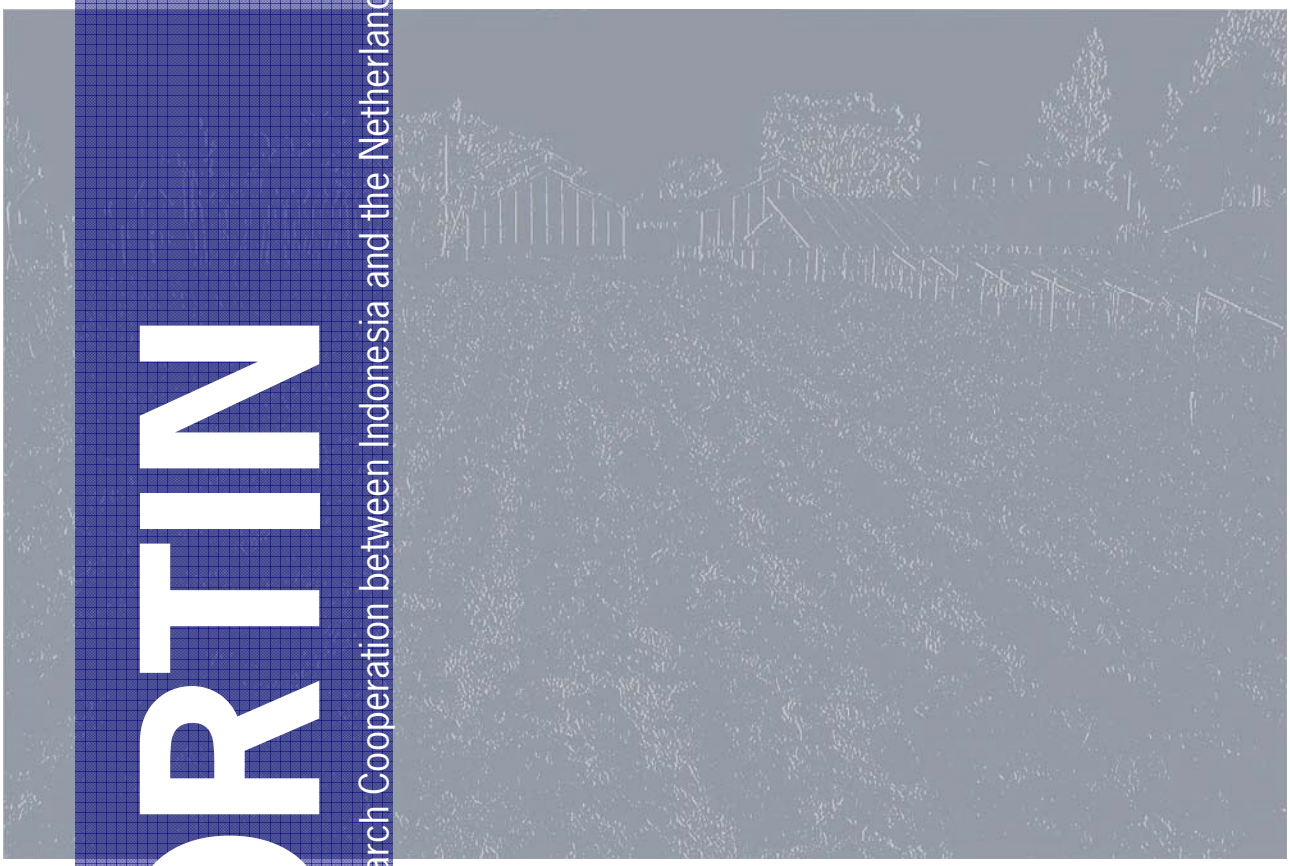
PROTFLOW mission report

Visit to Indonesia from 4 – 15 September 2006

Ruud Maaswinkel
Yoyo Sulyo



HORTIN

Horticultural Research Cooperation between Indonesia and the Netherlands

Mission report number: MR 34

The HORTIN Research Programme

HORTIN aims at stimulating development through research in public-private partnerships. It is a genuine partnership, which matches the research and agribusiness priorities of both countries. By doing so, it stimulates private-private partnerships, attracts donors, and so assures the transfer of knowledge to practice.

Formal partners are the Indonesian Agency for Agricultural Research and Development (IAARD, Indonesia), and the Directorate of Knowledge Dissemination (LNV-DWK, the Netherlands). The programme is covered by an Administrative Arrangement.

On the Indonesian side, the programme is carried out by four horticultural institutes under IAARD-ICHORD: the Indonesian Vegetable Research Institute (**IVEGRI**) in Lembang, the Indonesian Ornamental Crops Research Institute (**IOCRI**) in Segunung, the Indonesian Fruit Research Institute (**IFRURI**) in Solok, West Sumatra, and the Citrus and Subtropical Horticulture Research Station (**CISTROPHRES**) in Batu. In the Netherlands PRI and PPO are the principal partners.

The formal relations with Indonesia date from 1987, when a cooperation programme on vegetables started. After that, a cooperation programme on Biotechnology, Plant breeding, and Seed technology (BIOBREES) ran from 1994 until 2002.

The present programme is more market-oriented and focuses on upstream and downstream technologies.

At present HORTIN covers 10 projects of strategic and applied nature, with a total budget of about 0.6 million Euro per year.

AN EVER-EXPANDING NETWORK

HORTIN forms the centre of a continually expanding network of working relationships, where an increasing number of scientists and teachers collaborate on the work floor.
The programme is aimed at joint research, knowledge transfer and implementation of results together with the Indonesian and Dutch private sector. A number of projects are getting financial support from SenterNovem (agency of the Dutch Ministry of Economic Affairs).

The HORTIN Programme Management

If you think you could contribute to the goals of HORTIN in any way, please contact the Programme management.

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1 Introduction

From 4 till 15 September 2006 a visit to Indonesia was made. The aim of the visit was the following motives:

1. Working out the publication in English: The effect of irrigation frequency and leaf detachment on chrysanthemum.
2. Discussion about the results of the substrate and fertilizer trials. Working out the publication in English.
3. First results of the trial in 2006.
4. Workshop with companies, growers and advisers.
5. Preparation of the proposal for a new Hortin - Protflow project.
6. Results of list of actions to be taken from March 2006.
7. List of actions to be taken from September 2006

The list of activities is given as Annex 1.

2 Working out the publication in English: "The effect of irrigation frequency and leaf detachment on chrysanthemum"

The results of the trial: "The effect of irrigation frequency and leaf detachment on chrysanthemum" which was taken place in 2005, was discussed.
In the trial the following treatments were admit:

1. Difference in frequency in irrigation:
    a. An irrigation frequency of twice a week (30 minutes each)
    b. An irrigation frequency of four times a week (15 minutes each)
2. Differences in leaf detachment against Japanese white rust
    a. 6 leaves were detached 4 weeks after planting
    b. 10 leaves (6 leaves were detached in 4th week and followed by 4 leaves in 6th week
    c. 4 leaves (6 leaves were removed in 4th, 4 leaves in 6th and followed by another 4 in 8th week after planting)
    d. no leaf was detached.
3. Compare the growth of bamboo- and woodhouse.

The following conclusions were drawn:

1. Frequency of irrigation gave significant effects on the plant growth and quality flower produced of the chrysanthemum grown in both plastic house types. Plants supplied with water four times per week showed better performance than those provided with twice per week irrigation.
2. Numbers of leaf retained on the plants affected to subsequent growth and flower quality. The more leaf on the plants, contributed to the higher numbers of flower produced and lengthened the life span of plant after cut in the room temperature.
3. Plants grown under bamboo and wood-constructed plastic houses showed different performance in the quality of growth and flower produced. The less optimal environment under the bamboo plastic house contributed to the shorter plant height, fresh weight, and decreased on the numbers of flower produced per plant compared to those planted under the wood plastic house.

The publication will be published in English in the Indonesian Journal of Agricultural Science.
The publication is given as Annex 5.

3 Discussion about the results of the substrate and fertilizer trials. Working out the publication in English

The trial "Effects of fertilizer and type of media on the rooting capacity of chrysanthemum cutting" was conducted from February till May 2005 in Segunung.
In the trial the following treatments were admit:

1. Four difference rooting media: carbonized rice husk, coco peat, perlite and a mixture of 50% perlite and 50% vermiculite.
2. Two differences of fertilizer concentration: 1.0 and 1.5 $dS.cm^{-1}$
3. Four differences in fertilizer application: every day, every 2, 3 and 4 days.

The following conclusions were drawn:

1. Type of media gave significant effects on the rooting quality of cuttings. Better qualities of rooting and cutting performance were obtained from the cuttings rooted in carbonized rice husk.
2. Nutrient availability on the rooting media highly influenced the root growth and development. Supplemental fertilizer with the concentration up to 1.5 $mS.cm^{-1}$ gave significant increase in root formation and cutting quality.
3. The rooting capacities of the cuttings were not affected by the frequency of fertilizer application.

The publication will be published in English in the Indonesian Journal of Agricultural Science.
The publication is given as Annex 6.

4 First results of the trial in 2006

After the damage of the storm at the end of 2005 and the renovation in 2006, the trial started in July. During the renovation the same plastic was placed on the three houses

Figure 1: The houses after the renovation

The main objects of this trial were:

1. Compare the property of the bamboo, woodhouse and the house with ventilation.
2. Examine the type of plastic house on the growth, production and product quality of chrysanthemum.
3. Frequency of water during the short day with the drip system:

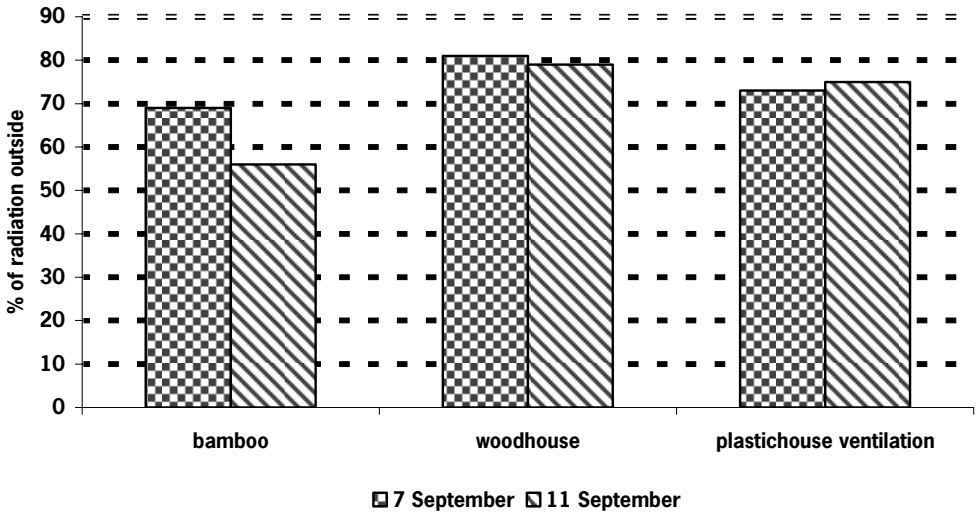
(the sunctionpower measured by tensiometer should be at 30cm at least 100hPa. The amount of water dependent on the sunctionpower)

   a. Every day the amount of water
   b. Every two days the amount of water of treatment a.

