151 CD	1,24 ABCD
	O'Neal	288 D	1,38 ABC
S_greenhouse	Star	2302 A	1,49 AB
	Paloma	2289 AB	1,36 ABC
	O'Neal	787 D	1,03 CD
E1 (9 Jan)	Star	1835 ABC	1,61 A
	Paloma	2194 AB	1,58 A
	O'Neal	936 CD	1,08 BCD
E2 (30 Jan)	Star	2274 AB	1,23 ABCD
	Paloma	2381 A	1,08 BCD
	O'Neal	1257 BCD	0,93 D
	Prob (F)	P<0,001	0,0156
	EP	215,26	0,1263

Means followed by different letters are significantly different according to Tukey test (p<0.05).


Standard open field
Yield (g)
3500
3000
2500
2000
1500
1000
500
0
20-Fev
28-Fev
08-Mar
16-Mar
24-Mar
01-Abr
09-Abr
17-Abr
25-Abr
03-Mai
11-Mai
19-Mai
27-Mai
04-Jun
12-Jun
20-Jun
Paloma
Star
O'Neal



(Parente, 2013)



24 of March

1 of April

Conclusions

- Cultivar Star had the longest floral length but ‘Paloma’ had the highest number of fruit per trust.
- ‘Paloma’ showed low yields in open field but high yield in all other treatments,
- ‘Star’ had the highest yield in open field,
- All cultivars started two and an half month earlier (79 days) in the greenhouse compared with the open field,
- Cold treatments postponed harvest when compared with the greenhouse plants.

Heavy pruning was done at he end of harvest (June)

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Late production

- Northern Highbush -

Parente, 2013

GOVERNO DE PORTUGAL

MINISTÉRIO DA AGRICULTURA, DO MAR, DO AMBIENTE E DO ORDENAMENTO DO TERRITÓRIO

Objetive

- Try to delay harvest with cold storage using three NHB cultivars.

Materials and methods

- Three NHB cultivars: Legacy, Elizabeth e Duke,

- Substrate culture in 12 liter pots,

- Two standard treatments (open field and greenhouse) and four cold storage periods at 2 C; S1 (15 May), S2 (1 Jun.); S3 (15 Jun.) and S4 (30 Jun.).

Vegetative and floral length (cm), diameter (mm), number of fruits per trust, number of vegetative and floral buds per cultivar.

Cultivar	Length		Diameter (mm)	Nº buds		Nº fruits
	Vegetative (cm)	Floral (cm)		Vegetative	Floral	
Legacy	10,1 B	9,9	2,9 B	4,3 B	7,1 AB	4,4
Elizabeth	19,6 A	12,8	4,4 A	7,0 A	6,8 B	5,2
Duke	13,3 B	13,3	4,2 A	4,6 AB	8,7 A	4,7
Prob (F)	P<0,001	NS	P<0,001	0,03	0,03	NS
EP	2,23	1,67	0,23	1,08	0,77	0,57

Means followed by different letters are significantly different according to Tukey test (p<0.05).

