HORTIN II Co Innovation Programme

Towards cost effective, high quality value chains

Effect of variety, container type, Regent drench, transplant depth and transplant age on transplant raising and yield of hot pepper.

HORTIN-II Research Report nr. 10

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The purpose of the HORTIN-II programme is to contribute to the development of cost effective high quality value chains for vegetables and fruits. Among others this can be achieved when technology development takes place in close collaboration between public institutions, farmers and private companies.

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Executive summary

An experiment was carried out to investigate the effect of container, variety, drenching with the insecticide Regent SC at a rate of 20 or 40 ml on transplant raising and yield of hot pepper. Besides the effect of transplant age and planting depth was investigated on yield earliness and yield of hot pepper.
The experiment was carried out from July 16 till December 31, 2008 on a field located near Brebes, Central Java. Transplants were raised in simple nursery constructions. Treatments included raising in individual plastic bags or in plastic modular trays with 128 cells and were compared with direct sowing, which is currently the standard cultivation technique. Tested varieties were the hybrid variety Gada F_1 of PT EWINDO, the open pollinated variety Tit Segitiga, and the improved open pollinated varieties Balitsa 3 and Balitsa 4. Gada planted at 50% of the plant population of the other varieties, showed a two times higher yield per plant resulting in comparable yields per square meter. Yield of transplants raised in plastic bags or plastic trays were in general higher than the yield of plants cultivated with direct sowing.
The effect of transplant age and planting depth were not so conclusive, but it seems that with the use of 5 day older transplants than normally used and with deeper planting up to cotyledons instead up to root ball level, yield increased.
Finally, yield of transplants drenched twice in the nursery phase and once immediately after transplanting with 40 ml Regent SC, was higher than the yield of transplants with no drenching or with 20 ml drench or with direct sowing.
Results of this experiment were not optimal since during harvesting the pressure of pests and diseases increased to such an extend that before the planned end date of the crop, harvesting was terminated. Another aspect that reduced the potential yield was the restriction in available water during the first three months of the cultivation.

1 Introduction

In 2007 the HORTIN II project was initiated in order to improve the hot pepper supply chain.
A main constraint in the supply chain is the production of hot pepper (*Capsicum annuum*). Farmers indicated that yield is low due to lack of good starting material and to the presence of pests and diseases. In Brebes, central Java, direct sowing of open pollinated varieties is common practice. With direct sowing per plant hole, five seeds are sowed, meaning that only 20 % of the used seeds gives a plant per plant hole while 80% is wasted.
Yield of open pollinated varieties is usually lower compared to hybrid varieties. However, due to the use of direct sowing at which high amounts of seeds are required, the use of hybrid varieties with higher seed costs not acceptable by the farmers.
With the use of transplants seed use can be reduced, since per plant hole only one plant is required and a higher percentage of seeds will result in a good plant. With this technique costs for seeds are reduced thus the use of hybrid varieties will become within reach of the farmers. Positive may also then the better performance of hybrid varieties in terms of pest and disease resistance and in yield.
A field in the area of Brebes was selected for performing experiments, since it is estimated that approximately 40% of the hot pepper production on Java takes place here. Hot pepper is considered as a secondary crop by the local farmers and is used to intercrop with shallot which they consider as the main crop. Rotation takes place with rice and sugar cane. In general, the climate in Brebes is suitable for hot pepper cultivation except for the months December and January when heavy rainfall is present. Hot pepper main season only starts after the harvest of rice in April.
Since August 2007 experiments have been carried out to test the effect of container, variety and media on transplant raising of hot pepper. From these experiments concluded could that raising seedlings in individual plastic bags gave the best results. For media a mixture of 1 volume part of manure and 1 volume part of top soil resulted in the highest percentage of usable transplants. The hybrid variety Gada gave a higher yield per plant compared to Tit Segitiga. Since the Gada plant population was 50% of the population present at Tit Segitiga yield per square meter was similar. However, yield is still not optimal since due to the presence of pests and diseases average yield is not exceeding 2 ton per hectare whereas under favourable conditions 5 to 6 tonnes are possible.
In 2007 and early 2008 observed was that mainly thrips and *helicoverpa* were present in the cop. Commonly, those pests are controlled by frequent field application with a cocktail of insecticides up tot three times a week. However, the effect of these sprayings seems to be limited due to high insect pressure, wrong use and timing of insecticides and presumably resistance of insects against the used pesticides.
To protect the seedlings against pests responsible for yield losses, drenching with a systemic insecticide may be an effective alternative to routinely spraying of insecticides. With drenching he insecticide is present at the right place and at the right time. In previous experiments a systemic insecticide with good control of thrips, white fly and aphids, Actara 25 WG (thiamethoxam 25%), was tested. However, results from those experiments showed that Actara at the tested rates, did not show any effect on controlling thrips, white fly and virus incidence. Therefore, decided was to test Regent SC (fipronil 50 g/l) applied as a drench. The active ingredient fipronil shows systemic activity and is particular effective by ingestation and has already shown effective control of sucking insect pests by seed treatment application.
Another aspect of seedling raising is transplant age. Using older transplants can result in more generative plant growth, resulting in earlier yields but also risk on lower yields since vegetation of the plant is not sufficient to support the production. An advantage of using older plants is that plants are also raised for a longer period under protected conditions, hence protected against field influences and therefore can result in higher yields. At the other hand younger seedlings are more vigorous and transplant shock is less compared to older transplants resulting in a more vegetative plant with possible higher yields. With using younger plants occupation of the nursery is less and in this way per year a higher number of seedlings can be raised in the nursery resulting in lower fixed costs.
Planting depth too has an influence on plant performance. With tomato cultivation, practice is to plant as low as the first true leave in order to increase productivity. Some experiments have been carried out with a deeper planting of hot pepper plants up to the first true leave which showed a higher yield. Both tomato and hot pepper are capable of forming new roots easily at below soil surface plant parts and therefore uptake of water and nutrients is more and returns in a higher yield.

With this test the aim was to:

- Test the effect of variety on seedling production and yield
- Test the effect of type of container on seedling raising
- Test the effect of drenching seedlings with Regent
- Test the effect of transplant age on seedling quality and yield
- Test the effect of planting depth on yield

1.1 Acknowledgements

The research was done in close cooperation with farmers in Brebes. PT EWINDO supplied materials for the nursery construction and seeds of the hybrid hot pepper variety Gada F_1. Mr. Rien Rodenburg, director R&D of EWINDO offered valuable advice on hot pepper cultivation. PT Syngenta also assisted the research by supplying pesticides and advice on pest control.
Special thanks also to Uka and Arifin for their important role in the cultivation of the hot pepper crop, in carrying out the experiment and in assisting with the observations.

2 Materials and methods

The experiment was performed in the area of Kersana Brebes (Fig. 1) . Brebes is located on the northern coast of Java adjacent to the Java Sea at 7° S and 109° E. The climate can be classified as a humid tropical lowland climate with clear distinguished dry and wet seasons. A field was rented from farmers and the nurseries were constructed at the entrance of the field while the production fields were located behind the nurseries (Fig. 2). Soil type of the field can be characterized as a fluvisol with 70% clay.

Figure 1. Location of the hot pepper cultivation area where the experiment took place.

In August 2007 soil samples were taken from the experimental site (Table 1). Three samples were taken from the field of the top layer of 0 – 30 cm depth. Sampling was done by taking 5 sub samples along the diagonal of each replication. pH-H_2O of the soil is slight acid to neutral. Phosphate content in the soil is present at an excessive level while potassium is present at an adequate medium level. Both calcium and magnesium content is medium to high.

Table 1. Analyse results of soil samples taken in August 2007 at experimental site.

Sample	pH-H_2O	pH-KCl	N (%) Kjeldahl	P_2O_5 (ppm) Olsen	K (ppm) MV	Ca	Mg
						(meq/100g) Ammonium acetate 1N pH 7	
I	6.5	5.8	0.13	108.2	181.8	45.74	8.55
II	6.6	5.8	0.10	84.8	190.8	50.89	8.96
III	6.5	5.7	0.11	99.3	178.6	52.48	8.65

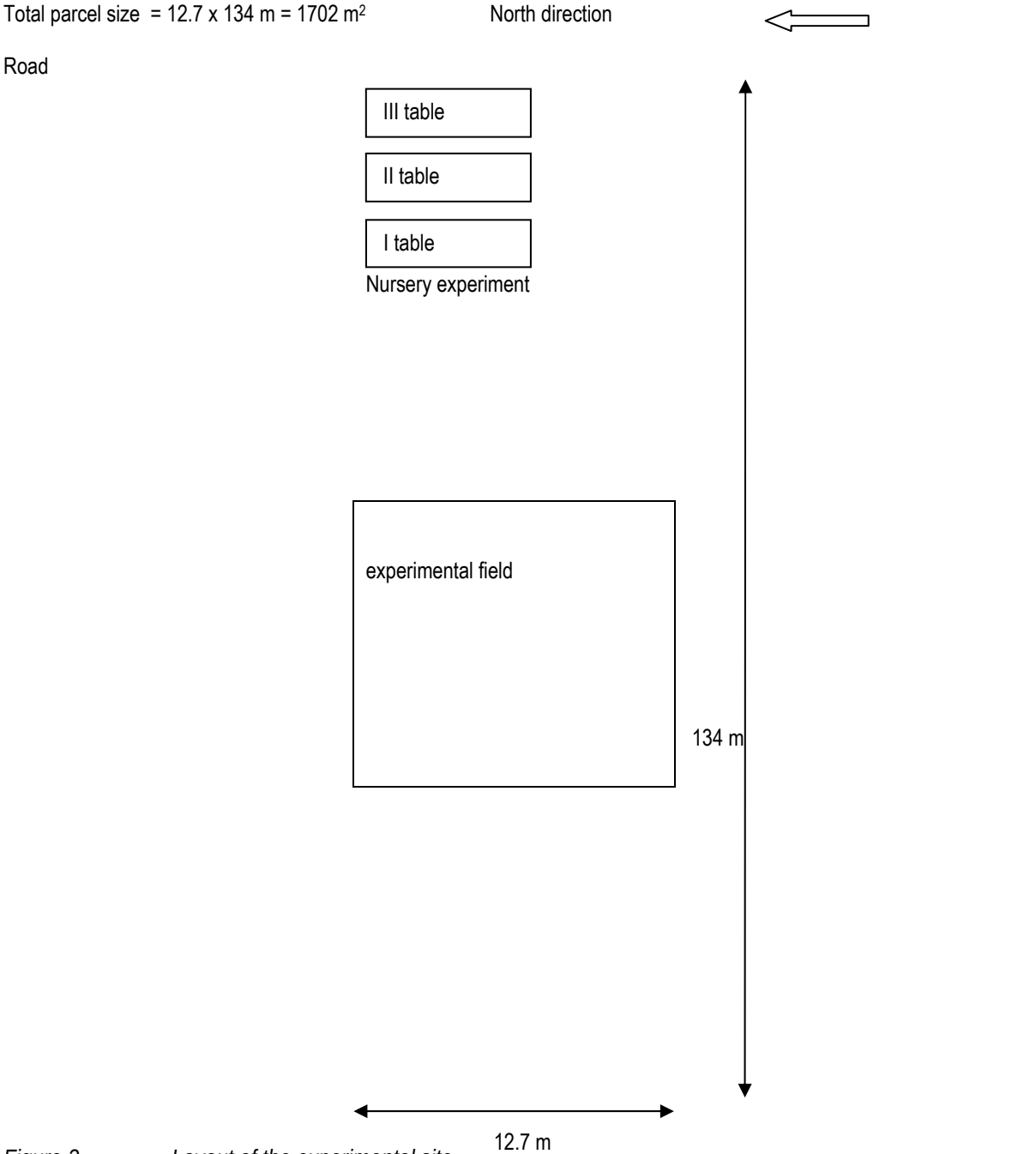

Figure 2. Layout of the experimental site.

2.1 Treatments in the experiment

Single treatments factors are presented in table 2. Two varieties, two nurseries and six treatments were tested and compared with results of direct sowing. Not all treatments were combined with each other and in table 3 a complete overview of all treatment combinations is presented.