4. Cuttings rooted in three difference rooting media during the cultivation
   a. carbonized rice husk
   b. coco peat
   c. perlite

4.1 Results of measuring radiation

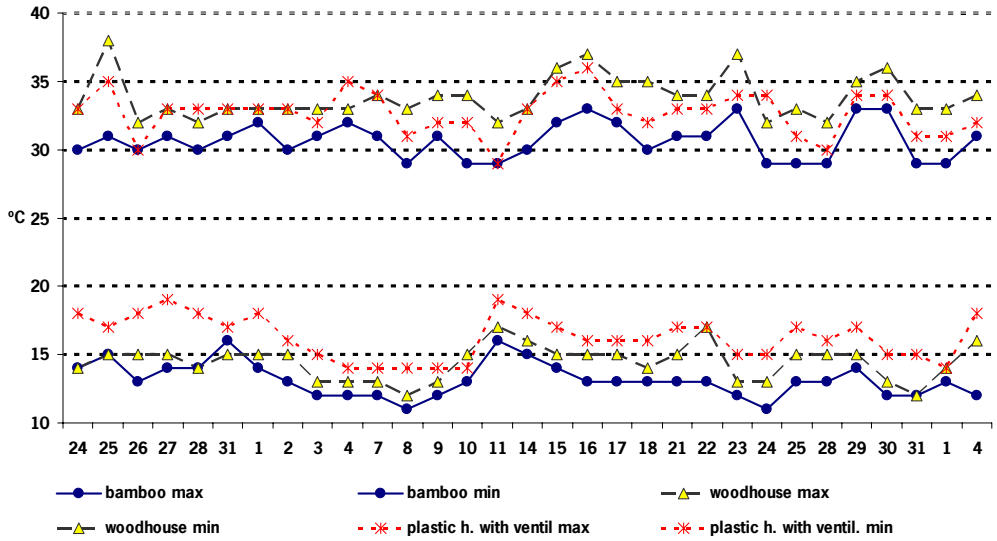
The results of measuring the percentage of outside radiation that could be measured in the houses is given in figure 2.



From figure 2 it appears that there are differences in radiation inside the three houses. The highest level of radiation is found by the woodhouse and the lowest percentage of radiation is found by the bamboo house. The differences in radiation inside between the woodhouse and the plastic-house (with ventilation) is small.

4.2 Results of measuring the temperature in the house

The temperature was measured daily, on two places in every house with a maximum/ minimum thermometer. The mean maximum and minimum temperature per week from 24 of July till 5 of September is given in figure 3.



From figure 3 it appears that the highest maximum temperature is realized in the woodhouse. The lowest maximum temperature appeared in the bamboo house. The highest minimum temperature appeared in the plastic house with ventilation and the lowest minimum temperature is realized in the bamboo house.

The mean maximum temperature from the 24 of July till the 5 of September was in the bamboo house: 30.6 °C , woodhouse 33.8 °C and plastic house with ventilation 32.7 °C. The mean minimum temperature of the same period: bamboo house: 13.1 °C , woodhouse 14.4 °C and plastic house with ventilation 16.3 °C.

Figure 4: The trial in the house with ventilation

5 Workshop with companies, growers and advisers

On September 11 a lecture was given by Ruud Maaswinkel and Yoyo Sulyo. In the lecture of Ruud Maaswinkel topics of the chrysanthemum cultivation were discussed. Topics like production of mother-plants and rooting of the cuttings, water-management, pests, diseases and the influence of the type of house on the yield. The lecture is given as Annex 2.
The topic of the lecture of Yoyo Sulyo was the fertilisation of chrysanthemum; the lecture is given as Annex 3.
The book "Krisan Bunga Potong" was given by The director of IOCRI (Dr Yusdar Hilman) to the participants. The basis of the content of the book is the chrysanthemum courses which were given by Ruud Maaswinkel.

Figure 5: The cover of the book "Budidaya Krisan Bunga Potong"

On the workshop there were 71 participants. A copy of the list of participants is given as Annex 4.

6 Preparation of the proposal for a new Hortin-Protflow project

With the director of IOCRI, Yoyo Sulyo and some researchers a discussion for a new proposal of a Hortin-Protflow project was made. There is a preference for a project with the flower rose. Roses are in Indonesia and international in demand. On September 8, 12 and 13 six different rose growers were visited in the surroundings of Cipanas and Bandung.

The following important main lines came from the visits:

- Most growers are cultivating roses in a bamboo house. There was one nursery where roses were cultivated in a Dutch Venlo glasshouse. There was

a big difference in the size of the nurseries. The smallest size was 800m^2 and the biggest size was 6000m^2.

- All the growers are cultivating different colours and varieties of roses. The most popular colour is red. Well known varieties are Red Baron, First Lady and Black Magic
- The main problems with the cultivation of roses are:
  - Scales (Coccoidea),
  - Mildew
  - Trips
  - Spider
  - Bad plant-material
- All the growers are selling the roses in the cities of Indonesia. The prospects of roses are good if the flower quality is good. The prices of roses are better then the prices of other flowers. With the cultivation of flowers it is possible for a small grower to earn a sufficient income.
- The growers who were visit during this mission like to cooperate in a new project.
- The following topics for a new project are mentioned by the growers:
  - Improvement of plant-material and better varieties
  - Introduction and testing of different substrates
  - Solving problems of diseases against: scales, trips, spider and mildew
  - Courses about the cultivation of roses

Figure 6:
A small grower in a bamboo house of 1000m^2. A small nursery with lot of attention for the cultivation.

7 Results of the list of actions to be taken from March 2006

nr	Action	Who, when	Situation
1	Make a report in English from the research of different substrates.	DWI (Yoyo Sulyo responsible) July 2006	not done list Sept 2006
2	Make a report in English from the research in the different houses. Trial June 2005.	DWI (Yoyo Sulyo responsible) July 2006	Done by Iwan September 2006
3	New plastic for bamboo house, woodhouse and plastic house with ventilation. Rp 27.000.000	Ruud Maaswinkel March 2006	Done
4	Repair bamboo, woodhouse, plastic house with ventilation. (Pek. Cor tiang bamboo, pek. Pas tiber karet talang air lbr 90cm, pek. Perbaikan dab pergantian tiang balok dan pipa yang rusak, pek. Pas kabel penahan atap) Rp 8.228.000	Yoyo Sulyo March 2006	Done
5	Deliver photo's for book: Krisan bunga potong to Kurniawan Budiarto	Ruud Maaswinkel March 2006	Done
6	Printing books, at least 250.	Kusumah Effendie July 2006	Done
7	Paying € 1000,- for printing costs.	Ruud Maaswinkel June 2006	Done
8	Preparing a lecture for the workshop in July 2006 with topics of excursion to small growers in February 2006.	Ruud Maaswinkel July 2006	Done in September 2006
9	Preparing a lecture for the workshop in July 2006	Yoyo Sulyo March 2006	Done in September 2006
10	Preparing everything for the new trial in April 2006. (Spraying once a week with Amistar against Japanse white rust)	Yoyo Sulyo March 2006	Done trial in July 2006

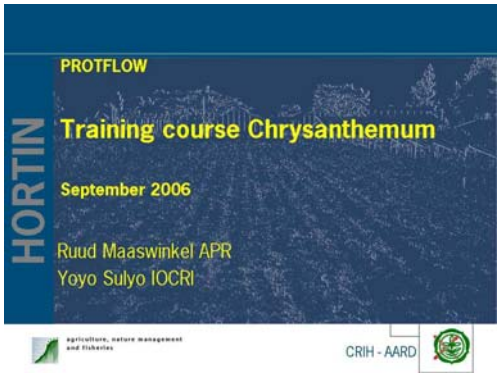
8 List of actions to be taken from September 2006

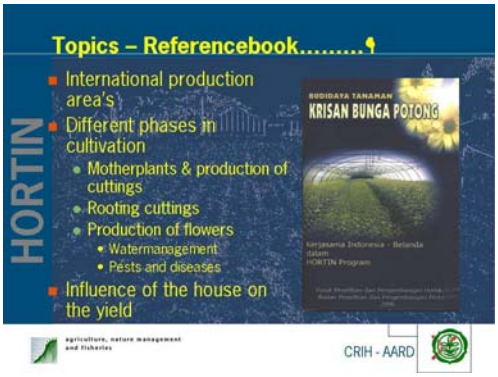
nr	Action	Who, when	Situation
1	Make a report in English from the research of different substrates of the trials in 2004 and 2005	Iwan (Yoyo Sulyo responsible) 2006	
2	Make a report in English from the research in 2006	Yoyo Sulyo	
3	Giving topics to Yoyo Sulyo for the Hortin meeting in November 2006	Ruud Maaswinkel	
4	Preparing and giving lecture on Hortin meeting in November 2006	Yoyo Sulyo	