S1

S2

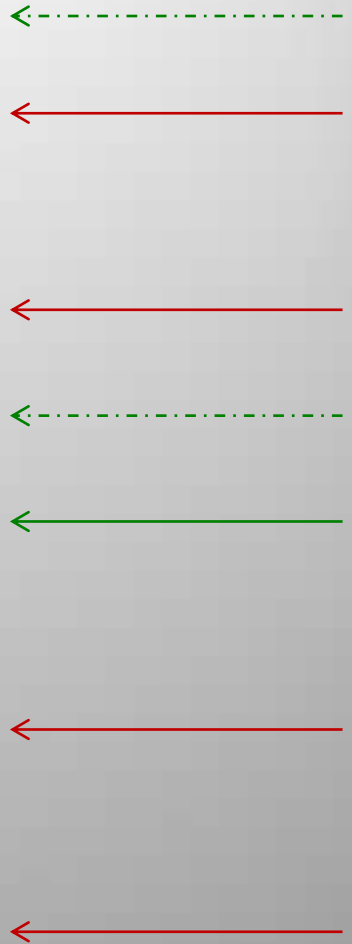
S3

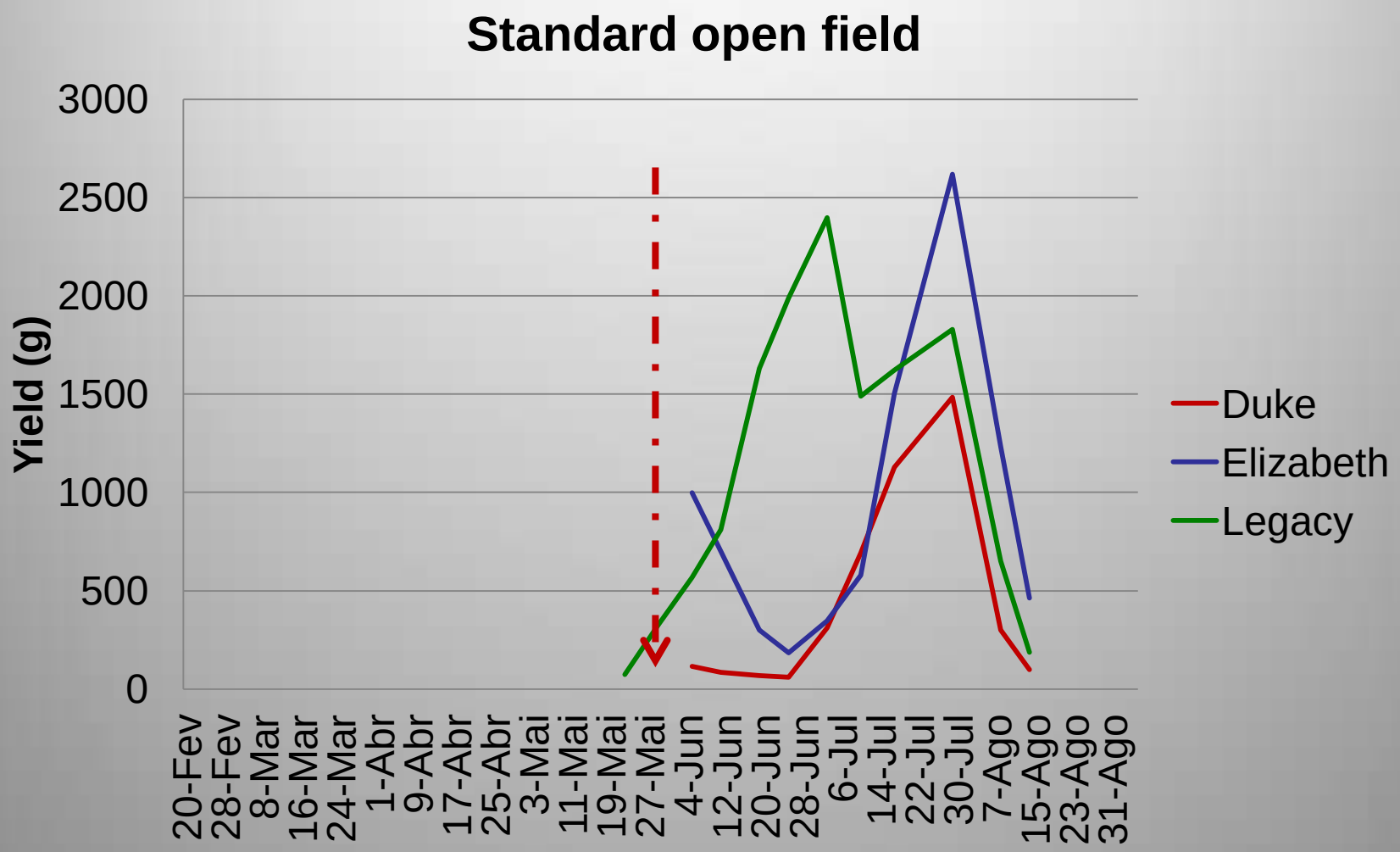
General view of the trial

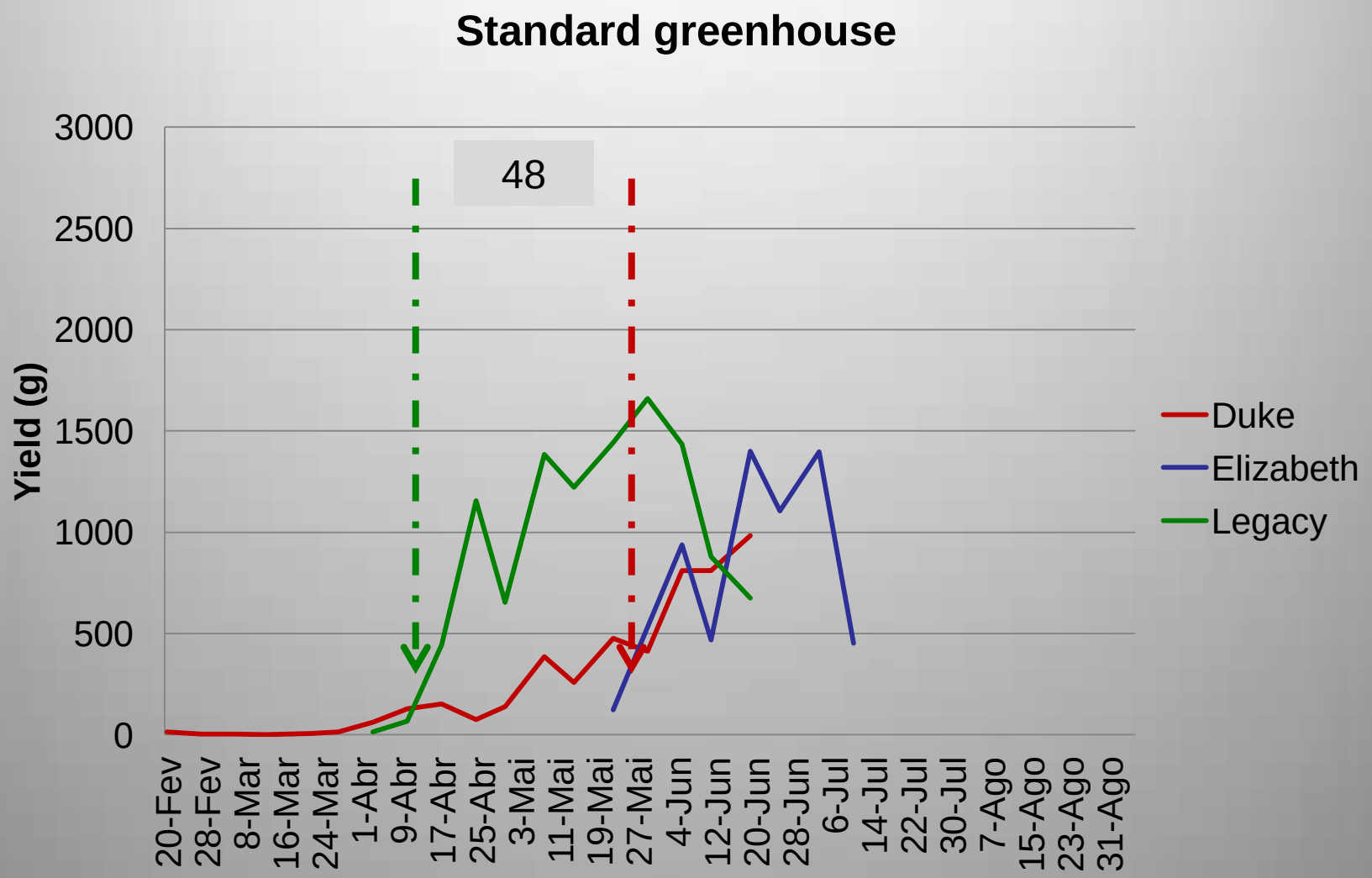
Cultivar Duke at flowering in S3 treatment and fruiting at S1 treatment (photos taken in the same day)