Table 2. Single treatments factors.

Variety:	A1:	Tit Segitiga
	A2:	Gada F_1
	A3:	Balitsa nr 3
	A4:	Balitsa nr 4
Tray:	B1:	Transparent plastic bag
	B2:	Modular tray with 128 cells
Transplant	TA0:	normal age
age	TA1:	normal age + 5 days
	TA2:	normal age + 10 days
Regent	R0:	0 ml Regent SC drench
	R1:	20 ml Regent SC drench (after 15 and 25 days after sowing)
	R2:	40 ml Regent SC drench (after 15 and 25 days after sowing)
Transplant	TD0:	Normal (at same level as seedlings show edge between upper soil part and below soil level parts
depth	TD1:	Planting of seedlings as deep as till cotyledons are just below soil level
Nursery	S1:	Table nursery
	S2:	Direct sowing – 5 seeds per hole

Table 3. Treatment combination in the experiment.

	Code	Variety	Container	Regent	Transplanting age	Transplanting depth
A1	A1B1C2D1E1	Tit Segitiga	Transparent plastic bag	20 ml	30 days	normal
A2	A1B1C2D2E1	Tit Segitiga	Transparent plastic bag	20 ml	35 days	normal
A3	A1B1C2D3E1	Tit Segitiga	Transparent plastic bag	20 ml	40 days	normal
A4	A1B1C2D1E2	Tit Segitiga	Transparent plastic bag	20 ml	30 days	cotyledons
A5	A1B1C3D1E1	Tit Segitiga	Transparent plastic bag	40 ml	30 days	normal
A6	A1B1C1D1E1	Tit Segitiga	Transparent plastic bag	0 ml	30 days	normal
A7	A1B2C2D1E1	Tit Segitiga	Plastic tray 128 modules	20 ml	30 days	normal
A8	A2B1C2D1E1	Gada	Transparent plastic bag	20 ml	30 days	normal
A9	A2B1C2D2E1	Gada	Transparent plastic bag	20 ml	35 days	normal
A10	A2B1C2D3E1	Gada	Transparent plastic bag	20 ml	40 days	normal
A11	A2B1C2D1E2	Gada	Transparent plastic bag	20 ml	30 days	cotyledons
A12	A2B1C3D1E1	Gada	Transparent plastic bag	40 ml	30 days	normal
A13	A2B1C1D1E1	Gada	Transparent plastic bag	0 ml	30 days	normal
A14	A2B2C2D1E1	Gada	Plastic tray 128 modules	20 ml	30 days	normal
A15	A3B1C2D1E1	Balitsa 3	Transparent plastic bag	20 ml	30 days	normal
A16	A4B1C2D1E1	Balitsa 4	Transparent plastic bag	20 ml	30 days	normal
A17	A1B3	Tit Segitiga		Direct sowing		
A18	A2B3	Gada		Direct sowing		
A19	A3B3	Balitsa 3		Direct sowing		
A20	A4B3	Balitsa 4		Direct sowing		

2.2 Nursery for raising of seedlings

For raising seedlings a simple nursery construction was used. (Figure 3 and 4). The nursery house was present in threefold.

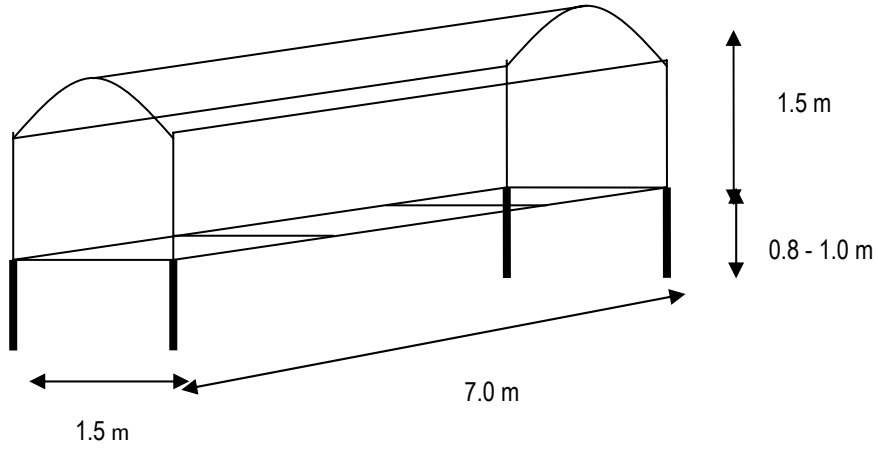

Figure 3. Schematic view of a table nursery.

Figure 4. Inside of a table nursery.

2.3 Hot pepper varieties used for the experiment

Three types of varieties were used in the experiments:

- Local open pollinated variety (Tit Segitiga)
- Hybrid variety (Gada F_1)
- Improved open pollinated variety (Balitsa 3 and Balitsa 4)

Seeds from Tit Segitiga were obtained locally from farmers while seeds from Gada F_1 were received from EWINDO PT located at Purwakarta. Seeds of the varieties Balitsa 3 and Balitsa 4 were obtained at IVEGRI.

2.4 Cultivation

2.4.1 Intercropping and plant density

Hot pepper was intercropped together with shallot (Figure 5). In Annex I a lay out for the intercropping pattern as was present in the experiment is given. Crops were grown on suats or beds surrounded by ditches. Each plot consisted of half a suat with a size of 1.5 x 5.7 m. Shallots were planted a day before sowing of hot pepper seeds. Population density of the open pollinated hot pepper variety was twice the density present with the hybrid variety (Table 4). Hot pepper seedlings were transplanted 3 to 4 weeks after shallot was planted

Table 4. Number of plants and planting distances for shallot and hot pepper.

	Plants per plot	Number of rows	Plants per row	Distance within a row	Distance between rows
Shallot	260	10	26	21	15
Hot pepper (OP)	100	4	25	21	30/60
Hot pepper (F_1)	50	4	13	42	30/60

Figure 5. One Suat or bed containing two experimental plots.

2.4.2 Cultivation practice

Sowing of hot pepper in the field and in the nurseries took place on July 16, 2008 (Table 5). Per plot 200 seeds were sown for transplant raising treatments while with direct sowing of Gada 250 seeds were used per plot and with Tit Segitiga 500 seeds. With direct sowing, per planting hole 5 seeds were sowed. With transplant raising per cell or per plastic bag only one seed was sowed. Shallot was planted in the field on July 12. Transplanting of seedlings raised in the nursery into the field took place on 19, 24 and 29 August 2008. Different planting dates were present to investigate the effect of transplant age on yield and possible earliness of harvest.

Table 5. General information on the cultivation.

Hot pepper sowing	:	16 July, 2008.
Hot pepper transplanting	:	19, 24 and 29 August, 2008.
Shallot transplanting	:	12 July, 2008.
Shallot harvest	:	September, 2008.
Used seeds in nursery	:	200 per plot
Direct sowing (5 seeds per plant hole)	:	500 per plot for Balitsa 3 and 4 and Tit Segitiga 250 per plot for Gada
Plant density	:	Balitsa 3, Balitsa 4 and Tit Segitiga at 12.2 plants per m^2 Gada F_1 at 6.1 plants per m^2

Further cultivation, method of harvesting, amount of fertiliser and pest control of hot pepper took place as common farmers practice in Kersana Brebes.

2.5 Type of containers

For container, two types were tested namely a modular tray with 128 modules per tray and individual plastic bags (Fig. 6). At the 128 module tray the cell shape was pyramidal with a cell content of 13 cm^3. Plastic bags could hold a volume of 15 cm^3 and holes were punctured in the bottom to provide drainage.

Figure 6. Plastic bags and modular tray with 128 cells, used for seedling raising of hot pepper.

2.6 Seedling raising treatments

2.6.1 Potting soil

Components for media were manure purchased from nearby farms, and top soil collected from the field near to the nursery. Media was prepared by thoroughly mixing 1 volume part of manure with 1 volume part of top soil. After preparing the media was sampled by taking 1kg of media for analyses on nutrient content, pH, EC and bulk density.

Per litre media 100 mg NPK fertiliser was added. From sowing onwards, every other day with each watering in the morning, 2 gram NPK fertiliser per litre was added to the irrigation water.

2.6.2 Regent drench

In combination with the plastic bag container the effect of Regent SC (fipronil 50 g/l) drench was tested as well with the variety Gada and Tit Segitiga (Table 6).

Table 6. Scheme for applying Regent SC as a drench .

	Application schedule	Method	Dosage of Regent SC
1	15 days after sowing	drenching	20 or 40 ml/l water --- 200 ml solution/plant
2	25 days after sowing	drenching	20 or 40 ml/l water --- 200 ml solution/plant
3	3 days after transplanting	drenching	20 or 40 ml/l water --- 200 ml solution/plant

2.6.3 Transplant age

Seedlings were transplanted at a time deemed ready for transplanting. Five days and ten days after this date seedlings were also transplanted.

2.7 Transplant depth

Normally planting depth of transplants is up to a same level as present at the seedlings in the trays. With deeper transplanting, plants are planted where cotyledons are just below soil level.

2.8 Observations

2.8.1 Climate

During the experiment temperature was recorded by taking readings at 14.00 p.m. each day on maximum and minimum temperature. One thermometer was placed in one of the nurseries and one outside in the field. Thermometers were placed in a shaded position. Rainfall data were gathered from Brebes Agricultural Office weather station and measured daily at 6.30 a.m. using a simple rain gauge. Data of these recordings are listed in Annex IV.

2.8.2 Nutrient content

From the media used for filling the trays and plastic bags a sample of 1 kg was taken before adding NPK to the media for analyse on nitrogen, potassium, phosphate, calcium and pH level.

2.8.3 Light intensity

During seedling raising, light intensity in Lux was measured with a handheld Lux meter (LX93 from Nieuwkoop) inside and outside the nurseries on July 16th and August 19th, 2008. Inside each nursery at two spots light intensity was measured and outside each nursery light intensity was measured at one spot (Annex II). Percentage available light inside the nurseries, was calculated based on these readings.

2.8.4 Nursery observations

Emergence was observed 10, 20 and 30 days after sowing of the treatments. Percentage of normal and abnormal seedlings was calculated.

At transplanting number of normal, usable and abnormal transplants were observed and percentage was calculated as well. Also number of plants with virus symptoms and infected with thrips were observed. At transplanting randomly per plot 15 seedlings were selected, cut off at soil level, and measured for plant length, individual plant weight and number of fully developed leaves.

Plant length was measured from the cut off point to the end tip of a leave of a fully stretched out plant. After drying at 70 ^{o}C for 24 hours the total weight of the 15 plants together was weighed. Percentage dry weight was calculated as well.

2.8.5 Harvest observations

Fruits were harvested when mature, and harvesting took place every two to five days place depending on the speed of fruit maturing.
At each harvest date, per plot number and total weight in gram accurate of harvested fruits was observed. After this fruits were graded in marketable fruits and unmarketable fruits. The number and weight of marketable fruits was observed. At each harvest also the number of present plants per plot was observed.
Based on the observations total fruit number and weight, marketable fruit number and weight per plant and per square meter cultivation surface was calculated. Also share of marketable weight in total yield and average fruit weight was calculated.

2.9 Statistical information

The experiment was carried out as a randomized block design in three replications (Annex II and III). Results were analysed with ANOVA (analysis of variance) by using the statistical program Genstat for Windows 11th edition.

3 Results

3.1 Climate

During transplant raising, minimum temperature was about 22°C (Fig. 7). Maximum temperature was approximately 20 degrees higher and was on average 42 to 43 degrees. Inside temperature in the nursery was similar to the outside temperature.