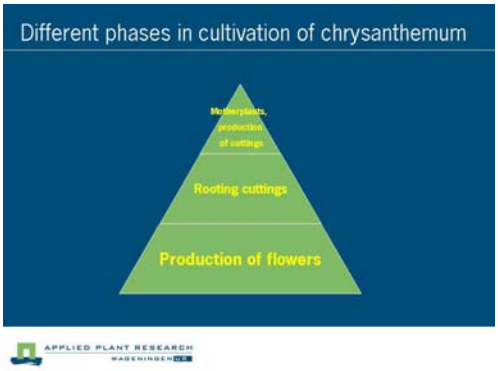
Annex 1: List of activities

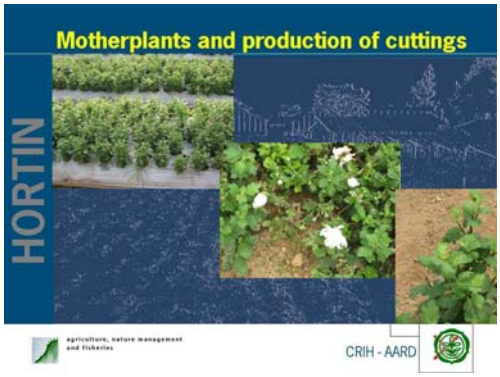
Date	Activity
4 September	Travelling to Jakarta.
5 September	Arrival in Jakarta.
6 September	Discussion list of actions Preparing workshop
7 September	Discussion about the results of the trials
8 September	Visit rose growers
11 September	Workshop with growers and advisers
12 September	Visit rose growers
13 September	Visit rose growers
14 September	Discussion list of actions to be taken from September 2006. Travelling to Jakarta. Departure for Amsterdam.
15 September	Arrival in Amsterdam. Travelling to Naaldwijk

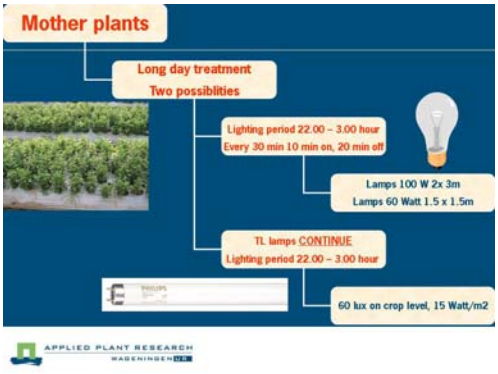
Annex 2: Training course by Ruud Maaswinkel

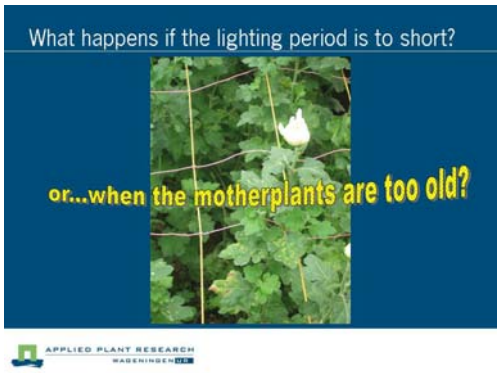


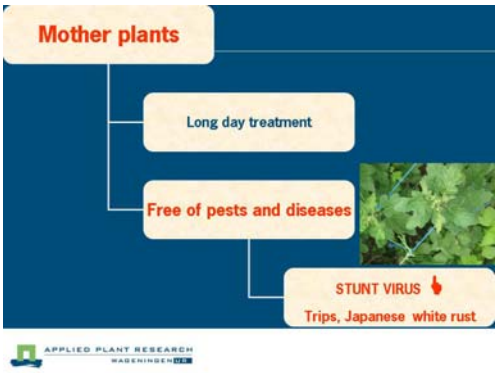


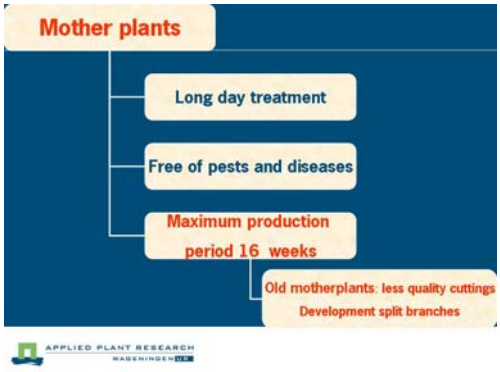




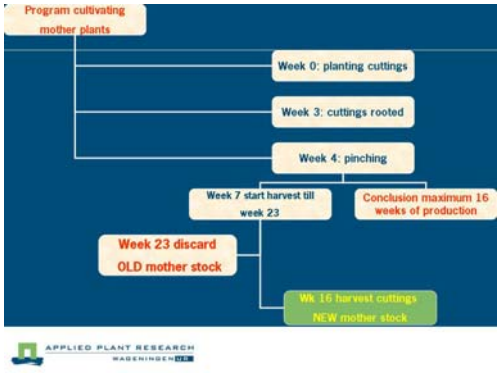


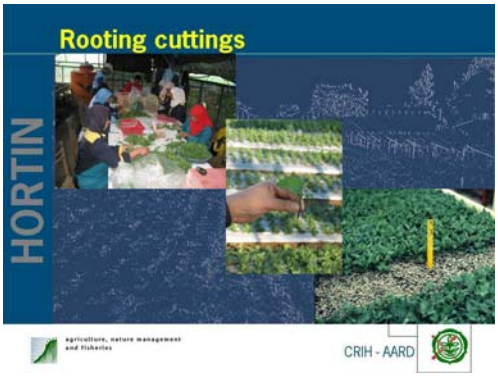

What happens if the lighting period is to short?
or...when the motherplants are too old?
APPLIED PLANT RESEARCH


Mother plants
Long day treatment
Free of pests and diseases
STUNT VIRUS
Trips, Japanese white rust
APPLIED PLANT RESEARCH


Mother plants
Long day treatment
Free of pests and diseases
Maximum production period 16 weeks
Old motherplants: less quality cuttings
Development split branches
APPLIED PLANT RESEARCH

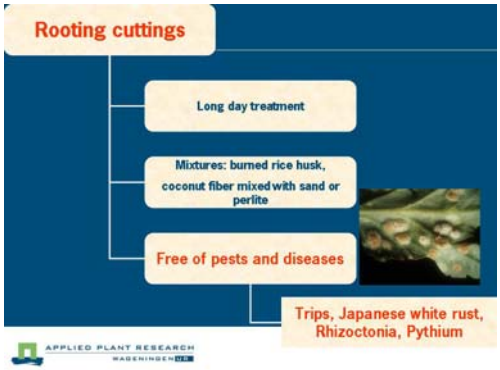

Spilt-branches
good
single
double
APPLIED PLANT RESEARCH

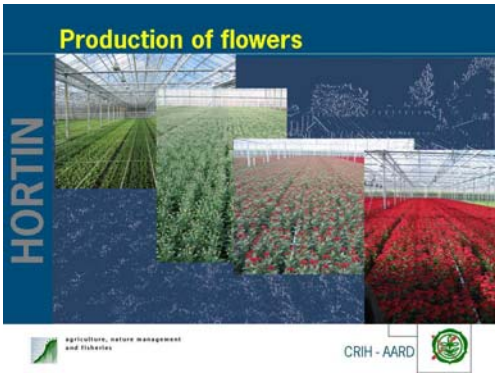

Program cultivating mother plants
Week 0: planting cuttings
Week 3: cuttings rooted
Week 4: pinching
Week 7 start harvest till week 23
Conclusion maximum 16 weeks of production
Week 23 discard OLD mother stock
Wk 16 harvest cuttings NEW mother stock
APPLIED PLANT RESEARCH


Rooting cuttings
HORTIN
CRIH - AARD


Rooting cuttings
Long day treatment
Lighting period
22.00 – 3.00 hour
30 min 10 min on,
20 min off
TL lamps continues!
Lighting period
22.00 – 3.00 hour
APPLIED PLANT RESEARCH


Rooting cuttings
Long day treatment
Burned rice husk,
coconut fiber mixed with sand, perlite
Drainage media good
First 8 days covered cuttings with shade
After 8 days less shading
After 14 days
transplant the plants to the house
APPLIED PLANT RESEARCH


Rooting cuttings
Long day treatment
Mixtures: burned rice husk,
coconut fiber mixed with sand or
perlite
Free of pests and diseases
Trips, Japanese white rust,
Rhizoctonia, Pythium
APPLIED PLANT RESEARCH


Production of flowers
HORTIN
CRIH - AARD


Program
chrysanthemum
cultivation
Greenhouse Long Day
3 weeks
Lighting period 22.00 – 3.00 hour
Every 30 min 10 min on, 20 min
off
or continues
When after 3 weeks
Plantlength about 25 cm
Then enough length at the
harvest
APPLIED PLANT RESEARCH


Program chrysanthemum
cultivation
Greenhouse Long Day 3 weeks
Short Day period about 8
weeks
First 3 weeks development of buds
from top till botom
Important: watermanagement
pests and diseases
APPLIED PLANT RESEARCH


Watermanagement
HORTIN
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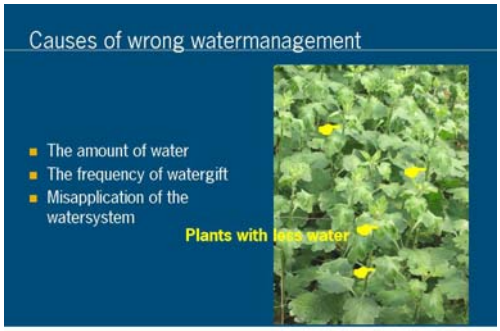
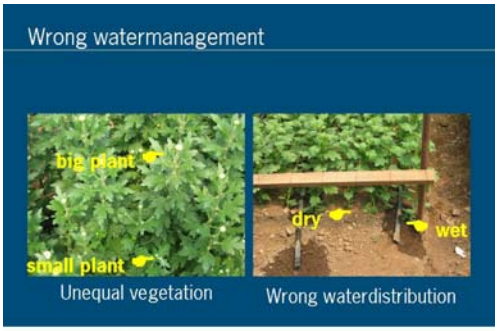
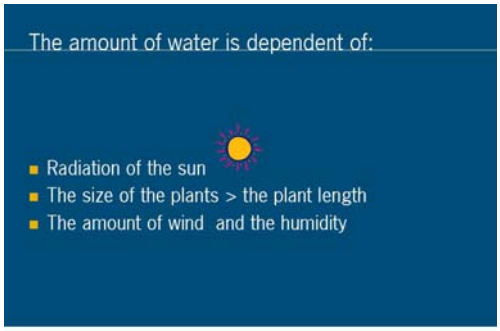
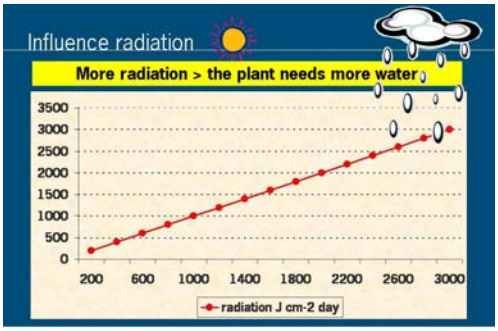
Problems on different nurseries
Small branches
Unequal vegetation
Caused by:
Unequal water-distribution
Big branches