Total yield per plant (g) per treatment. Treatments: Standard open field (S_open field); Standard greenhouse (S_greenhouse); Out 1 (S_1) – natural cold + 2904h; Out 2 (S_2) – natural cold + 3288h; Out 3 (S_3) - natural cold + 3648h

Treatament	Cultivar	Yield (g/plant)	
S_open field	Legacy	2167	AB
	Elizabeth	1323	BCD
	Duke	704	D
S_greenhouse	Legacy	1839	ABC
	Elizabeth	986	CD
	Duke	789	CD
S_1	Legacy	2593	A
	Elizabeth	1437	BCD
	Duke	2585	A
S_2	Legacy	932	CD
	Elizabeth	1122,3	BCD
	Duke	1283,2	BCD
S_3	Legacy	419,3	D
	Elizabeth	399,2	D
	Duke	609,7	D
	Prob (F)	P<0,001	
	EP	302,04	




Standard open field
Yield (g)
3000
2500
2000
1500
1000
500
0
20-Fev
28-Fev
8-Mar
16-Mar
24-Mar
1-Abr
9-Abr
17-Abr
25-Abr
3-Mai
11-Mai
19-Mai
27-Mai
4-Jun
12-Jun
20-Jun
28-Jun
6-Jul
14-Jul
22-Jul
30-Jul
7-Ago
15-Ago
23-Ago
31-Ago
Duke
Elizabeth
Legacy


Standard greenhouse
Yield (g)
3000
2500
2000
1500
1000
500
0
48
20-Fev
28-Fev
8-Mar
16-Mar
24-Mar
1-Abr
9-Abr
17-Abr
25-Abr
3-Mai
11-Mai
19-Mai
27-Mai
4-Jun
12-Jun
20-Jun
28-Jun
6-Jul
14-Jul
22-Jul
30-Jul
7-Ago
15-Ago
23-Ago
31-Ago
Duke
Elizabeth
Legacy

Dates of 5, 50 and 95% harvest for cultivar Duke in standards and at the three cold chamber coming out dates ; S1 (15 May), S2 (1 Jun.) and S3 (15 Jun,).

Cultivar	S_open field			S_greenhouse		
	5%	50%	95%	5%	50%	95%
Duke	25.Jun	17.Jul	29.Jul	10.Apr	5.Jun	19.Jun

Cultivar	S1			S2			S3		
	5%	50%	95%	5%	50%	95%	5%	50%	95%
Duke	17.Jul	29.Jul	14.Aug	17.Jul	8.Aug	14.Aug	8.Aug	14.Aug	21.Aug

Conclusions

- Cultivar Elizabeth had the bigger vegetative growth with bigger vegetative and floral length but showed the lowest yield in almost all treatments,
- ‘Duke’ presented low yields in open field and greenhouse standards. The S1 treatment (15 May) was the best treatment, with the later treatments showing and detrimental effect of too much chilling,
- ‘Legacy’ showed a typical SHB behavior.
- With NHB cultivars harvest in the greenhouse was one and an half month (48 days) before open field.

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