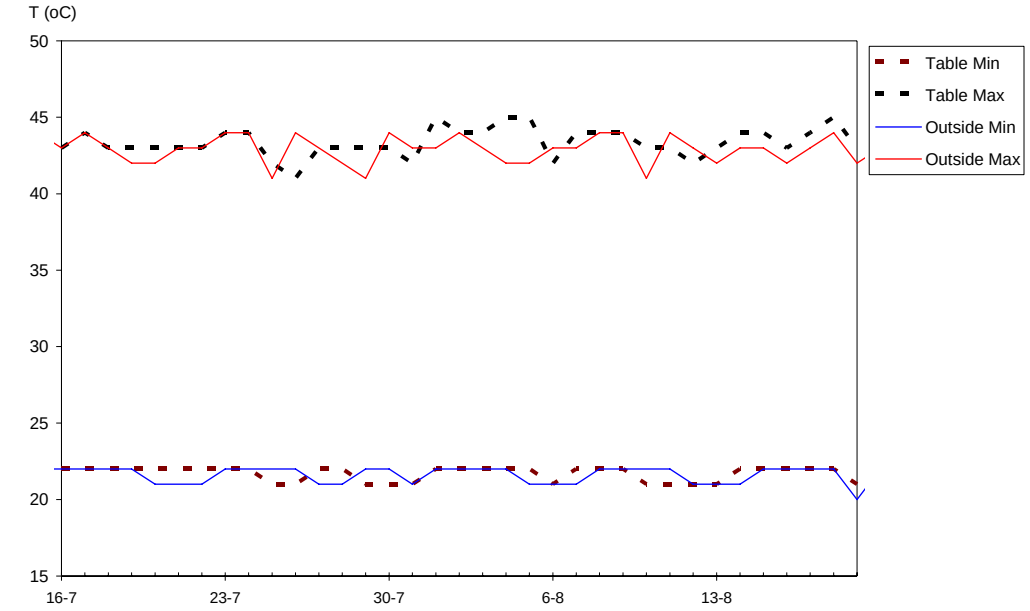

Figure 7. Inside and outside maximum and minimum temperature during transplant raising.

At transplanting, maximum temperature was about 40°C. Almost immediately after transplanting the temperature increased to 45°C (Fig. 8).

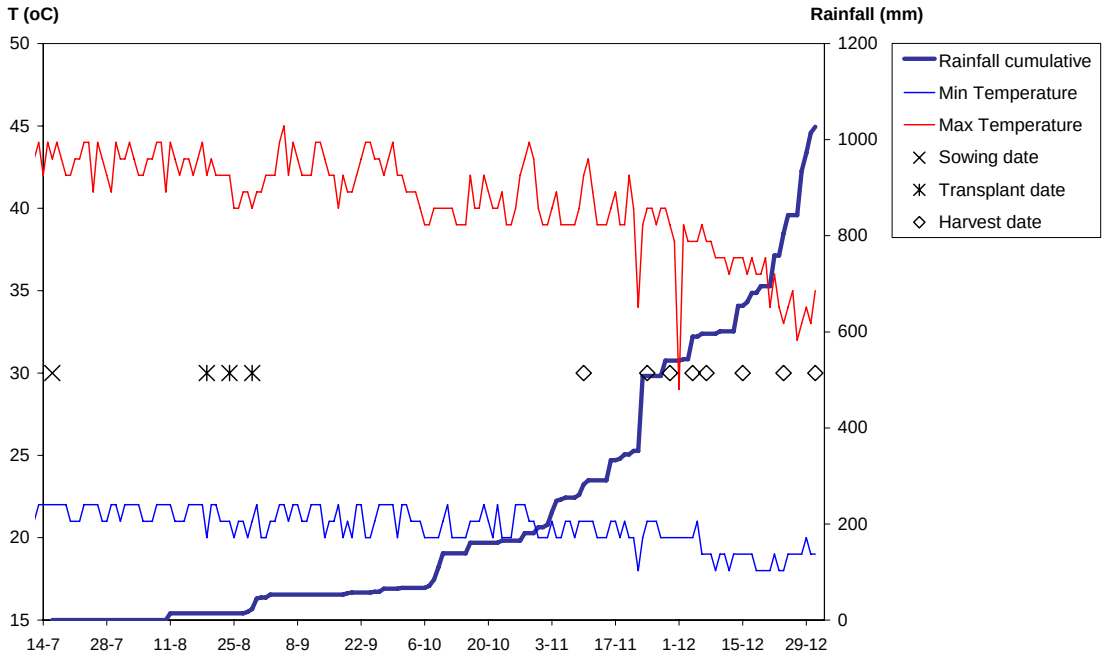

Figure 8. Rainfall and maximum and minimum temperature.

From early October temperature decreased gradually from 45°C to 35°C the end of December. At the same time rainfall intensity increased and from October till the end of December around 900 mm was recorded.

3.2 Light levels

On July 16, light intensity in the nursery was on average 65% of the outside light intensity. On August 19, the inside light intensity was 70% of the outside conditions.

3.3 Nutrient content of media

The used media in this experiment was the combination of top soil with manure (TS+M) (Table 7). The pH of this media is alkaline with a pH-H_2O of 7.2, in standard ready available potting soils for vegetable seedling production a pH of 5.6 to 6.0 is advisable. Total nitrogen content is about 0.48 % or 480 mg per 100 gram media. For standard potting soils it is recommended to add on average of 0.2 kg nitrogen per m^3 potting soil, ranging from 0.12 till 0.45 kg, with fertilizers such as potassium nitrate, calcium nitrate or ammonium nitrate (Argo, 1998). With those recommendations about 200 mg per litre is applied. When assuming that 1 litre media weighs approximately 400 gram, this amount is 50 mg per 100 gram, which is 10% of the measured total N content in the used substrate in this experiment. It seems nitrogen content in the used media is quite high then. However, not known is how much of the total N content in the used substrate is ready available nitrate and ammonium.

Table 7. Nutrient content of media/substrate samples taken in August 2007.

Media	pH-H_2O	pH-KCl	N (%)	P_2O_5 (%)	K_2O (%)	CaO (%)	MgO (%)
Rice husk (RH)	7.6	7.2	0.43	0.36	0.77	0.17	0.06
Manure (M)	7.7	7.4	0.72	1.74	1.77	4.99	1.61
Top soil (TS)	6.7	5.9	0.16	0.02	0.03	1.15	0.23
RH + M	7.7	7.3	0.68	1.46	1.22	3.55	1.15
TS + M	7.2	6.8	0.48	0.78	0.89	2.24	1.54
RH + M + TS	7.4	6.9	0.48	0.87	1.00	2.48	1.30

3.4 Results of variety and raising system

3.4.1 Nursery results

After 10 days emergence was the highest at direct sowing, but not different from transplants raised in plastic bags (Table 8). Tit Segitiga showed a significant lower emergence than Balitsa 4 and Gada. Emergence of Balitsa 3 was not significant different from the emergence of Baltisa 4 and Gada.

Table 8. Emergence 10 days after sowing (%).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	55.1	51.2	32.5	46.3	46.3
Plastic bag	15.7	31.2	20.8	34.5	25.5
Average	35.4	41.2	26.7	40.4	
	LSD	p=			
Variety (V)	15.1	<0.001			
Treatment (T)	10.7	0.2			
V * T	21.4	0.2			

After 20 days emergence of transplants raised in plastic bags was not different from direct sowing (Table 9). Tit Segitiga showed a significant lower emergence than the emergence of Gada and Balitsa 4. Balitsa 3, Balitsa 4 and Gada showed a similar emergence.

Table 9. Emergence 20 days after sowing (%).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	49.9	49.3	45.7	46.9	48.0
Plastic bag	66.8	56.8	33.0	65.3	55.5
Average	58.4	53.1	39.4	56.1	
	LSD	p=			
Variety (V)	14.0	0.05			
Treatment (T)	9.9	0.1			
V * T	19.7	0.1			

At transplanting the percentage of usable transplants of Gada was the highest (Table 10). Tit Segitiga showed the lowest percentage but between varieties no significant differences were present. A significant higher usable transplants was present at raising transplants in plastic bags compared to direct sowing.

Table 10. Usable seedlings at transplanting (%).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	36.1	32.5	32.6	34.4	33.9
Plastic bag	68.5	66.2	43.0	71.0	62.2
Average	52.3	49.3	37.8	52.7	
	LSD	p=			
Variety (V)	13.9	0.1			
Treatment (T)	9.9	<0.001			
V * T	19.7	0.2			

Fresh weight of seedlings with direct sowing was higher compared to the weight of transplants raised in a plastic bag (Table 11). Tit Segitiga seedlings showed a lower fresh weight compared to the other varieties.

Table 11. Fresh weight (g) of seedlings at transplanting.

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	31.8	28.2	20.0	26.4	26.6
Plastic bag	14.2	17.1	8.9	13.9	13.5
Average	23.0	22.7	14.5	20.2	
	LSD	p=			
Variety (V)	5.3	0.01			
Treatment (T)	3.7	<0.001			
V * T	7.4	0.5			

Direct sowing seedlings showed a higher dry weight than transplants raised in a plastic bag (Table 12). Dry weight of Tit Segitiga seedlings was significant lower than the weight of the other three varieties.

Table 12. Dry weight (g) of seedlings at transplanting.

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	0.32	0.32	0.20	0.35	0.30
Plastic bag	0.13	0.26	0.12	0.23	0.19
Average	0.23	0.29	0.16	0.29	
	LSD	p=			
Variety (V)	0.09	0.03			
Treatment (T)	0.07	0.002			
V * T	0.13	0.4			

Plant length of direct sowing seedlings was significant higher than of transplants (Table 13). Tit Segitiga showed the shortest plants and they were significant shorter then seedlings of Gada, Baltisa 3 and Balitsa 4. Between Gada, Balitsa 3 and Balitsa 4 no significant differences in plant length were present.

Table 13. Plant length (cm) of seedlings at transplanting.

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	15.2	13.6	12.8	15.0	14.1
Plastic bag	10.4	10.9	7.2	11.3	10.0
Average	12.8	12.2	10.0	13.2	
	LSD	p=			
Variety (V)	2.0	0.02			
Treatment (T)	1.4	<0.001			
V * T	2.9	0.5			

At transplanting the number of leaves per plant raised in plastic bags was on average 9.8. This was significant lower than the number of leaves with direct sowing (Table 14). Tit Segitiga showed a significant lower number of

leaves than the number present at the other three varieties. Balitsa 3 showed the highest number and was significant different from the other varieties.

Table 14. Number of leaves of seedlings at transplanting.

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	13.4	12.1	9.9	10.9	11.6
Plastic bag	10.6	10.4	8.7	9.7	9.8
Average	12.0	11.2	9.3	10.3	
	LSD	p=			
Variety (V)	0.8	<0.001			
Treatment (T)	0.6	<0.001			
V * T	1.1	0.1			

In the field no observation on virus symptoms was done at seedlings with direct sowing. In the nursery between varieties no significant difference in percentage of seedlings with virus symptoms was present (Table 15). Average percentage of seedlings with virus symptoms was 0.9 %.

Table 15. Seedlings at transplanting infected with virus (%).

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Plastic bag	0.5	1.0	0.7	1.3	0.9
	LSD	p=			
Variety (V)	0.8	0.7			

Seedlings with thrips incidence were only found with direct sowing (Table 16). Gada and Tit Segitiga showed a lower incidence than Balitsa 3 and 4.

Table 16. Seedlings at transplanting with thrips incidence (%).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	24.4	24.5	12.3	17.1	20.0
Plastic bag	0.0	0.0	0.0	0.0	0.0
Average	12.2	12.3	6.1	8.5	
	LSD	p=			
Variety (V)	4.5	0.03			
Treatment (T)	3.2	<0.001			
V * T	6.4	0.03			

3.4.2 Yield results

Gada showed the highest yield per plant (Table 17). On average 17.4 gram per plant was harvested while at Balitsa 3, Balitsa 4 and Tit Segitiga a significant lower yield was present. At the open pollinated varieties no significant difference in yield per plant was present. With transplants average yield per plant was 12.9 gram and 1.9 gram higher compared to direct sowing. However, this difference was not significant.