Causes of wrong watermanagement
The amount of water
The frequency of watergift
Misapplication of the watersystem
Plants with less water


Wrong watermanagement
big plant
small plant
dry
wet
Unequal vegetation
Wrong waterdistribution


The amount of water is dependent of:
Radiation of the sun
The size of the plants > the plant length
The amount of wind and the humidity


Influence radiation
More radiation > the plant needs more water
3500
3000
2500
2000
1500
1000
500
0
200
600
1000
1400
1800
2200
2600
3000
radiation J cm-2 day

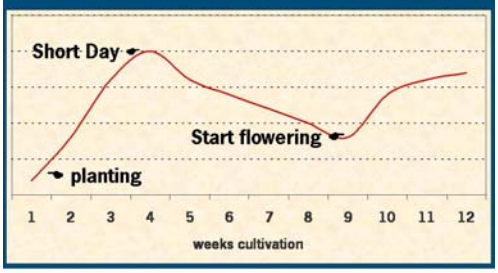
The amount of water is dependent of:

- The amount of wind
- The humidity
- The size of the plants > the plant length

- More wind ➧ **more water**
- Lower humidity ➧ **more water**
- Maximum by plant length of 25 cm

APPLIED PLANT RESEARCH WAGENINGEN UR

Root development of chrysanthemum



APPLIED PLANT RESEARCH WAGENINGEN UR

Root development of chrysanthemum

- After planting the root development is very fast
- After the beginning of the generative period (Short Day) the root development is slower and the number of roots decrease
- By the beginning of flowering the number of roots increase

APPLIED PLANT RESEARCH WAGENINGEN UR

Giving water

Two possiblities

- **Sprinkler system**
  - The water distribution is better
  - The uniformity of the plants is better
  - By the beginning of the cultivation is the profile of the soil good saturated
- **Drip system**
  - The leaves are keeping dry (Japanese white rust)
  - Before the first treatment the soil has to be quit humid
  - Best results in combination with sprinkler system

APPLIED PLANT RESEARCH WAGENINGEN UR

Advice water management

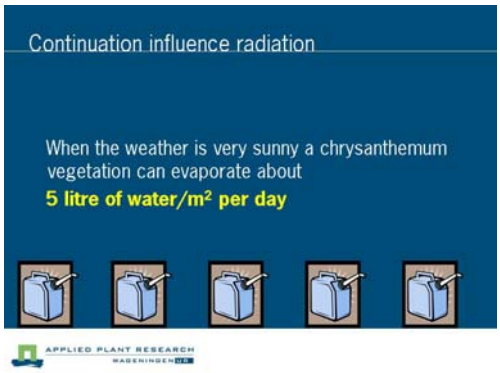
- Chrysanthemum uses a lot of water to grow well
- Normally by using a sprinkler installation:
  - 3 times/ week every time 6 – 15 litre/m²
  - Total gift depends on season (dry/ raining)
  - Depends on type of soil
- By using a dripsystem daily gift of water is recommend

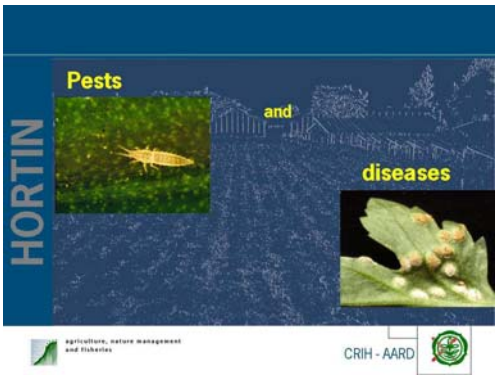
APPLIED PLANT RESEARCH WAGENINGEN UR

Measuring the moisture of the soil

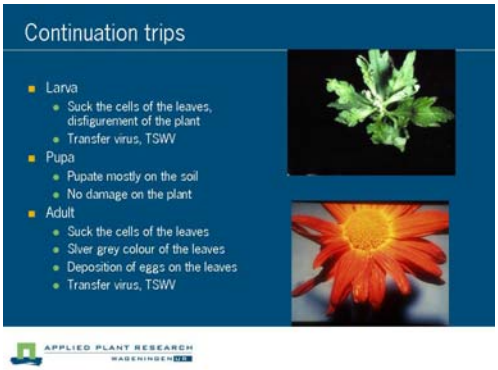
- Ground bore (till 25cm deep)
- Tensiometers
  - Simple measuring with manometer
  - Electronic tensiometer with using a computer

APPLIED PLANT RESEARCH WAGENINGEN UR


Continuation influence radiation
When the weather is very sunny a chrysanthemum vegetation can evaporate about
5 litre of water/m² per day
APPLIED PLANT RESEARCH


HORTIN
Pests
and
diseases
CRIH - AARD


Trips
Development 6 phases
Egg
Larva (2 larva phases)
Pupa (2 pupa stadia)
Adult
adult
pupa
larva
APPLIED PLANT RESEARCH


Continuation trips
Larva
Suck the cells of the leaves, disfigurement of the plant
Transfer virus, TSWV
Pupa
Pupate mostly on the soil
No damage on the plant
Adult
Suck the cells of the leaves
Silver grey colour of the leaves
Deposition of eggs on the leaves
Transfer virus, TSWV
APPLIED PLANT RESEARCH


Leaf miner
Development 6 phases:
Egg
Larva (3 larva phases)
Pupa
Adult
Adult of leaf miner
APPLIED PLANT RESEARCH

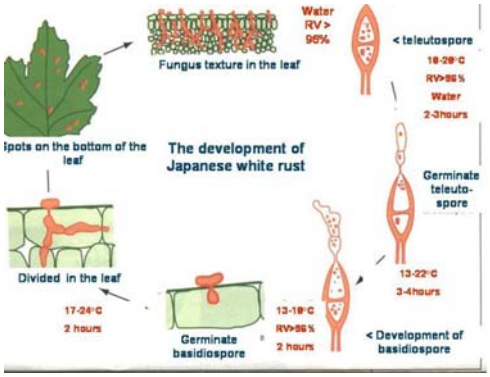

Continuation leafminer
Larva
Making corridors in the leaves
The damage is cosmetic
Sometimes premature loss of leaves
Pupa
Pupate in the soil
No damage on the plant
Adult
Cause point on the leaves
Deposition of eggs on the leaves
The damage is cosmetic
Corridor with pupa
APPLIED PLANT RESEARCH

Japanse white rust (Puccinia horiana)

- Big problem on chrysanthemum nurseries in Indonesia

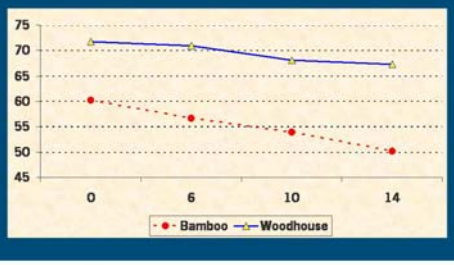
Japanese white rust (Puccinia horiana)

- Top of the leaves green yellow spots
- Buttom of the leaves brown spots
- Spread by high temperature (25°C) and high humidity



Influence of removing leaves?

Influence of removing leaves on the production



Treatments against Japanese white rust

- Using **Amistar**, Syngenta
- Only use **PREVENTIVE** on the motherplants and during the cultivation of the flowers.
- During short day period spraying every 10 – 14 days
- If the flowers are free of Japanese white rust, the grower will get more

Treatment against Japanese white rust

- Giving water with sprinklersystem early in the morning (so that plants dry as soon as possible)
- Second part of the cultivation use the drip system
- **Take care for clean mother plants and cuttings!**
- **Resistent varieties !**
- Remove weeds

APPLIED PLANT RESEARCH WAGENINGEN UR

Indonesian practical experience

- Indonesian grower sprays **Amistar**
- Preventive motherplants once a week!
- Preventive flower cultivation during the first weeks once a week later every 14 days
- Result:
  - **NO Japanese white rust**
  - **Better prices on the market**

APPLIED PLANT RESEARCH WAGENINGEN UR

Rhizoctonia

- Caused by an fungus
- At the foot of the stem on the border of air and soil there is a brown cobweb texture
- At first during the day flat, at night recovery, but later the plant will not recover
- Rhizoctonia can survive on organic material

APPLIED PLANT RESEARCH WAGENINGEN UR

Treatment against Rhizoctonia

- Take care that the cuttings are free of diseases
- Sterilize the soil
- Preventive spray with Amistar

APPLIED PLANT RESEARCH WAGENINGEN UR

Pythium

- Caused by an fungus
- Mostly in the beginning of the cultivation
- At the foot of the stem on the border of air and soil the stem and the roots are rot

APPLIED PLANT RESEARCH WAGENINGEN UR

Treatment against Pythium

- Take care that the cuttings are free of diseases
- Sterilize the soil
- Remove weeds
- Take care of good structure of the soil

APPLIED PLANT RESEARCH WAGENINGEN UR

Botrytis

- On the stem and the leaves there are grey brown spots of fungus
- On the flowers there are brown spots

APPLIED PLANT RESEARCH WAGENINGEN UR

Treatment against botrytis

- If the weather is humid be careful with giving water
- Plant less plants/m^2 and take care for open vegetation
- Clean plantmerial-cuttings
- Disinfect the soil
- Remove weeds
- Spray against botrytis

APPLIED PLANT RESEARCH WAGENINGEN UR

Stuntviroide

- A very big problem in Indonesia
- The plant will be backward in growth and develop more side shoots
- The leaves and flowers are smaller than normal

APPLIED PLANT RESEARCH WAGENINGEN UR

Treatment against Stuntviroide

- Transfer by sap (pick cuttings of motherplants and treatments in the vegetation)
- Remove attacked plants
- Buy only cuttings from reliable origin