Table 17. Total yield per plant (g).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	8.3	9.7	9.6	16.3	11.0
Plastic bag	11.3	12.1	9.7	18.6	12.9
Average	9.8	10.9	9.7	17.4	
	LSD	p=			
Variety (V)	2.9	<0.001			
Treatment (T)	2.1	0.06			
V * T	4.1	0.7			

Transplants raised in plastic bags showed a higher but not significant different marketable yield per plant (Table 18). Gada showed a higher marketable yield per plant than the open pollinated varieties Balitsa 3, Balitsa 4 and Tit Segitiga. Yield of Gada was almost double of the yield of those three varieties.

Table 18. Marketable yield per plant (g).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	5.8	7.1	7.8	13.1	8.4
Plastic bag	9.0	10.3	7.1	14.1	10.1
Average	7.4	8.7	7.5	13.6	

	LSD	p=
Variety (V)	2.8	0.001
Treatment (T)	2.0	0.09
V * T	4.0	0.4

Total yield per square meter was not significant different between varieties (Table 19). On average 88.2 g per square meter was harvested, which is 0.9 ton per hectare. Between direct sowing and transplants raised in plastic bags no significant difference in total yield per square meter was present.

Table 19. Total yield per square meter (g).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	77.2	89.1	91.8	75.9	83.5
Plastic bag	107.0	105.3	82.6	76.8	92.5
Average	92.1	97.2	76.3	87.2	

	LSD	p=
Variety (V)	26.6	0.4
Treatment (T)	18.8	0.3
V * T	37.6	0.4

No significant difference in marketable yield per square meter was present between direct sowing and transplants raised in plastic bags (Table 20). Although Gada showed a lower yield per square meter this was not significant different from the yield present at the open pollinated varieties. Balitsa 3 and Balitsa 4 showed both a quite high marketable yield with raising in plastic bags. Nevertheless this was not significant different from direct sowing. Interaction between treatment and variety was not present in spite of the higher yield of Balitsa 3 and Balitsa 4 transplants raised in plastic bags, while yield of Tit Segitiga and Gada was lower with using transplants compared to direct sowing.

Table 20. Marketable yield per square meter (g).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	54.2	64.6	74.5	61.4	63.6
Plastic bag	85.3	89.7	60.7	58.8	73.6
Average	69.7	77.1	67.6	60.1	

	LSD	p=
Variety (V)	26.1	0.6
Treatment (T)	18.4	0.3
V * T	36.9	0.2

Production of marketable hot peppers with transplants raised in plastic bags started sooner than the production of direct sowed seedlings of Balitsa 3 and Balitsa 4 (Fig. 9). Tit Segitiga transplants showed a later start, but this was also related to the one week later sowing of transplants compared to the other varieties and to direct sowing of Tit Segitiga. Gada transplants also showed a delayed start of production compared to direct sowing.
Except for Tit Segitiga, after early December a higher increase in yield was present with transplants than with direct sowing.

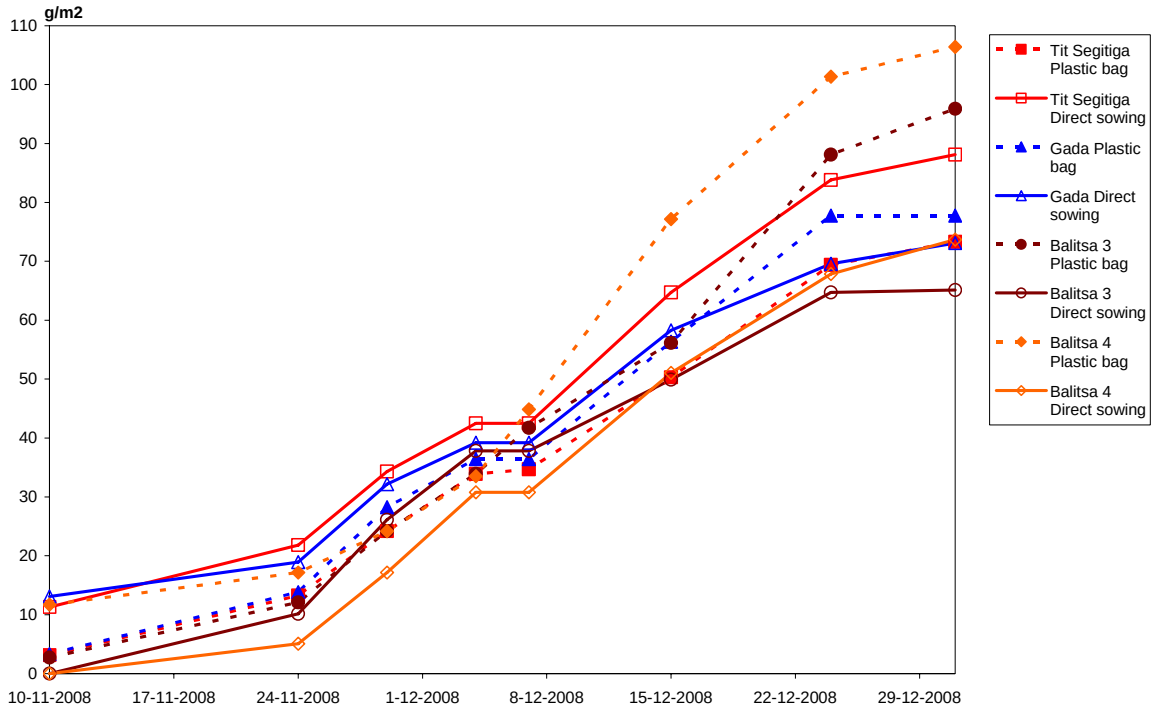

Figure 9. *Marketable yield per square meter with direct sowing and transplants of Balitsa 3, Balitsa 4, Tit Segitiga and Gada.*

Between direct sowing and transplant use no significant difference was present in percentage of marketable yield of the total production (Table 21). On average 77% of the harvested hot peppers was marketable. Between varieties also no significant differences in percentage marketable yield were present. Although not significant, it seems that with the Balitsa varieties a higher marketable percentage is present with transplant raising while at Tit Segitiga and Gada a lower percentage was present. At the other hand with direct sowing Balitsa 3 and Balitsa 4 showed a lower marketable production in the total production than Tit Segitiga and Gada.

Table 21. Share of marketable yield in total production (%).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	70.5	71.2	81.1	81.0	76.0
Plastic bag	79.3	84.7	73.4	75.1	78.1
Average	74.9	78.0	77.3	78.0	
	LSD	p=			
Variety (V)	10.9	0.9			
Treatment (T)	7.7	0.6			
V * T	15.4	0.1			

Per plant a higher number of fruits was harvested with transplants than with direct sowing (Table 22). Between the open pollinated varieties Tit Segitiga, Balitsa 3 and Balitsa 4, no difference in fruit number was present. Gada showed a significant higher fruit number than the open pollinated varieties.

Table 22. Fruit number of total production per plant.

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	1.3	1.4	1.4	2.4	1.6
Plastic bag	1.8	1.7	1.5	2.8	1.9
Average	1.5	1.5	1.5	2.6	
	LSD	p=			
Variety (V)	0.4	<0.001			
Treatment (T)	0.3	0.03			
V * T	0.5	0.8			

Marketable number per plant was higher with transplants compared to direct sowing, but the difference was not significant (Table 23). Gada showed a higher fruit number than Balitsa 3, Balitsa 4 and Tit Segitiga.

Table 23. Fruit number of marketable production per plant.

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	0.8	0.9	1.1	2.5	1.3
Plastic bag	1.3	1.7	1.1	2.0	1.5
Average	1.1	1.3	1.1	2.2	
	LSD	p=			
Variety (V)	0.7	0.007			
Treatment (T)	0.5	0.4			
V * T	0.9	0.2			

Per square meter the total fruit number was on average 13.2. No significant differences were present between treatments or variety (Table 24).

Table 24. Fruit number of total production per square meter.

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	11.7	12.7	13.5	11.5	12.4
Plastic bag	16.7	14.8	13.0	11.7	14.0
Average	14.2	13.7	13.3	11.6	
	LSD	p=			
Variety (V)	3.7	0.5			
Treatment (T)	2.6	0.2			
V * T	5.2	0.4			

Marketable fruit number per square meter was with direct sowing 9.6 and with transplants raised in plastic bags it was 11.2 (Table 25). Differences between those treatments were not significant. Also between varieties no significant differences were present.

Table 25. Fruit number of marketable production per square meter.

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	7.5	8.5	10.5	11.6	9.6
Plastic bag	12.3	14.7	9.3	8.3	11.2
Average	9.9	11.6	9.9	9.9	
	LSD	p=			
Variety (V)					
Treatment (T)					
V * T					

Individual fruit weight of the total production was with direct sowing 6.8 gram and with transplants raised in plastic bags 6.6 gram (Table 26). No significant difference between these treatments was present.
On average, weight of Balitsa 4 fruits was higher than the weight of Balitsa 3, Tit Segitiga and Gada fruits.

Table 26. Individual fruit weight of total production (g).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	6.6	7.0	6.8	6.6	6.8
Plastic bag	6.4	7.1	6.4	6.6	6.6
Average	6.5	7.1	6.6	6.6	
	LSD	p=			
Variety (V)	0.3	0.01			
Treatment (T)	0.2	0.2			
V * T	0.5	0.3			

In individual fruit weight of the marketable production no significant differences were present in raising method or between varieties (Table 27).

Table 27. Individual fruit weight of marketable production (g).

Treatment	Balitsa 3	Balitsa 4	Tit Segitiga	Gada	Average
Direct sowing	7.2	7.5	7.1	5.9	6.9
Plastic bag	6.9	6.6	6.6	7.1	6.8
Average	7.1	7.1	6.9	6.5	

	LSD	p=
Variety (V)	1.2	0.7
Treatment (T)	0.9	0.8
V * T	1.7	0.3

3.5 Results of variety and container

3.5.1 Nursery results

Percentage of emerged seedlings 10 days after sowing was higher at Gada than at Tit Segitiga (Table 28). On average the percentage of direct sowing was higher than with seedlings raised in plastic bags. Also the percentage of raising in plastic bag was higher than the percentage of raising in trays. WithTit Segitiga raised in trays no emergence at all was present.

Table 28. Effect of container use on emergence 10 days after sowing (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	46.3	32.5	39.4
Plastic bag	34.5	20.8	27.7
Tray 128 cells	3.2	0.0	1.6
Average	28.0	17.8	

	LSD	p=
Variety (V)	10.1	0.05
Treatment (T)	12.4	<0.001
V * T	17.6	0.6

After 20 days percentage of emergence of Gada raised in plastic bags was significant higher than the emergence with direct sowing and with raising in a tray (Table 29). Between raising in a tray and direct sowing no significant difference was present. With Tit Segitiga percentage of raising in a tray was lower than that present with direct sowing. Percentage of emergence of seedlings raised in plastic bags did not differ significantly from direct sowing or from raising in a tray.

Table 29. Effect of container use on emergence 20 days after sowing (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	46.9	45.7	46.3
Plastic bag	65.3	33.0	49.2
Tray 128 cells	40.0	17.3	28.7
Average	50.8	32.0	

	LSD	p=
Variety (V)	10.0	0.002
Treatment (T)	12.2	0.008
V * T	17.3	0.05

At transplanting, percentage of usable seedlings of direct sowing was with Gada significant lower compared to the percentage present with raising in a plastic bag or in a tray (Table 30). With Tit Segitiga the percentage of direct sowing did not differ from nursery treatments. With Gada the percentage of usable seedlings was higher with raising in plastic bag compared to the percentage present with raising in a tray.
Percentage usable seedlings of both varieties was not different with direct sowing. With both nursery treatments a higher percentage of seedlings was present at Gada than at Tit Segitiga.

Table 30. Effect of container use on usable seedlings at transplanting (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	34.4	32.6	33.5
Plastic bag	71.0	43.0	57.0
Tray 128 cells	52.3	28.5	40.4
Average	52.6	34.7	
	LSD	p=	
Variety (V)	9.7	0.002	
Treatment (T)	11.9	0.004	
V * T	16.9	0.07	

Fresh weight of direct sowing seedlings was significant higher than of transplants raised in a plastic tray or in plastic bags (Table 31). Between the transplant raising treatments no significant differences were present. Gada showed a higher fresh weight at transplanting than Tit Segitiga.

Table 31. Effect of container use on fresh weight (g) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	26.4	20.0	23.2
Plastic bag	13.9	8.9	11.4
Tray 128 cells	12.1	3.4	7.8
Average	17.5	10.8	
	LSD	p=	
Variety (V)	3.8	0.003	
Treatment (T)	4.7	<0.001	
V * T	6.7	0.7	

With direct sowing the dry weight was significant higher compared to the weight of transplants in the nursery (Table 32). Difference in dry weight between plastic bag raised transplants and plastic tray raised transplants was almost significant. On average the dry weight of Gada seedlings was twice as much as the weight of Tit Segitiga seedlings.

Table 32. Effect of container use on dry weight (g) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	0.35	0.20	0.27
Plastic bag	0.23	0.12	0.18
Tray 128 cells	0.16	0.51	0.10
Average	0.24	0.12	
	LSD	p=	
Variety (V)	0.07	0.002	
Treatment (T)	0.08	0.003	
V * T	0.12	0.8	

At transplanting the plant length of seedlings with direct sowing was significant more than the length of the transplants in the nursery (Table 33). Gada seedlings were on average taller than Tit Segitiga seedlings.

Table 33. Effect of container use on plant length (cm) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	15.0	12.8	13.9
Plastic bag	11.3	7.2	9.3
Tray 128 cells	15.0	4.1	7.1
Average	12.1	8.0	
	LSD	p=	
Variety (V)	2.1	0.001	
Treatment (T)	2.6	<0.001	
V * T	3.6	0.3	

Number of leaves per plant was the highest with direct sowing compared to the leaf number of transplants raised in plastic bags or in trays (Table 34). Transplants raised in plastic bags showed a significant higher number of leaves than the transplants raised in plastic trays.
Ti Segitiga showed less leaves per plant than Gada.

Table 34. Number of leaves of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	10.9	9.9	10.4
Plastic bag	9.7	8.7	9.2
Tray 128 cells	9.5	6.6	8.0
Average	10.0	8.4	
	LSD	p=	
Variety (V)	0.7	<0.001	
Treatment (T)	0.9	<0.001	
V * T	1.3	0.06	

Virus incidence was only observed in the nursery and was not observed in the field due to difficult recognizable symptoms in the field caused by the presence of severe thrips symptoms (Table 35). Between nursery treatments no significant differences between variety and used container type were present.

Table 35. Effect of container use on seedlings infected with virus at transplanting (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	-	-	-
Plastic bag	1.3	0.7	1.0
Tray 128 cells	1.0	1.3	1.2
Average	0.8	0.7	
	LSD	p=	
Variety (V)	1.1	0.2	
Treatment (T)	1.4	0.8	
V * T	1.9	0.7	

Thrips incidence was only found in the field with direct sowing (Table 36). Gada showed a higher percentage than Tit Segitiga.

Table 36. Effect of container use on seedlings with thrips incidence at transplanting (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	17.1	4.1	14.7
Plastic bag	0	0	0
Tray 128 cells	0	0	0
Average	5.7	4.1	
	LSD	p=	
Variety (V)	1.7	0.07	
Treatment (T)	2.1	<0.001	
V * T	3.0	0.05	

3.5.2 Yield results

Yield per plant was on average higher with Gada than with Tit Segitiga (Table 37). Between direct sowing and plastic bag raised transplants no significant difference in yield per plant was present. Yield of plants raised in a plastic tray was significant higher than the yield of plants with direct sowing. Between transplants raised in plastic bag or tray no significant difference was present in yield per plant.

Table 37. Effect of container use on total yield per plant (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	16.3	9.6	13.0
Plastic bag	18.6	9.7	14.1
Tray 128 cells	20.0	13.6	16.8
Average	18.3	11.0	
	LSD	p=	
Variety (V)	2.4	<0.001	
Treatment (T)	2.9	0.04	
V * T	4.1	0.6	

Gada showed on average a higher marketable yield than Tit Segitiga (Table 38). Yield of Gada was 14.6 gram while Tit Segitiga showed a yield 8.8 gram per plant. Marketable yield of plants raised in a plastic tray was 14.1 gram and significant higher than the yield of plants raised in plastic bags or of plants raised with direct sowing. Yield of plants raised in plastic bags was not different from yield of direct sowing.

Table 38. Effect of container use on marketable yield per plant (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	13.1	7.8	10.4
Plastic bag	14.1	7.1	10.6
Tray 128 cells	16.6	11.5	14.1
Average	14.6	8.8	
	LSD	p=	
Variety (V)	2.3	<0.001	
Treatment (T)	2.9	0.03	
V * T	4.0	0.7	

Per square meter yield of Gada was almost significant lower than the yield of Tit Segitiga (Table 39). Also yield of plants raised in plastic trays was almost significant higher than the yield with direct sowing. Yield per square meter of plants raised in plastic bags was lower than of plants raised in plastic trays.

Table 39. Effect of container use on total yield per square meter (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	75.9	91.8	83.9
Plastic bag	76.8	82.6	79.7
Tray 128 cells	92.0	122.1	107.0
Average	81.5	98.8	
	LSD	p=	
Variety (V)	19.2	0.07	
Treatment (T)	23.5	0.06	
V * T	33.3	0.5	

Marketable yield per square meter of Gada was 65.8 gram and was not significant different from the yield of Tit Segitiga (Table 40). Marketable yield per square meter of plants raised in plastic trays was 90.1 gram and significant more than the yield of plants raised in plastic bags and plants raised with direct sowing.

Table 40. Effect of container use on marketable yield per square meter (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	61.4	74.5	67.9
Plastic bag	58.8	60.7	59.8
Tray 128 cells	77.1	103.1	90.1
Average	65.8	79.4	
	LSD	p=	
Variety (V)	17.6	0.1	
Treatment (T)	21.5	0.03	
V * T	30.5	0.5	

Gada and Tit Segitiga showed a comparable share of marketable yield in the total production (Table 41). On average about 80% of the total production was marketable. Plants raised in plastic bags showed a lower percentage than plants raised in plastic trays.

Table 41. Effect of container use on share of marketable yield in the total production (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	81.0	81.1	81.0
Plastic bag	75.1	73.4	74.3
Tray 128 cells	83.8	83.4	83.6
Average	80.0	79.3	
	LSD	p=	
Variety (V)	5.8	0.8	
Treatment (T)	7.2	0.04	
V * T	10.1	1.0	

Per plant the total fruit number of Gada was 2.8 while only 1.7 fruits of Tit Segitiga were harvested (Table 42). Fruit number of plants raised in plastic tray was higher compared to the number with direct sowing. Fruit number of plants raised in plastic bags did not differ from direct sowing nor from plastic tray

Table 42. Effect of container use on fruit number of total production per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	2.4	1.4	1.9
Plastic bag	2.8	1.5	2.2
Tray 128 cells	3.0	2.0	2.5
Average	2.8	1.7	
	LSD	p=	
Variety (V)	0.3	<0.001	
Treatment (T)	0.4	0.03	
V * T	0.6	0.7	

Marketable fruit number with Gada was 2.2 and the fruit number with Tit Segitiga was significant lower with 1.2 fruits (Table 43). Marketable fruit number of plants raised with direct sowing was not different from the number present with transplants raised in plastic bags or trays.

Table 43. Effect of container use on fruit number of marketable production per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	2.5	1.1	1.8
Plastic bag	2.0	1.1	1.5
Tray 128 cells	2.3	1.5	1.9
Average	2.2	1.2	
	LSD	p=	
Variety (V)	0.7	0.008	
Treatment (T)	0.8	0.6	
V * T	1.2	0.7	

The total fruit number per square meter was with Tit Segitiga slightly higher but not significant than the number present with Gada (Table 44). With transplants raised in plastic trays the number was significant higher than the number present with direct sowing or with plants raised in plastic bags.

Table 44. Effect of container use on fruit number of total production per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	11.5	13.5	12.5
Plastic bag	11.7	13.0	12.4
Tray 128 cells	14.1	18.2	16.1
Average	12.4	14.9	
	LSD	p=	
Variety (V)	2.7	0.07	
Treatment (T)	3.3	0.05	
V * T	4.7	0.6	

The marketable fruit number per square meter was with Tit Segitiga 1 more than with Gada (Table 45). The difference however, was not significant. Between cultivation method, direct sowing or use of transplants, no significant differences in fruit number were present.

Table 45. Effect of container use on fruit number of marketable production per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	11.6	10.5	11.1
Plastic bag	8.3	9.3	8.8
Tray 128 cells	10.6	13.6	12.1
Average	10.1	11.1	
	LSD	p=	
Variety (V)	3.9	0.6	
Treatment (T)	4.8	0.3	
V * T	6.8	0.6	

No significant differences in fruit weight of the total production was present (Table 46). Gada showed on average a similar fruit weight as the fruits present at Tit Segitiga. Fruit weight with direct sowing was the same as the individual fruit weight with transplants raised in plastic trays and not different from the weight present at transplants raised in plastic bags.

Table 46. Effect of container use on individual weight of fruits of the total production (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	6.6	6.8	6.7
Plastic bag	6.6	6.4	6.5
Tray 128 cells	6.6	6.7	6.7
Average	6.6	6.6	
	LSD	p=	
Variety (V)	0.3	0.9	
Treatment (T)	0.4	0.3	
V * T	0.5	0.4	

Of the marketable production the individual fruit weight was on average 7 gram (Table 47). No significant differences were present between fruit weight at direct sowing or fruit weight of plants raised in plastic bag or tray.

Table 47. Effect of container use on individual weight of fruits of the marketable production (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	5.9	7.1	6.5
Plastic bag	7.1	6.6	6.9
Tray 128 cells	7.4	7.5	7.5
Average	6.8	7.1	
	LSD	p=	
Variety (V)	0.9	0.5	
Treatment (T)	1.1	0.2	
V * T	1.6	0.3	

3.6 Results of Regent SC drench

3.6.1 Nursery results

Percentage of emerged seedlings after 10 days, 5 days before the first drench application, was significant higher at the seedlings selected for applying 40 ml Regent drench compared to untreated (Table 48). At the intended 0 ml treatment, Tit Segitiga showed a higher emergence percentage compared to the respective treatment at Gada, while at the other treatments Gada showed a higher percentage.

Table 48. Effect of Regent treatment on emergence 10 days after sowing (%).

Treatment	Gada	Tit Segitiga	Average
0 ml	26.0	35.5	30.8
0 ml (will be drenched with 20 ml)	34.5	20.8	27.7
0 ml (will be drenched with40 ml)	41.2	12.7	26.9
Average	33.9	23.0	

	LSD	p=
Variety (V)	7.7	0.01
Treatment (T)	9.4	0.6
V * T	13.3	0.004

Five days after drenching of seedlings with Regent, emergence of all Gada treatments was the same (Table 49). At Tit Segitiga the percentage was lower at 20 and 40 ml compared to 0 ml. With 0 ml the percentage was not different between the two varieties while at the other rates emergence was higher at Gada.

Table 49. Effect of Regent treatment on emergence 20 days after sowing (%).

Treatment	Gada	Tit Segitiga	Average
0 ml	67.7	64.7	66.
20 ml	65.3	33.0	49.2
40 ml	65.7	43.2	54.4
Average	66.2	46.9	

	LSD	p=
Variety (V)	10.7	0.002
Treatment (T)	13.0	0.04
V * T	18.4	0.08

At transplanting, Gada showed a higher percentage of usable transplants than Tit Segitiga (Table 50). With Gada no differences between treatments were present while with Tit Segitiga a significant lower percentage was present at 20 and 40 ml compared to untreated.

Table 50. Effect of Regent treatment on usable seedlings at transplanting (%).

Treatment	Gada	Tit Segitiga	Average
0 ml	79.8	70.2	75.0
20 ml	71.0	43.0	57.0
40 ml	65.5	32.3	48.9
Average	72.1	48.5	

	LSD	p=
Variety (V)	9.9	<0.001
Treatment (T)	12.2	0.002
V * T	17.2	0.13

Fresh weight of Gada seedlings was higher than fresh weight of Tit Segitiga seedlings (Table 51). Seedlings raised in the nursery showed a lower fresh weight then those present with direct sowing. Between Regent rates no differences where present.