APPLIED PLANT RESEARCH WAGENINGEN UR

Influence of the house on the yield

HORTIN

agriculture, nature management and fisheries

CRIH - AARD

Influence of the house on the yield

- Differences between bamboo and woodhouse
  - Radiation inside
  - Temperature > minimum and maximum
  - Water supply
  - Production

APPLIED PLANT RESEARCH WAGENINGEN UR

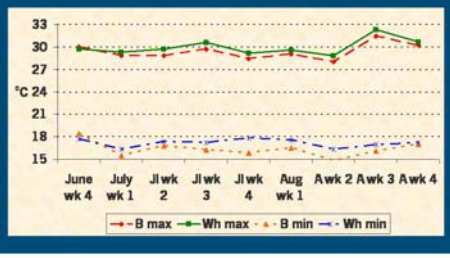
Radiation inside

- Bamboo house
  - In 2004: 50%
  - In 2005: 50%
- Woodhouse
  - In 2004: 78%
  - In 2005: 71%

More radiation = **more light** ⇨ **higher production**

APPLIED PLANT RESEARCH WAGENINGEN UR

Maximum and minimum temperature



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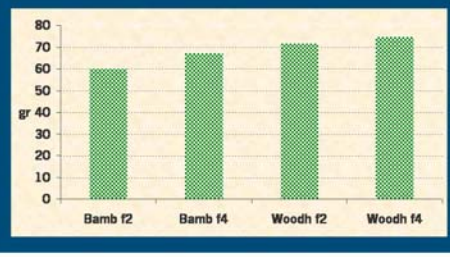
Water supply

- **More radiation** inside the house > **more water**

- **Higher temperature** in the house > **more water**

APPLIED PLANT RESEARCH WAGENINGEN UR

Plant weight water-frequency 2 and 4 a week



APPLIED PLANT RESEARCH WAGENINGEN UR

Conclusions

- Higher production frequency 4 times a week
- Production in woodhouse is higher then in bamboo house

APPLIED PLANT RESEARCH WAGENINGEN UR

HORTIN

Terima kasih

Ruud Maaswinkel & Yoyo Sulyo

agriculture, nature management and fisheries

CRIH - AARD


Questions?
Suggestions?
APPLIED PLANT RESEARCH
WAGENINGEN UR

Annex 3: Training course chrysanthemum by Yoyo Sulyo

Bahasa Indonesia

FERTIGASI DALAM BUDIDAYA TANAMAN HIAS

Yoyo Sulyo
Balai Penelitian Tanaman Hias

Pendahuluan

- Hukum Leibig: pemberian suatu unsur hara tidak akan menunjukkan efek, kalau masih ada unsur hara lain yang dalam keadaan minimum belum terpenuhi
- Pemberian Hara harus seimbang
- Kelebihan : Tidak efisien/pemborosan
- Pencemaran lingkungan (nitrat)
- Gangguan kesehatan
- Kekurangan: Hasil rendah
- Kualitas menurun
- Vase life pendek

PEMBERIAN PUPUK

1. Dibenam
2. Disebar (pelepas lambat)
3. Pupuk cair (diberikan ke media tanam atau ke daun)

FERTIGASI

- Singkatan dari:
- FERTILIZATION
- IRRIGATION

Pemberian (sebagian) hara (10-50 %) melalui pengairan

KEUNTUNGAN

- Mengurangi biaya aplikasi pupuk
- Meningkatkan efisiensi pupuk, karena pemberian hara mendekati saat dibutuhkan tanaman
- Mengurangi kehilangan N melalui leaching dan melalui denitrifikasi
- Kekurangan:
- - tidak cocok ditempat terbuka dimana curah hujan tinggi

Cara pemberian

- Manual
- Ebb and flow
- Drip (trickle)(35 % lebih efisien d/p selang dan sprinkle)
- Sprinkle
- Micro sprinkle (mist nozzle)(satu jalur atau dua jalur)

Bahasa Indonesia

Cara pemberian

- Manual
- Ebb and flow
- Drip (trickle)(35 % lebih efisien d/p selang dan sprinkle)
- Sprinkle
- Micro sprinkle (mist nozzle)(satu jalur atau dua jalur)

Waktu Pemberian

- Idealnya diberikan kalau diperlukan, untuk mempertahankan level hara di media tanam/di larutan yang diketahui memberikan laju pertumbuhan

- Diberikan Setiap penyiraman
- Diberikan berselang seling
- Diberikan sesuai kebutuhan

Jenis pupuk yang diberikan

- Umumnya N & K2O saja (umumnya ratio 1:1) Tanaman tertentu spt Anyelir 2:3
- Fe, Zn (dalam bentuk chelat)
- S, kalau air < 25 ppm
- P jarang diberikan, krn sering bergumpal, hanya akumulasi 2.5-5.0 cm di atas permukaan
- Kalau diberi P (ratio 1: 0.2)
- Ca tidak boleh ketemu SO4 atau PO4

Konsentrasi hara yang diberikan

- Menggunakan program komputer IRNMA
- Hasil analisis hara tanah
- DITENTUKAN OLEH
- - Apakah di dalam medium sudah mengandung pupuk (slow release)
- - Apakah air irigasi sudah mengandung cukup hara
- - Waktu
- - Laju kecepatan pertumbuhan tanaman
- Pembuatan stok (100 X)
- pH diusahakan sekitar 6 (umum)
- N:K2O masing-masing 200 ppm (1:1)
- Berdasrkan EC tanah, diberikan EC 1.5
- Kalau Urea menjadi sumber N: EC ditambah 1.5 per 1 g/l dari pembacaan

Teknik Aplikasi

- (1) Pupuk dicampur dengan air dalam satu tangki (perlu di aduk, kadang2 haru 2 tangki terpisah, hanya satu kali pakai)
- (2) Menggunakan alat pencampur
  (Proportioner, siphon mixture, Injector)

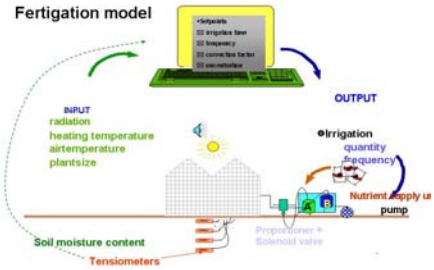
Tipe-tipe injektor

- 1.Bypass Pressure tank
- 2. Venturi(flow rate > 3 galon/mnt, ratio 1:15)dapat dimodifikasi ?
- 3.Volumetric flow-through menggunakan Piston (Dosmatic, Dosatron), mahal ratio dapat diatur (s/d 1:500)
- 4.Pompa listrik atau Peristaltik

Bahasa Indonesia

Kalibrasi Ratio proportioner

- Berdasarkan volume air yang diisap
- (demo kalibrasi)
- Berdasarkan EC yang keluar
-



sekian dan terima kash

Annex 4: List of participants on September 11

DAFTAR HADIR

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5	SONDANG 104MA SIAGIAN, And	RETOOLING	
6	Anto Susanto	"	
7	Eti Rostika, SP. MP.	BBDAH KAYUAMBON	
(8)	Edi Tajuan	Balitbi	
9	Olyndriana Dewi	BPTP Jabar	
(10)		Balitbi.	
11	Sutarto A.Md	Retooling IV	
12	Edy Wahyu Irwandana A.Md	Retooling	
13	YENI RACHMAWATI A.Md	Retooling	
14	SULISTIYANI A.Md.	- " -	
15	Puji Astuti A.Md.	— " —	
16	Syaptarina, A.md	"	
17	TRI WAHYU WIDODO	INGGU LAUT ABADI	
18	YUSTINA DIEN	INGGU LAUT ABADI	
19	LIHARTI, A.Md	Retooling IPB	
20	SARI Mudiyanti, A.Md.	Retooling, IPB	
21	Syarip Hidayatullah	INggu Laut Abadi	
(22)	Dewi Pramanik, S.P	Balitbi	
23	Herwalia A.Md	Retooling	
24	Yoselvina, A.Md	Retooling	
25	SRI EKA RIANI A.Md.	"	
26	Fitriani, A.Ma	Retooling	

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29	Donald S	Balitri.	
30	Dedy K.	Balitri.	
31	GUSMIANITI, A.Md.	RETOOLING	
32	M. Anshari, A.Md	"	
33	Ahmad Thabrani, A.Md	"	
34	ANDY PURWANTO.	— " —	
35	DONI Pasande	— " —	
36	Eka Febriauty	Balitri	
37	Darliah	— " —	
38	Tina Boedi Yanti KARTINI	Retooling	
39	Herlin EVITA	Retooling	
40	M. Yamin	Balitri.	
41	Fitri Rachmawati	— " —	
42	Laily Rodriyah	Balitri	
43	Yoyo S	— " —	
44	R Maminar	APR	
45	HENDRIK Y AM.d.	RETOOLING	
46	Yadi supriyadi. SP	Balitri	
47	EVI SILVIA T.	"	
48	BIMA. S. DEWONO	CISAPUA CIDOKOM. 0818 0861 0831	
49	YUS. R	KP. Cijanan	
50	Nina Marlina	Segunung	
51	Asep saefullah.	— " —	
52	Risdiyanto, S.P.	Purwakarta	

No.	NAMA	ALAMAT INSTANSI dan NOMOR TELEPON	TANDA TANGAN
53	E. Kusnadi	Dinas Pertanian	
54	Ir. Sodikin	— " —	
55	Ir. Kurniawan Budianto	Balitbi	
56	Suhardi	Balitbi	
57	DESRIAL	PT BISI	
58	Saepulah	Balitbi	
59	Wahyu Handayati	— " —	
60	MARIS	Dinas pertanian dan perkebunan kab. Sorong - Sorong	
61	Indro Susilo	Balitbi	
62	Ir. Wahyuningsih	— " —	
63	Suskandari K	— " —	
64	D Herlina	— " —	
65	~~Ahmad~~ ~~MUSTHOLIH~~		
66	AHMAD MUSTHOLIH	Retooling	
67	Hasyanto	"	
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No.	NAMA	ALAMAT INSTANSI dan NOMOR TELEPON	TANDA TANGAN
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80	Agung Wahyudi	PT. Bina Inti Nusantara 081611634567.	
81	Singgih Andyantoro	BALITEK	
82	Benny Tjia	MJ Floka	
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Annex 5: Effect of irrigation frequency and leaf detachment on chrysanthemum grown in two plastic house types

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Abstract. Chrysanthemum is one of important ornamentals in Indonesia and it ranks in the first quantity of cut flower marketed every year. In most of cases, the low productivity is still become the constraint for the traditional growers to make production process more profitable. Several problems revealed in chrysanthemum production were investigated. The experiment was conducted in Segunung, Indonesian Ornamental Crops Research Institute during the dry season in 2005. The research dealt with the effect of different types of plastic house constructions, irrigation frequencies and leaf detachments on the growth and development of chrysanthemum. Result of the experiment showed that plants grown in wood-constructed plastic house had better growth performance and flower quality than those under bamboo plastic house. Frequency of four times per week irrigation was also considered to have better impact on the plants performance than twice per week. Leaf removal that often practiced by the growers are no longer recommended, since numbers of leaf on the plant influenced the growth in all parameters observed. The more leaves were detached; the more negative impacts on plant growth were found.