Table 51. Effect of Regent treatment on fresh weight (g) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	26.4	20.0	23.2
0 ml	14.4	13.5	14.0
20 ml	13.9	8.9	11.4
40 ml	15.3	5.9	10.6
Average	17.5	12.1	
	LSD	p=	
Variety (V)	2.5	<0.001	
Treatment (T)	3.6	<0.001	
V * T	5.0	0.13	

Dry weight of Gada seedlings was higher than that of Tit Segitiga (Table 52). Dry weight of Regent treated seedlings was not different from untreated. Dry weight of direct sown seedlings was higher than the dry weight of the transplants.

Table 52. Effect of Regent treatment on dry weight (g) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	0.35	0.20	0.27
0 ml	0.22	0.17	0.19
20 ml	0.23	0.12	0.18
40 ml	0.17	0.10	0.14
Average	0.24	0.15	
	LSD	p=	
Variety (V)	0.5	<0.001	
Treatment (T)	0.6	0.004	
V * T	0.9	0.5	

Gada plant length with direct sowing was significant taller than the length of nursery transplants (Table 53). No differences were present between Regent treatments of Gada. With Tit Segitiga, the plant length of direct sown seedlings was not different from 0 ml Regent treatment. Length of 20 ml Regent was significant shorter than the length of 0 ml and direct sowing. The length of transplants drenched with 40 ml Regent was shorter than the length of transplants with 20 ml Regent drench.

Table 53. Effect of Regent treatment on plant length (cm) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	15.0	12.8	13.9
0 ml	12.3	11.7	12.0
20 ml	11.3	7.2	9.3
40 ml	11.2	4.8	8.0
Average	12.5	9.1	
	LSD	p=	
Variety (V)	1.2	<0.001	
Treatment (T)	1.7	<0.001	
V * T	2.5	0.018	

Between the Regent treatments no difference in leaf number was present (Table 54). The number of leaves at direct sowing was significant higher than that of transplants raised in the nursery.

Table 54. Effect of Regent treatment on number of leaves of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	10.9	9.9	10.4
0 ml	9.6	8.6	9.1
20 ml	9.7	8.7	9.2
40 ml	10.0	7.6	8.8
Average	10.0	8.7	
	LSD	p=	
Variety (V)	0.5	<0.001	
Treatment (T)	0.7	0.002	
V * T	1.1	0.17	

In virus incidence no differences were present between treatments (Table 55). Also between variety no significant difference was found.

Table 55. effect of Regent treatment on seedlings infected with virus at transplanting (%).

Treatment	Gada	Tit Segitiga	Average
0 ml	1.8	2.0	1.9
20 ml	1.3	0.7	1.0
40 ml	1.7	3.8	2.8
Average	1.6	2.2	
	LSD	p=	
Variety (V)	1.3	0.4	
Treatment (T)	1.6	0.1	
V * T	2.3	0.2	

Seedlings with thrips were only present with direct sowing (Table 56). Tit Segitiga showed a significant lower incidence than Gada. With transplants raised inside the nursery no thrips incidence was found.

Table 56. Effect of Regent treatment on seedlings with thrips incidence at transplanting (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	17.1	12.3	14.7
0 ml	0	0	0
20 ml	0	0	0
40 ml	0	0	0
Average	4.3	3.1	
	LSD	p=	
Variety (V)	1.3	0.07	
Treatment (T)	1.8	<0.001	
V * T	2.6	0.03	

3.6.2 Yield results

Total yield per plant of transplants drenched with 40 ml Regent was higher than the yield of direct sowing (Table 57). Compared to 0 ml Regent the difference was not significant although a yield of 2.5 gram per plant more was present.

Table 57. Effect of Regent treatment on total yield per plant (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	16.3	9.6	13.0
0 ml	19.7	9.8	14.7
20 ml	18.6	9.7	14.1
40 ml	22.3	12.1	17.2
Average	19.2	10.3	
	LSD	p=	
Variety (V)	2.4	<0.001	
Treatment (T)	3.4	0.09	
V * T	4.7	0.7	

Differences in marketable yield per plant were not significant. When looking at the LSD value only , Gadat seedlings treated with Regent 40 ml showed a higher marketable yield than Regent 20 ml but not higher than the yield of the 0 ml treatment.

Table 58. Effect of Regent treatment on marketable yield per plant (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	13.1	7.8	10.4
0 ml	19.7	7.7	12.4
20 ml	18.6	7.1	10.6
40 ml	22.3	9.2	13.6
Average	19.2	10.3	
	LSD	p=	
Variety (V)	2.3	<0.001	
Treatment (T)	3.3	0.2	
V * T	4.6	0.5	

Per square meter yield of Regent drench 40 ml was 99.8 gram or 1 ton per hectare (Table 59). With direct sowing yield was 83.9 gram and at 0 ml regent drench this was 89.6 gram. No significant differences between treatments in yield were present.

Table 59. Effect of Regent treatment on total yield per square meter (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	75.9	91.8	83.9
0 ml	91.6	87.7	89.6
20 ml	76.8	82.6	79.7
40 ml	104.0	95.5	99.8
Average	87.0	89.4	
	LSD	p=	
Variety (V)	18.1	0.8	
Treatment (T)	25.5	0.4	
V * T	36.1	0.7	

No significant differences in marketable yield per square meter were observed (Table 60). Yield of 40 ml Regent drench was 78.8 gram and with 0 ml this was 74.8 gram. Yield of 20 ml was lower with only 59.8 gram, but this was not significant different from the other treatments.

Table 60. Effect of Regent treatment on marketable yield per square meter (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	61.4	74.5	67.9
0 ml	80.1	69.5	74.8
20 ml	58.8	60.7	59.8
40 ml	84.9	72.6	78.8
Average	71.3	69.3	
	LSD	p=	
Variety (V)	16.3	0.8	
Treatment (T)	23.0	0.3	
V * T	32.5	0.6	

An almost significant effect was observed in percentage of marketable yield in the total production (Table 61). With direct sowing the share was 81% while with 20 ml this was 74.3%. Compared to 0 ml the share present at 20 ml regent was lower. The 40 ml Regent drench did not result in a higher marketable share compared to direct sowing or 0 and 20 ml Regent drench.

Table 61. Effect of Regent treatment on share of marketable yield in total production (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	81.0	81.1	81.0
0 ml	86.8	78.9	82.8
20 ml	75.1	73.4	74.3
40 ml	80.8	75.3	78.0
Average	80.9	77.2	
	LSD	p=	
Variety (V)	4.6	0.1	
Treatment (T)	6.6	0.07	
V * T	9.3	0.6	

A the total production the fruit number with application of 40 ml Regent drench was significant higher then the number present at direct sowing (Table 62). With the use of 0 ml the difference in fruit number was not significant compared to direct sowing. Also with 40 ml Regent no significant higher fruit number was present compared to 0 ml.

Table 62. Effect of Regent treatment on total fruit number per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	2.4	1.4	1.9
0 ml	2.9	1.5	2.2
20 ml	2.8	1.5	2.2
40 ml	3.3	1.8	2.6
Average	2.9	1.6	
	LSD	p=	
Variety (V)	0.3	<0.001	
Treatment (T)	0.4	0.05	
V * T	0.6	0.7	

No significant differences between direct sowing and Regent drench treatments were present in number of marketable fruits per plant (Table 63).

Table 63. Effect of Regent treatment on number of marketable fruits per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	2.5	1.1	1.8
0 ml	2.6	1.1	1.9
20 ml	2.0	1.1	1.5
40 ml	2.5	1.3	1.9
Average	2.4	1.1	
	LSD	p=	
Variety (V)	0.5	<0.001	
Treatment (T)	0.7	0.7	
V * T	1.0	0.7	

Per square meter the total production of Regent 40 ml drench was 15.1 gram (Table 64). Between the Regent drench treatments and direct sowing no significant differences were present.

Table 64. Effect of Regent treatment on total fruit number per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	11.5	13.5	12.5
0 ml	13.8	13.3	13.5
20 ml	11.7	13.0	12.4
40 ml	15.7	14.5	15.1
Average	13.2	13.6	
	LSD	p=	
Variety (V)	2.5	0.7	
Treatment (T)	3.5	0.3	
V * T	4.9	0.7	

Marketable production per square meter with direct sowing was 11.1 gram, this was not significant different from the Regent drench treatments (Table 65).

Table 65. Effect of Regent treatment on marketable number of fruits per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	11.6	10.5	11.1
0 ml	12.3	9.5	10.9
20 ml	8.3	9.3	8.8
40 ml	11.6	10.2	10.9
Average	11.0	9.9	
	LSD	p=	
Variety (V)	2.8	0.4	
Treatment (T)	3.9	0.6	
V * T	5.5	0.8	

No significant difference in individual fruit weight of the total production were present between regent drench treatments and direct sowing (Table 66).

Table 66. Effect of Regent treatment on individual fruit weight of the total production (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	6.6	6.8	6.7
0 ml	6.8	6.6	6.7
20 ml	6.6	6.4	6.5
40 ml	6.7	6.6	6.6
Average	6.7	6.6	
	LSD	p=	
Variety (V)	0.3	0.5	
Treatment (T)	0.4	0.6	
V * T	0.6	0.7	

Individual weight of marketable fruits was 7.2 gram with applying regent 40 ml drench to the transplants (Table 67). This weight however, was not significant different from the individual fruit weight of direct sowing or the fruit weight of other regent drench treatments

Table 67. Effect of Regent treatment on individual weight of marketable fruits (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	5.9	7.1	6.5
0 ml	6.5	7.3	6.9
20 ml	7.1	6.6	6.9
40 ml	7.3	7.2	7.2
Average	6.7	7.0	
	LSD	p=	
Variety (V)	0.7	0.3	
Treatment (T)	1.0	0.5	
V * T	1.4	0.3	

3.7 Results of transplant age

3.7.1 Nursery results

After 10 days when all transplant treatments are still the same, percentage emergence was not significant different for all treatments (Table 68). On average a higher percentage was present at Gada as compared to Tit Segitiga.

Table 68. Emergence 10 days after sowing (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	46.3	32.5	39.4
to be planted at 34 days	34.5	20.8	27.7
to be planted at 39 days	28.7	29.2	28.9
to be planted at 44 days	44.2	21.3	32.8
Average	38.4	26.0	
	LSD	p=	
Variety (V)	10.4	0.02	
Treatment (T)	14.7	0.3	
V * T	20.7	0.4	

After 20 days, when all transplant treatments are still the same too, the percentage of Gada seedlings intended to use for the 39 day old transplant seedlings showed a significant lower emergence than the intended treatments for transplanting after 34 and 44 days (Table 69). At Tit Segitiga the treatment to be used for 39 day old seedlings showed a higher percentage than the other nursery treatments.

Table 69. Emergence 20 days after sowing (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	46.9	45.7	46.3
34 days	65.3	33.0	49.2
39 days	48.2	50.2	49.2
44 days	67.2	36.2	51.8
Average	56.9	41.4	
	LSD	p=	
Variety (V)	8.4	0.001	
Treatment (T)	11.8	0.8	
V * T	16.7	0.01	

At transplanting of Gada, the percentage of usable seedlings with direct sowing was significant lower than the percentage of all nursery treatments (Table 70). Usable seedlings at 39 days was significant lower than the percentage of the other two transplant age treatments. At Tit Segitiga the percentage usable seedlings of 39 day old seedlings was higher, but not significant, than the percentage of the other nursery treatments.

Table 70. Effect of transplant age on usable seedlings at transplanting (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	34.4	32.6	33.5
34 days	71.0	43.0	57.0
39 days	58.7	55.5	57.1
44 days	71.0	46.0	57.9
Average	58.5	44.3	
	LSD	p=	
Variety (V)	7.9	0.002	
Treatment (T)	11.1	<0.001	
V * T	15.8	0.05	

At transplanting, fresh weight of 34 or 39 day old seedlings was not significant different from each other and was lower than the fresh weight of direct sowing (Table 71). The fresh weight of 44 day old seedlings was not different from the weight of direct sown seedlings and was higher than the weight of seedlings of 34 and 39 days old.

Table 71. Effect of transplant age on fresh weight (g) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	26.4	20.0	23.2
34 days	13.9	8.9	11.4
39 days	14.2	12.6	13.4
44 days	22.1	14.7	18.4
Average	19.2	14.1	
	LSD	p=	
Variety (V)	3.1	0.003	
Treatment (T)	4.3	<0.001	
V * T	6.1	0.5	

Dry weight of 34 and 39 day old transplants raised in the nursery was not different from each other (Table 72). Dry weight of 39 days old transplants was not significant different from the dry weight of direct sowing and of 44 days old transplants. Dry weight of 44 day old seedlings and direct sowing was significant higher than the dry weight of 34 day old seedlings.

Table 72. Effect of transplant age on dry weight (g) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	0.35	0.20	0.27
34 days	0.23	0.12	0.18
39 days	0.22	0.19	0.21
44 days	0.36	0.18	0.27
Average	0.29	0.17	
	LSD	p=	
Variety (V)	0.06	<0.001	
Treatment (T)	0.09	0.08	
V * T	0.12	0.3	

Plant length of 34 and 39 days old seedlings was shorter than the length of direct sown seedlings (Table 73). Length of 34 day old seedlings was also shorter than the length of 44 days old seedlings. The latter did no show a different plant length compared to the length of direct sowing.

Table 73. Effect of transplant age on plant length (cm) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	15.0	12.8	13.9
34 days	11.3	7.2	9.3
39 days	11.2	10.0	10.6
44 days	14.8	10.8	12.8
Average	13.1	10.2	
	LSD	p=	
Variety (V)	1.3	<0.001	
Treatment (T)	1.9	<0.001	
V * T	2.7	0.3	

Number of leaves of 34 days old seedlings was significant lower then the number at 44 days old seedlings and direct sowing (Table 74). Number of leaves of 39 and 44 days old seedlings did not differ significantly from direct sowing.

Table 74. Effect of transplant age on number of leaves of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	10.9	9.9	10.4
34 days	9.7	8.7	9.2
39 days	10.1	9.6	9.9
44 days	11.0	9.9	10.4
Average	10.4	9.5	
	LSD	p=	
Variety (V)	0.6	0.003	
Treatment (T)	0.8	0.014	
V * T	1.1	0.9	

No significant differences in percentage of seedlings with virus symptoms were present (Table 75). However, at Tit Segitiga it seemed if a higher percentage was present with 44 days old seedlings than with 34 days old seedlings. At Gada, 39 days old seedlings showed a higher percentage compared to the percentage of 34 and 44 days old seedlings.

Table 75. Effect of transplant age on seedlings with virus symptoms at transplanting (%).

Treatment	Gada	Tit Segitiga	Average
34 days	1.3	0.7	1.0
39 days	3.7	1.3	2.5
44 days	1.2	3.0	2.1
Average	2.1	1.7	
	LSD	p=	
Variety (V)	1.4	0.5	
Treatment (T)	1.7	0.2	
V * T	2.4	0.06	

Seedlings raised in the nursery did not show seedlings with thrips incidence (Table 76). With direct sowing, Gada showed a higher percentage of seedlings with thrips incidence than Tit Segitiga.

Table 76. Effect of transplant age on seedlings with thrips incidence at transplanting 9%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	17.1	12.3	14.7
34 days	0	0	0
39 days	0	0	0
44 days	0	0	0
Average	4.3	3.1	
	LSD	p=	
Variety (V)	1.3	0.07	
Treatment (T)	1.8	<0.001	
V * T	2.6	0.03	

3.7.2 Yield results

Yield per plant of direct sowing was the lowest with 13 gram per plant while with 39 days old transplants yield per plant was 16.2 gram (Table 77). However, observed differences in yield per plant were not significant different.

Table 77. Effect of transplant age on total yield per plant (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	16.3	9.6	13.0
34 days	18.6	9.7	14.1
39 days	20.5	11.9	16.2
44 days	21.1	10.8	16.0
Average	19.1	10.5	
	LSD	p=	
Variety (V)	3.6	<0.001	
Treatment (T)	5.1	0.5	
V * T	7.1	0.9	

Marketable yield per plant was the highest with 39 days old transplants (Table 78). No significant differences in yield between transplant age and direct sowing were present.

Table 78. Effect of transplant age on marketable yield per plant (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	13.1	7.8	10.4
34 days	14.1	7.1	10.6
39 days	14.9	9.8	12.4
44 days	15.9	8.5	12.2
Average	14.5	8.3	
	LSD	p=	
Variety (V)	3.7	0.003	
Treatment (T)	5.2	0.8	
V * T	7.4	0.9	

A similar trend in total yield per square meter was present as with yield per plant (Table 79). Transplants of 39 days old showed the highest yield with 108.4 gram per square meter. This was not different from the yield of the other treatments.

Table 79. Effect of transplant age on total yield per square meter (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	75.9	91.8	83.9
34 days	76.8	82.6	79.7
39 days	97.1	119.6	108.4
44 days	96.4	95.2	95.8
Average	86.5	97.3	
	LSD	p=	
Variety (V)	27.8	0.4	
Treatment (T)	39.3	0.4	
V * T	55.6	0.9	

No significant differences in marketable yield per square meter were present between treatments (Table 80).

Table 80. Effect of transplant age on marketable yield per square meter (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	61.4	74.5	67.9
34 days	58.8	60.7	59.8
39 days	71.0	98.8	84.9
44 days	75.6	75.9	75.7
Average	66.7	77.4	
	LSD	p=	
Variety (V)	25.9	0.4	
Treatment (T)	36.6	0.5	
V * T	51.8	0.8	

All treatments showed a similar percentage of marketable production in the total production (Table 81).

Table 81. Effect of transplant age on share of marketable yield in total production (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	81.0	81.1	81.0
34 days	75.1	73.4	74.3
39 days	72.4	82.4	77.4
44 days	71.0	77.8	74.4
Average	74.9	78.7	
	LSD	p=	
Variety (V)	6.4	0.2	
Treatment (T)	9.1	0.4	
V * T	12.9	0.5	

No significant differences in fruit number per plant was found between direct sowing and transplants of different age (Table 82). With direct sowing the number of fruits was 1.9 and with 39 day old transplants this was 2.5.

Table 82. Effect of transplant age on total fruit number per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	2.4	1.4	1.9
34 days	2.8	1.5	2.2
39 days	3.1	1.8	2.5
44 days	3.0	1.6	2.3
Average	2.8	1.6	
	LSD	p=	
Variety (V)	0.5	<0.001	
Treatment (T)	0.6	0.4	
V * T	0.9	0.9	

In number of marketable fruit per plant, no significant differences were present (Table 83).

Table 83. Effect of transplant age on number of marketable fruits per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	2.5	1.1	1.8
34 days	2.0	1.1	1.5
39 days	2.1	1.3	1.7
44 days	2.2	1.1	1.7
Average	2.2	1.2	
	LSD	p=	
Variety (V)	0.6	0.003	
Treatment (T)	0.9	0.9	
V * T	1.3	0.9	

With direct sowing the number of fruits was on average 12.5 and with 39 days old transplants this number was 16.5 (Table 84). However, differences between treatments were not significant.

Table 84. Effect of transplant age on total fruit number per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	11.5	13.5	12.5
34 days	11.7	13.0	12.4
39 days	14.9	18.0	16.5
44 days	13.7	14.2	14.0
Average	13.0	14.7	
	LSD	p=	
Variety (V)	3.7	0.3	
Treatment (T)	5.3	0.3	
V * T	7.5	1.0	

Marketable fruit number per square meter was not significant different between treatments (Table 85).

Table 85. Effect of transplant age on number of marketable fruits per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	11.6	10.5	11.1
34 days	8.3	9.3	8.8
39 days	10.1	13.4	11.8
44 days	10.4	10.1	10.3
Average	10.1	10.9	
	LSD	p=	
Variety (V)	4.0	0.7	
Treatment (T)	5.7	0.7	
V * T	8.0	0.9	

With direct sowing the average fruit weight was 6.7 gram (Table 86). With 44 days old transplants individual fruit weight was 6.8 gram, and the highest of all treatments, but no significant differences between transplant age and direct sowing were present.

Table 86. Effect of transplant age on individual fruit weight.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	6.6	6.8	6.7
34 days	6.6	6.4	6.5
39 days	6.6	6.6	6.6
44 days	7.1	6.6	6.8
Average	6.7	6.6	
	LSD	p=	
Variety (V)	0.3	0.4	
Treatment (T)	0.4	0.3	
V * T	0.6	0.4	

Individual weight of marketable fruits ranged from 6.5 gram with direct sowing to 7.2 gram at plants from 39 and 44 day old transplants (Table 87). In spite of the 10% increase in weight, differences between those fruit weights were not significant.

Table 87. Effect of transplant age on individual weight of marketable fruits.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	5.9	7.1	6.5
34 days	7.1	6.6	6.9
39 days	7.0	7.3	7.2
44 days	6.9	7.4	7.2
Average	6.7	7.1	
	LSD	p=	
Variety (V)	0.7	0.3	
Treatment (T)	1.0	0.4	
V * T	1.4	0.4	

3.8 Yield results of transplant depth

A significant higher total yield per plant was present at Gada compared to Tit Segitiga (Table 88). With different planting depths no significant differences in total yield per plant were present. Direct sowing showed per plant a yield of 13 gram where plants with a transplant depth up to cotyledons showed 15.6 gram.

Table 88. Effect of transplant depth ontotal yield per plant (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	16.3	9.6	13.0
Normal	18.6	9.7	14.1
Cotyledon	19.9	11.4	15.6
Average	18.2	10.2	
	LSD	p=	
Variety (V)	4.1	0.002	
Treatment (T)	5.1	0.5	
V * T	7.2	0.9	

Plants cultivated with direct sowing showed a marketable yield of 10.4 gram where transplants planted till cotyledons in the field showed 12.3 gram (Table 89) Differences in yield however, were not significant.

Table 89. Effect of transplant depth on marketable yield per plant (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	13.1	7.8	10.4
Normal	14.1	7.1	10.6
Cotyledon	15.7	8.9	12.3
Average	14.3	8.0	
	LSD	p=	
Variety (V)	3.6	0.003	
Treatment (T)	4.5	0.6	
V * T	6.3	0.9	

Total yield per square meter was with direct sowing on average 83.9 gram (Table 90). With plants planted till cotyledon depth total yield was 94.3 gram per square meter, but did not differ significantly from direct sowing or from normal transplant depth.

Table 90. Effect of transplant depth on total yield per square meter (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	75.9	91.8	83.9
Normal	76.8	82.6	79.7
Cotyledon	85.7	102.9	94.3
Average	79.5	92.5	
	LSD	p=	
Variety (V)	32.0	0.4	
Treatment (T)	39.1	0.7	
V * T	55.3	0.9	

The highest marketable yield per square meter was 74.9 g and was observed at plants planted till cotyledon depth (Table 91). Between treatments however, no significant differences were present.

Table 91. Effect of transplant depth on marketable yield per square meter (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	61.4	74.5	67.9
Normal	58.8	60.7	59.8
Cotyledon	68.4	81.2	74.8
Average	62.9	72.1	
	LSD	p=	
Variety (V)	27.8	0.5	
Treatment (T)	34.1	0.6	
V * T	48.2	0.9	

In percentage of marketable yield in the total production no significant differences were present (Table 92).

Table 92. Effect of transplant depth on share of marketable yield in total production (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	81.0	81.1	81.0
Normal	75.1	73.4	74.3
Cotyledon	78.5	75.9	77.2
Average	78.2	76.8	
	LSD	p=	
Variety (V)	6.3	0.6	
Treatment (T)	7.7	0.2	
V * T	10.9	0.9	

The highest fruit number per plant of 2.3 was present with plants planted till cotyledon depth (Table 93). Numbers at the other treatments did not differ significantly from this number.