Keywords: Chrysanthemum, bamboo and wood constructed plastic house, irrigation frequency, and leaf detachment

Introduction

Chrysanthemum (*Dendranthema grandiflora* [Ramat.] Kitam.) is one of the major cut flowers in the world. The demand for this commodity reached 35 % of the overall market request, second only to roses. In Indonesia, this commodity ranks in the first quantity of the cut flower product marketed every year. In traditional growers, the plants usually are grown in plastic house constructed from bamboo, since bamboo plants are abundant and naturally grown.

Most of chrysanthemum growers are still located mostly in Java and occupied for almost more than 100 ha, with three harvest periods every year. However, some constraints revealed during the production process are still unsolved up to this moment and the flower productivity and quality in traditional growers is still to be improved. The use of bamboo for plastic house construction are considered less durable compared to other materials such as wood or other permanent materials, like aluminium. This condition leads the growers to reconstruct and renovate the plastic house in almost every 5 years. The expense for these activities became additional input cost and finally made the production process less profitable. Instead of the bamboo construction, the life span of woodhouse is 10 years. In the wood house, there is measured 20 % more radiation inside from the bamboo house.

Another case within the observations is the use of drip system for irrigation. In some growers, these equipments were installed with the pump in facilitating the plants for water. This system was

applied due to reduce cost of man works in production process. However, some practical problems often occurred. The excessive water due to the frequent applications contributed to the high humidity in the plant environment under the plastic house. The less light interception to plants was also considered to have contribution to this condition. The dense bamboo constructions especially in the roof side were often found, since the bamboos were not easy to be constructed. Less light interception and high humidity, then, are predicted not only become the limiting factor of the plant growth, but also then, lead to the other problems, excessive spreading of diseases especially Japanese white rust. Aside from the pesticide application, in dealing with white rust, growers tend to remove the older infected leaves in the plants regularly. It is not clear whether the activity is conducted only for removing the infected leaves or these has significant impacts on the subsequent appearance of white rust or even for the plant growth and quality of the flower produced. Two types plastic house construction in this study (bamboo and wood house) were used and how their relations with the irrigation frequency and leaves detachment in influencing the growth quality of the plants are investigated.

MATERIAL AND METHODS

The experiment was conducted from June to October 2005 at Segunung, an experimental station of Indonesian Ornamental Crops Research Institute, located in 1,100 masl. Rooted cuttings of cv. Town Talk were planted and arranged in beds with the density of 64 plants/m^2. Long day condition was provided with 100 watt incandescent lamps cyclic lighting (20 min off followed by 10 min on) from 22.00 pm – 03.00 am for 4 weeks. The lamp points were arranged 2 x 2 m and 1.5 m above the planting beds. Manure was applied at the rate equal of 30 tons/ha for both houses. Fertilizers used were based on the soil analyses i. e. 4.4 kgs $Ca(NO_3)_2$ + 1.25 kgs SP-36 and 11 kgs K_2SO_4/ 100 m^2 for bamboo house, and 2.2 kgs $Ca(NO_3)_2$ + 1.25 kgs SP-36 and 11 kgs K_22SO_4/ 100 m^2 for wood house. Additional fertilizers were supplemented through drip irrigation. The concentration of stock solution were 100 times, comprised of KNO_3, $MgSO_4$ and $Ca(NO_3)_2$. Standard cultural practices were applied to maintain the plants throughout the experiment.

a. Type of plastic house construction

Plants growth quality was observed under two plastic houses types. Traditional construction made of bamboo (Indonesian) and wood (Malaysian type) were used to facilitate these observations. The bamboo pipes served for the pillars and roof construction, while in Malaysian type, the wood pillars were equipped with galvanized pipe for the roof. Both constructions used UV plastic for the roof cover and 1 mm green screen mass for the whole side wall of plastic houses.

b. Frequency of irrigation

During the first seven days, the water was given to the plants using sprinkler system in both plastic houses to maintain the newly planted cuttings. Then, three lines of drip tubes were installed in each

bed to facilitate the irrigation by drip system. The irrigation frequencies were arranged twice (30 min each) and 4 times (15 min each) per week in both plastic house constructions.

c. Leaf detachment

The leaf detachment was practiced to find out the effect of these activities on the growth quality of plants in both plastic house constructions. The treatments were :

1. 6 leaves were detached 4 weeks after planting
2. 10 leaves (6 leaves were detached in 4th week and followed by 4 leaves in 6th week
3. 4 leaves (6 leaves were removed in 4th, 4 leaves in 6th and followed by another 4 in 8th week after planting), and
4. no leaf was detached.

RESULT AND DISCUSSIONS

Irrigation frequencies on two plastic house constructions

The application of different frequencies of irrigation gave significant impacts on chrysanthemum growth in both of plastic house types. Figure 1 showed the plants irrigated four times per week had better performance compared to those provided twice per week irrigation. The higher values were observed in plant height, total plant fresh weight, and 80 cm long-stem fresh weight.

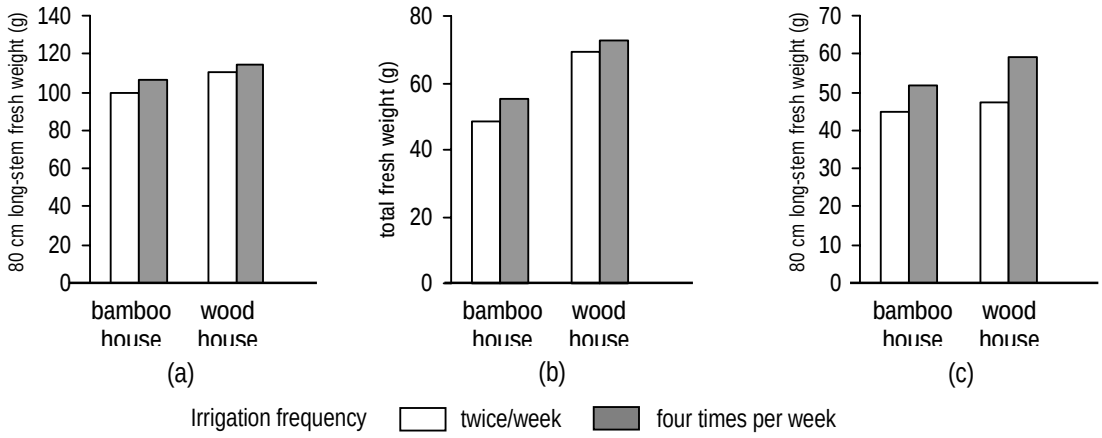

Figure 1. (a) Plant height, (b) total fresh weight, and (c) 80 cm long-stem fresh weight of chrysanthemum treated with different irrigation frequency in bamboo and wood plastic houses.

Water supply with the frequency of four times per week also gave significant influences to the generative stage. The increase numbers of flower per stem and longer vase life span in the room

temperature were observed from the plants in both plastic houses given four times irrigation per week (Figure 2).

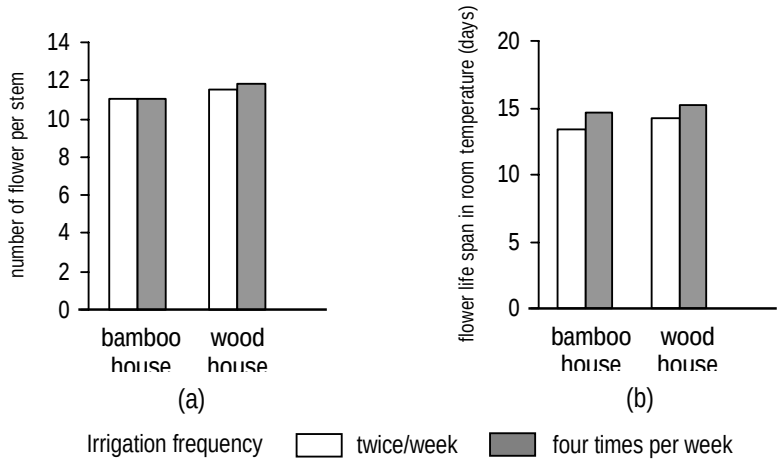

Figure 2. (a) Number of flowers per stem and (b) flower life span in room temperature of chrysanthemum treated with different irrigation frequency in bamboo and wood plastic houses.

Water availability was considered to be one of important factors in determining chrysanthemum growth and quality of the flower produced. Better growth performance viewed from plants given four times per week irrigation indicated that 15 minutes drip irrigation per application supplied the root system more constant moisture content. This water content was important not only for plant uptake in metabolic activities, but it also provided more favourable condition in the root environment (Karlsen and Bertram, 1995). Moisture content in root system provided sufficient humidity as well as less destructive temperature fluctuation that might be happened in the soil (Klapwijk, 1987), since from June to October, the experimental sites were in dry season.

Less growth performance showed by the plants treated with twice per week irrigation were predictably caused by inconstant water availability in the root system. The different duration in each application on twice and four times per week drip irrigation were arranged to provide the plants with water equally. However, twice per week irrigation seemed to be less effective in providing constant moisture for the root system and environment. The longer period between water applications made the water content in the soil more drastically fluctuated. Higher water loss in the soil due to high evaporation contributed to the decrease of humidity and temperature increase in the root area (Mortensen, 2000). This condition influenced the stability of root activities and metabolic process due to the use of additional energy for respiration. The use of energy due to high rate of respiration might limit the carbohydrate accumulation and distributions in the apical growing point (Trusty and Miller, 1991) and finally decrease the growth quality and flower produced.

Leaf detachment on plants grown in two plastic house constructions

The practice of leaf removal had significant influences on the growth performance and quality of flower produced in both plastic house types. From the figure 3, it can be shown that the more leaves to be removed, the less growth observed in plants. The number of flower per stem and flower life span were also observed decrease continuously in line with the increase of leaves detached.

The decrease of plant height in line with the increase number of leaves removed was an evident of the influence of leaves retained on the plants to the subsequent growth, since the decrease values of fresh weight observed among the treatments can be drifted from the more leaves detached from the plants. The slower subsequent growth after leaf detachment indicated the slower cell division and differentiation. The cells growth retardation inferred that the leaf detachment contributed to the less production of assimilate. This logical pathway was driven, since the more leaves were detached, automatically might decrease the light harvesting area and consequently the photosynthetic active area. These might directly influence the photosynthetic activity, e.g. decreasing the photosynthetic rate since the photosynthesis take place mainly in the leaves (Rademaker and De Jong, 1987).

The less assimilate produced due to the low photosynthesis activities contributed to imbalance carbohydrates partitioning in plant body, since the sink were competed with the limited assimilate. The competition, then affected the generative stage e.g flower initiation and development. These might explain for the less number of flowers produced in plant with more leaves detached, since plant needs abundant carbohydrates as sources of energy for flowering (De Ruiter, 1997).

The lack of energy sources might not be only decrease the number of flower but the quality of flower produced. The carbohydrate content in the plant body might determine the life span of flower, since the carbohydrates retained in plant body were consumed for respiration after the plant was cut (Chockshull, 1982). These might describe the reason for the shorter life spans found in plants with harass leaves detachment.

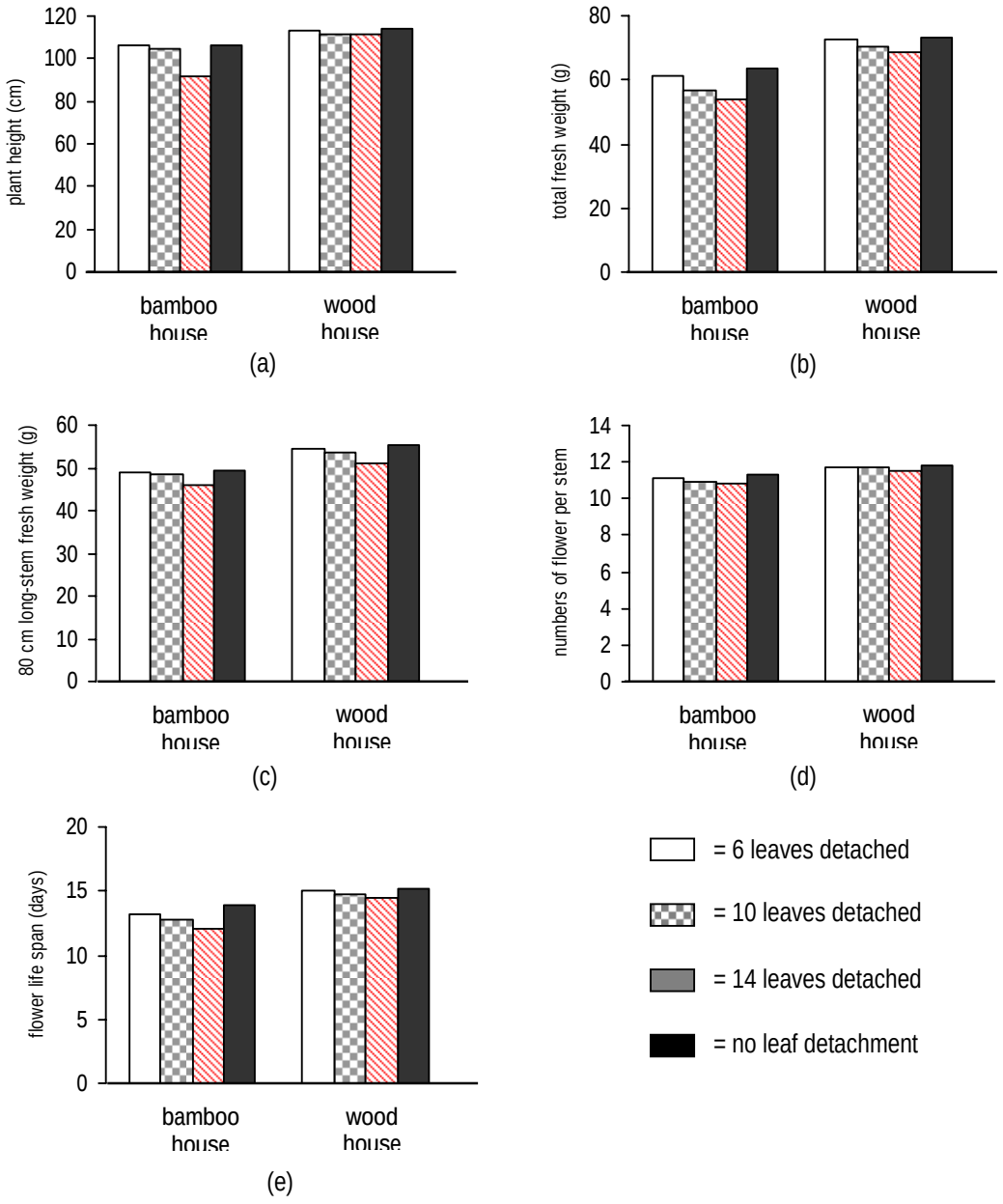

Figure 3. Effect of leaf detachment on (a) plant height, (b) total fresh weight, (c) 80 cm long-stem fresh weight, (d) number of flower per stem, and (e) flower life span in room temperature of chrysanthemum grown in bamboo and wood plastic houses.

Plant performance under bamboo and wood plastic houses

In general, the plants grown under the different plastic houses showed different characteristics in quality of growth and flower produced. The plants grown under the wood-constructed plastic house grew more vigorously than those plants under bamboo-constructed. These were viewed from the

higher values observed form the height and fresh weight as presented in table 1. The plants grown under wood plastic house also showed better flower quality, reflected from the numbers of flower formed per stem and longer life span.

Table1. Growth quality, numbers of flower and life span under room temperature of chrysanthemum grown under two different construction plastic houses.

Types of plastic houses	Plant height *) (cm)	Fresh weight *) (g)	Number of flower per stem *)	Life span *) (days)
Bamboo construction	103,15 a	58.72 a	35,05 a	13,78 a
Wood construction	112.36 b	71,08 b	48,26 b	14,92 a

**) values followed by different letters in the same column differ significantly at LSD 5 %*).

It was also observed that the light interception under the bamboo-constructed plastic house was lower than under wood house (data not presented). Light interceptions were only 50 – 55 % under the bamboo plastic house, compared to that 71 – 78 % detected under the wood house. The denser bamboo constructions in the roof side were predictably to be main reason of this condition.

Lower light intensities accepted by the plants due to low interception under the bamboo houses might become the limiting factors for the plants to have optimal growth. These were since the growth rate of chrysanthemum during vegetative phase is highest during summer and the rates of the stem length, leaf initiation and fresh weight were observed linearly correlated with the light intensities (Karlsen, 1997). These better growth performances in vegetative period then, might influence the flowering stage of the plants as viewed from the higher numbers of flower produced and life span.

CONCLUSIONS

1. Frequency of irrigation gave significant effects on the plant growth and quality flower produced of the chrysanthemum grown in both plastic house types. Plants supplied with water four times per week showed better performance than those provided with twice per week irrigation.
2. Numbers of leaf retained on the plants affected to subsequent growth and flower quality. The more leaf on the plants, contributed to the higher numbers of flower produced and lengthened the life span of plant after cut in the room temperature.
3. Plants grown under bamboo and wood-constructed plastic houses showed different performance in the quality of growth and flower produced. The less optimal environment under the bamboo plastic house contributed to the shorter plant height, fresh weight, and decreased on the numbers of flower produced per plant compared to those planted under the wood plastic house.

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Annex 6: Effects of fertilizer and type of media on the rooting capacity of chrysanthemum cutting

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Abstract. Chrysanthemum is one of important ornamentals in Indonesia and it ranks in the first quantity of cut flower marketed every year. In most of cases, the low quality of planting material is still become the constraint for the traditional growers to make production process more profitable. Several input aspects to improve the physiological status of cutting during rooting process were investigated. The experiment was conducted in Segunung, Indonesian Ornamental Crops Research Institute from February to May 2005. The research dealt with the effects of different type of media, fertilizer concentration and the frequency of fertilizer application on the rooting capacity of chrysanthemum cuttings. Results of the experiment showed that cuttings rooted in carbonized rice husk showed better quality performance than those rooted in coco peat, vermiculite and mixture of perlite + vermiculite. Higher concentration of fertilizer solution up to 1,5 $dS.cm^{-1}$ also gave significant effect on the root formation and further root growth of cuttings. However, the rooting capacities of cuttings were not affected by the frequency of fertilizer application.

Keywords : Chrysanthemum (*Dendranthema grandiflora*), type of media, fertilizer concentration, application frequency.

Introduction

Chrysanthemum (*Dendranthema grandiflora* Twelve) is one of the major cut flowers in the world. In Indonesia, this commodity ranks in the first quantity of the cut flower product marketed every year. The production areas occupied for almost more than 100 ha which are mostly still located in Java. In 2003, this commodity has contributed US $ 1 million to the national income with significant increase up to this moment (Indonesian Statistics Bureau, 2005). However, Southeast Asian countries including Indonesia, have supplied less than 10 % of world market share.

The fast and dynamic trend changes in the floriculture market have made quality and performance as the determining factors in grading and pricing. This is in addition to the consumer preferences on colour, size and flower types. In the other hands, these conditions have given significant impact to the traditional growers. It is often found that flower produced by traditional growers have poor physical performance and quality due to some constraints in the production process. These conditions then, led to the uncompensatable prices and finally made the production process become less profitable and uncompetitive.

Planting material was considered to be one of the most important factors in production process. The quality of cuttings highly influences the young plant's growth and the responses to the input factors being applied. These will affect the further stages of the plant growth and development, and finally the quality of the flowers produced (Grunewaldt, 1988). Aside from the systemic disease problem, the quality of cutting is highly influenced by the physiological status of the cutting. These

include the previous history of mother stock where the cutting taken from and the rooting capacity of the cutting. The rotting capacity itself however, is not only determined by the genotype, but it is known that this potential is also subject to the influence of environmental conditions (Horridge and Chockshull, 1989).

A set of conducive environment is needed to facilitate the rooting process of cutting. These include the physical environments and edifice factors that may act solely or simultaneously to the cutting in root initiation and further root growth. Environmental modifications in rooting process i.e. the use of different rooting media and fertilizer application then, became important to be investigated. Previous study by Nugroho *et. al*. (2004) indicated that higher dry weight, more compact and faster in rooting capacity was observed in the cuttings being applied with fertilizer during rooting process. However, the concentration and frequency of fertilizer application during the rooting process were still not clear. This study then, was conducted to find out the effect of different rooting media and the concentration and the frequency of fertilizer application during rooting process to the rooting capacity of the cutting.

MATERIAL AND METHODS

The experiment was conducted from February to May 2005 at Segunung, an experimental station of Indonesian Ornamental Crops Research Institute, located in 1,100 masl. Completely Randomized Block Design was used in this experiment. Unrooted cuttings of cv. Town Talk from Saung Mirwan Nursery Co. Ltd. were used in the experiment. The cuttings were planted and arranged in 30 x 40 cm plastic boxes with the density of 60 cuttings per replication. In the first three days, the boxes were covered with papers to keep the humidity and to avoid the excessive transpiration on the newly planted cuttings. During the rooting process, long day condition was provided with 75 watt incandescent lamps cyclic lighting (20 min off followed by 10 min on) from 22.00 pm – 03.00 am. The lamp points were arranged 1 m above the planting boxes. After 16 days rooting period, the rooting media were removed and the rooting capacity and quality of cuttings in each treatment were observed.

a. Type of rooting media

Rooting capacity of cuttings was observed under four different rooting media. The rooting media were carbonized rice husk, coco peat, perlite, and mixture of 50% perlite and 50 % vermiculite. The media were pasteurized in 80 ^{0}C for 4 hours. After 24 hours cooling, the media then were placed into the planting boxes with the height of 15 cm. To facilitate the humidity for the cutting, ½ l sterile water was given to each planting box before the cuttings were planted.

b. Fertilizer concentration

Three days after the cuttings were planted, the paper covers were removed. A compound of 25 : 7 : 7 NPK fertilizers were mixed with sterile water with the concentration served as the treatment. The

concentrations were arranged in 1.0 ± 0.1 and 1.5 ± 0.1 dS.cm^{-1} Electrical Conductivity (EC) of the fertilizer solutions.

c. Frequency of fertilizer application

The fertilizer was applied to the rooting media and arranged in 4 different frequencies. In each application, ½ l fertilizer solution was given to each box based on the treatments. The frequency of fertilizer application served as treatment were arranged in every : 1) 1 day, 2) 2 days, 3) 3 days, and 4) 4 days.

RESULT AND DISCUSSIONS

Effect of different media on the rooting capacity

Rooting media was observed to have impacts on the rooting capacity and performance of the cutting after 18 days rooting process. Data on Table 1 showed that cuttings planted in carbonized rice husk tend to have better rooting capacity. These were observed from the higher number of visible root and root length.

Table 1. Rooting capacity and cutting performances on four different rooting media after 16 days rooting.

Rooting media	Cutting height *) (cm)	Cutting diameter*) (mm)	Number of leaves*)	Number of visible root*)	Root length*) (cm)
Carbonized rice husk	13.575 a	2.768 a	6.837 a	26.650 a	7.065 a
Coco peat	13.389 a	2.713 a	6.667 a	23.663 ab	6.035 b
Vermiculite	12.876 a	2.724 a	6.550 a	20.517 b	5.587 b
50 % perlite + 50 % vermiculite	13.389 a	2.606 a	6.358 a	21.467 b	6.215 ab

**) values followed by different letters in the same column differ significantly at LSD 5 %.*

Environmental condition in rhizosphere was considered to be one of the important factors on root formation and further root growth. The better quality of cuttings observed in carbonized rice husk indicated that this media gave more conducive environment in rhizosphere to facilitate root initiation and formation during the rooting process. Even though not properly observed, carbonized rice husk was predictably to have better water holding capacity and drainage. These supplied the root environment more constant moisture content and sufficient air. The macro pores are filled with up with air and supply sufficient oxygen for cells respiration (Frenck and Kim, 1995) during the rooting process. The moisture in smaller pores then, serves not only for metabolic activities but also provides sufficient humidity to avoid excessive transpiration (Karlsen, 1997) and destructive temperature fluctuation that may be happened in the rhizosphere (Klapwijk, 1987)

Another possible roles is that the endogenous hormones that is influenced by the environment. Light apparently gave significant impact on the translocation/accumulation of root promoter (e.g. auxin). Low light interception due to the dark rhizosphere environment in carbonized rice husk promoted the accumulation of auxin at the basal part of cuttings where root initials appear and these induce the cell division and differentiation for root formation (Moe, 1988).

Even though higher values of cutting height, stem diameter and number of leaves were also observed in the cuttings rooted in carbonized rice husk, there is no generalization can be made in the differences among the rooting media. These indicated the cutting growth orientation during rooting process. The photosynthetic rates of cuttings during rooting period are relatively low (Davis and Potter, 1981), and current photosynthetic as energy sources prioritize served to encourage the development of root primordial. These conditions lead to the limited supply for upper plant part growth (Borrowski *et al*., 1981).

Effect of fertilizer and frequency of application on the rooting capacity

Fertilizer application was observed to have significant impacts on the root quality of cuttings after 16 days rooting process. Data on table 2 showed that the increase of fertilizer concentration contributed to higher number of visible root and root length. Although not significantly different, higher values of cutting height, stem diameter, number of leaves and shoot fresh weight were also observed in line with the higher concentration of fertilizer solution.

Tabel 2. Quality performances of cutting supplemented with fertilizer in different concentrations during rooting process.

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Fertilizer concentration	Cutting height *) (cm)	Cutting diameter*) (mm)	Number of leaves*)	Shoot fresh weight *) (g)	Number of visible root*)	Root length*) (cm)
EC = 1.0 ± 0.1 $dS.cm^{-1}$	13.156 a	2.672 a	6.667 a	2.723 a	21.601 a	5.812 a
EC = 1.5 ± 0.1 $dS.cm^{-1}$	13.573 a	2.734 a	6.837 a	2.946 b	29.817 b	6.739 b

**) values followed by different letters in the same column differ significantly at T-test 5 %*

According to De Vier and Geneve (1987), even though the responses of chrysanthemum are not fixed among genotypes, the visible primary root primordial usually appear within 8 days after the cutting was inserted. These indicated that growth orientation of cutting after this period was for the further root development. During the further root development, consequently, the nutrient availability in root zones became very important for further cutting growth, since the growth rate was then highly influenced by the nutritional status of cuttings (Buwalda, *et. al*., 1994). These implied that the amount of nutrient content in the root zones was also related with the growth of cutting, especially in further root growth rate.

.In relation with these situations, Buwalda and Kim (1994) also found that the significant increase of fresh weight, stem diameter and leaf formation of cutting occur after 15 days rooting. These indicated that in line with root development, the shoot growth was then, subsequently retained. This condition, then made the influences of fertilizer concentration on further cutting shoot development were not clearly reflected, since cutting observation was conducted after 16 days rooting.

In contrast with the effect of concentration, the frequency of fertilizer application did not give any significant impacts on the cutting performance in all parameters observed (Table 3). Cutting height, number of leaves, shoot fresh weight and number of visible root were found higher in the cuttings being applied with fertilizer solution everyday. While those every 3 days application gave higher value on stem diameter, longer root was observed on the cuttings given every 4 days solution. No generalizations though can be concluded a far these relationships are concerned.

Tabel 3. Quality performances of cutting supplemented with fertilizer in different application frequencies during rooting process.

Fertilizer application frequency	Cutting height *) (cm)	Cutting diameter*) (mm)	Number of leaves*)	Shoot fresh weight *) (g)	Number of visible root*)	Root length*) (cm)
every day	13.604 a	2.717 a	6.733 a	2.963 a	26.383 a	6.243 a
every 2 days	13.535 a	2.648 a	6.692 a	2.847 a	24.333 a	5.518 a
every 3 days	13.520 a	2.738 a	6.662 a	2.940 a	24.375 a	5.947 a
every 4 days	13.554 a	2.707 a	6.325 a	2.832 a	21.762 a	6.627 a

**) values followed by different letters in the same column differ significantly at LSD 5 %.*

The applications of fertilizer solution into the rooting media are often complicated with the dual nature of water. This complexity was related to the period when the cuttings were still in the early stage of rooting. On the one hand, water itself is indispensable for plant life (transpiration, turgor maintenance, cell expansion), while on the other hand, it serves as the transport medium for the essential mineral nutrient (Steiner, 1980). In the rhizosphere, water, nutrient and oxygen may interact with the air filled porosity of the media, for instance influx of nutrient may differ from the initial concentration, while, and the absorption of minerals is uncorrelated with water uptake (Jackson and Drew, 1984).

Another possible phenomenon is that the change of physiological orientation of plants during root initiation and formation. During the rooting process, especially in the early stage, roots were remained absent. Consequently, the site of nutrient absorption was not able to be supported by the basal part of cutting, though nitrogen was considered to be the limiting growth factor in this stage. The significant influences of nutrient concentration on the cutting growth were then, predictably obtained after the root functioned properly. These implied that the nutrient given before the roots were formed, was likely unusable.

CONCLUSIONS

4. Type of media gave significant effects on the rooting quality of cuttings. Better qualities of rooting and cutting performance were obtained from the cuttings rooted in carbonized rice husk.
5. Nutrient availability on the rooting media highly influenced the root growth and development. Supplemental fertilizer with the concentration up to 1.5 $mS.cm^{-1}$ gave significant increase in root formation and cutting quality.
6. The rooting capacities of the cuttings were not affected by the frequency of fertilizer application.

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