Table 93. Effect of transplant depth on total fruit number per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	2.4	1.4	1.9
Normal	2.8	1.5	2.2
Cotyledon	3.0	1.7	2.3
Average	2.7	1.5	
	LSD	p=	
Variety (V)	0.5	<0.001	
Treatment (T)	0.6	0.4	
V * T	0.9	0.9	

Marketable fruit number per plant was not significant different between treatments (Table 94).

Table 94. Effect of transplant depth on number of marketable fruits per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	2.5	1.2	1.8
Normal	2.0	1.1	1.5
Cotyledon	2.8	1.1	2.0
Average	2.4	1.1	
	LSD	p=	
Variety (V)	0.7	0.003	
Treatment (T)	0.9	0.6	
V * T	1.3	0.7	

Average fruit number per square meter was 12.9 (Table 95) No significant differences were present between transplant depth treatments and direct sowing.

Table 95. Effect of transplant depth on total fruit number per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	11.5	13.5	12.5
Normal	11.7	13.0	12.4
Cotyledon	12.9	15.0	13.9
Average	12.0	13.8	
	LSD	p=	
Variety (V)	4.0	0.3	
Treatment (T)	4.9	0.7	
V * T	7.0	1.0	

In marketable fruit number per square meter, no significant differences between treatments were present (Table 96). Both direct sowing as transplanting till cotyledon showed 11.1 fruits while normal transplant depth showed 8.8 fruits.

Table 96. Effect of transplant depth on number of marketable fruits per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	11.6	10.5	11.1
Normal	8.3	9.3	8.8
Cotyledon	11.7	10.5	11.1
Average	10.5	10.1	
	LSD	p=	
Variety (V)	5.5	0.9	
Treatment (T)	4.5	0.6	
V * T	7.7	0.9	

No differences in individual fruit weight of the total production were present between transplant depth and direct sowing (Table 97). On average a fruit weight of 6.6 gram was present.

Table 97. Effect of transplant depth on individual fruit weight (g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	6.6	6.8	6.7
Normal	6.6	6.4	6.5
Cotyledon	6.7	6.7	6.7
Average	6.6	6.6	
	LSD	p=	
Variety (V)	0.5	0.9	
Treatment (T)	0.6	0.6	
V * T	0.8	0.7	

Individual fruit weight of the marketable production was on average 6.8 gram (Table 98). No significant differences were present between transplant treatments or with direct sowing.

Table 98. Effect of transplant depth on individual weight of marketable fruits(g).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	5.9	7.1	6.5
Normal	7.1	6.6	6.9
Cotyledon	6.1	7.5	6.8
Average	6.4	7.1	
	LSD	p=	
Variety (V)	1.2	0.2	
Treatment (T)	1.5	0.9	
V * T	2.1	0.3	

4 Discussion

4.1 Variety

In this experiment performance of Tit Segitiga was less than that of the other open pollinated varieties, Balitsa 3 and Balitsa 4. Tit Segitiga treatments had to be re-sowed due to a poor germination and emergence of the first used batch. This resulted in a later transplant date for Tit Segitiga as compared to the other varieties.
The second sowing of Tit Segitiga still showed lower percentages of emerged seedlings after 10 and 20 days. With Balitsa 3 and Balitsa 4 which are improved varieties, more attention is given to seed quality and vigour, when saving seeds, resulting in improved germination and emergence. Gada is a commercial hybrid variety where a high level of attention is given to seed quality. At transplanting the highest percentage of usable transplants was present at Gada.
Original planned was to sow all treatments, both direct sowing and transplants on the same date. With the later sowing of Tit Segitiga it was expected that harvest of these treatments would commence quite later than the harvest of the other varieties. Harvest of Tit Segitiga started only slightly later than the harvest of the other varieties. Harvest of all treatments was terminated at a same date due to high pressure of pests and disease.
Although not significantly different, it seemed that at direct sowing Tit Segitiga gave higher marketable yield levels than Balitsa 3 and Balitsa 4 (Table 20). With the use of transplants Tit Segitiga showed lower yields than Balitsa 3 and Balitsa 4. Transplants were raised from a different seed source then plants of direct sowing. Also growing period of direct sowing was slightly longer than the growing period of plants cultivated from transplants. Especially due to the last aspect yield levels of transplants might be lower compared to direct sowing. And this might also be the reason for lower yield levels with transplant use of Tit Segitiga compared to yield of Balitsa 3 and Balitsa 4 transplants.
The variety Gada showed a double yield per plant compared to the results of the open pollinated varieties, resulting in similar yield levels per square meter. Although the yield at Gada per square meter was approximately 25 gram lower then the yield at Balitsa 3 and 30 gram lower than the yield at Balitsa 4, the differences were not significant. Expected is that yield of hybrid varieties would be substantial higher. Therefore it is advisable to optimize the cultivation of Gada to increase the yield per square meter. A major constraint in this is the presence of pests and diseases. Due to this harvest was terminated already after 6 harvests where 12 to 13 harvests are possible. As a result yield of Gada may be lower than the potential yield of this variety under optimal growing conditions. Under optimal conditions yield of Gada may be much higher compared to the yield of open pollinated varieties.
Fruit weight of all varieties was quite similar and based on personal observations differences in colour and shape were minimal.

4.2 Raising system

With transplant raising, seeds were more efficiently used compared to direct sowing. Percentage of usable Gada seedlings with transplants was 71% while with direct sowing this percentage was 34% (Table 10). With Tit Segitiga the percentage usable seedlings was quite low when using plastic bags and even lower when using plastic trays. Not known is what caused this, but perhaps seed quality was poor.
With raising transplants in a nursery, less plants were infected with thrips compared to seedlings in the field with direct sowing. Due to this, a transplants has a better start and might result in better growth which on its turn result in a higher yield compared to direct sowing. However, plant weight and length of direct sowed seedling was at the time of transplanting higher compared to that of transplants (Table 31 till table 34). Transplant raising need to be improved still, in order to obtain better quality seedlings than is the case now.
With Gada and Tit Segitiga transplants raised in plastic trays, yield was on average better than yield of plants cultivated with direct sowing (Table 37 till Table 40). On average, yield of transplants raised in plastic bags was higher than yield with direct sowing (Table 17 and Table 18). This was mainly a result of the better performance of Balitsa 3 and Balitsa 4 transplants compared to direct sowing. Yield of Gada transplants was not much different from yield of direct sowing. WithTit Segitiga, for reasons already mentioned, yield of transplants was similar or lower than the yields of direct sowing.
Surprisingly is that with the use of transplants raised in plastic trays yield was higher compared to transplants raised in plastic bags (Table 37 and 38). During the nursery phase at the time of transplanting, the transplants raised in plastic bags showed a higher fresh and dry weigh and a higher number of leaves than the transplants

raised in plastic trays (Table 31 till Table 34). Reported by Bar-Tal et al. (1990) is that with increasing container cell size bigger transplants were obtained but no increased yield levels were observed. In a literature review by NeSmith and Duval (1998) stated was that pepper yield levels were not influenced by container size, while in contrast yield of tomato and bell pepper increased with increasing container cell size.

4.3 Regent drench

When applying Regent 40 ml as a drench to transplants of Gada and Tit Segitiga a higher total yield per plant was present compared to direct sowing (Table 57). Compared to transplants with no drench applied, the increase in yield was almost significant higher. Higher yields are probably due to a better protection during the start of the cultivation. Observations on pest levels per treatment did not take place and therefore a direct relation between presence of pests and final yield results could not be analysed.
Used rates in this experiment where quite high compared tot the rates recommended by BASF for soil treatment and seed treatment. When applying 40 ml three times as a drench to seedlings, in total about 1 gram active ingredient per square meter is applied whereas BASF recommends to apply 1 g active ingredient per 10 square meter (Anonymous, 2005).
During transplant raising to some extend phytotoxic effects expressed as a lower emergence were present (Table 48 till Table 54). Tit Segitiga showed a lower emergence after 20 days and a lower percentage of usable transplants with the 20 and 40 ml drench compared to 0 ml, but Gada did not show this effect. Fresh weight and dry weight of Regent treated plants at a rate of 40 ml were lower than those weights at 0 ml. Plant length of Gada was for all Regent treatments the same, while Tit Segitiga plant length decreased with increasing rates of Regent. In a previous experiment however, no phytotoxic effects were observed with rates up to 100 ml. On the contrary, with 20, 40 or 100 ml fresh and dry weight were even higher than the weight present at 0 ml. Also no differences in emergence or usable transplants were present at that experiment.

4.4 Transplant age

With the use of 5 day older transplants than normal age, higher yields were observed at both Gada and Tit Segitiga (Table 78). However, results were not significant different from the normal transplant age. It seems also that with even older transplants, 10 days older, yield decreased again. When using somewhat older transplants an earlier start of harvest was present in tomato cultivation (Vavrina 1998).The advantage of slightly older transplants compared to normal age is that a prolonged protection against pests and diseases is present. The optimum transplant age for hot pepper transplant is 6-8 weeks (Vavrina, 1998). In this experiment transplant age of 45 days or 6 ½ weeks was the most which is within the range of 6 to 8 weeks.
When using too old transplants, transplant shock is more and they become too generative, resulting in early blooming en fruiting where plants are not vegetative enough to produce a maximum yield.
When using younger transplants, nursery costs per transplant are reduced but younger transplants with a less rooted plug, might be more difficult to remove from the tray without disturbing the rootball.

4.5 Transplant depth

Differences in yield between planting depth up to the original root ball level in the tray and planting depth up to cotyledons were no significant in this experiment. However, yield levels of plants planted up to cotyledons were consistent higher compared to the yield of plants with a planting depth up to root ball level.
By Vavrina (1995) an effect on yield was showed with tomato and pepper, where pepper yield increased when planted up to cotyledon depth or up to the first true leave instead of planting just up to original root ball level. Also yield at the first harvest increased when plants were transplanted deeper. Vavrina puts down the hypotheses that with a deeper planting depth a more favourable root zone temperature is present for root development and therefore a higher yield is present compared to the yield with a more shallow planting depth where temperatures might be too high. Especially in hot climates this effect will be more pronoun then.
The reason why in this experiment results were not significant different might be caused by the limited number of replications. Only 3 replications were present while Vavrina at least included 6 replications in his experiments. Recommended is to test the effect of planting depth again but then with more replications.

5 Conclusions

5.1 Variety

With direct sowing all open pollinated varieties showed a similar performance. When using transplant the performance of Tit Segitiga was poorer compared to Balitsa 3 and Balitsa 4 in terms of yield per plant and per square meter. Gada performs the best in terms of yield per plant. However, due to the planting system of Gada where plant population was only 50% of the population of the open pollinated varieties, yield per square meter was slightly lower than expected. All varieties showed a same yield per square meter where expected was that the hybrid variety would show a higher yield.

5.2 Raising system

When comparing the effect of container use with the varieties Gada and Tit Segitiga, performance of plants raised plastic trays was less than the performance of plants raised plastic bags. Results of plastic bag are not conclusive since Gada and Tit Segitiga plants raised in plastic bag did not show a better yields compared to direct sowing. However, with Balitsa 3 and Balitsa 4 yield was higher with transplants raised in plastic bags compared to direct sowing.

5.3 Regent drench

When drenching transplants with Regent 40 ml this results in higher yields. Pests observations were not related to yield but with Regent it might be well possible that transplants are less attacked by pests and therefore show a better growth and a higher yield. In this experiment some slight phytotoxic effects were observed, but these did not result in poor transplant quality or loss of transplants. Advised is to use at least a rate of 40 ml for drenching. Based on results of a previous experiment it is safe to use Regent up to a rate of 100 ml. At 100 ml no noticeable phytotoxic effects were observed.

5.4 Transplanting

Age and depth seems to influence yield results. A 5 day older transplant than normally used and planting of the transplants up to the cotyledons seems to increase yield. However, differences with direct sowing and control were not significant. Nevertheless it is advisable to test this effect in a follow up experiment.

6 Literature

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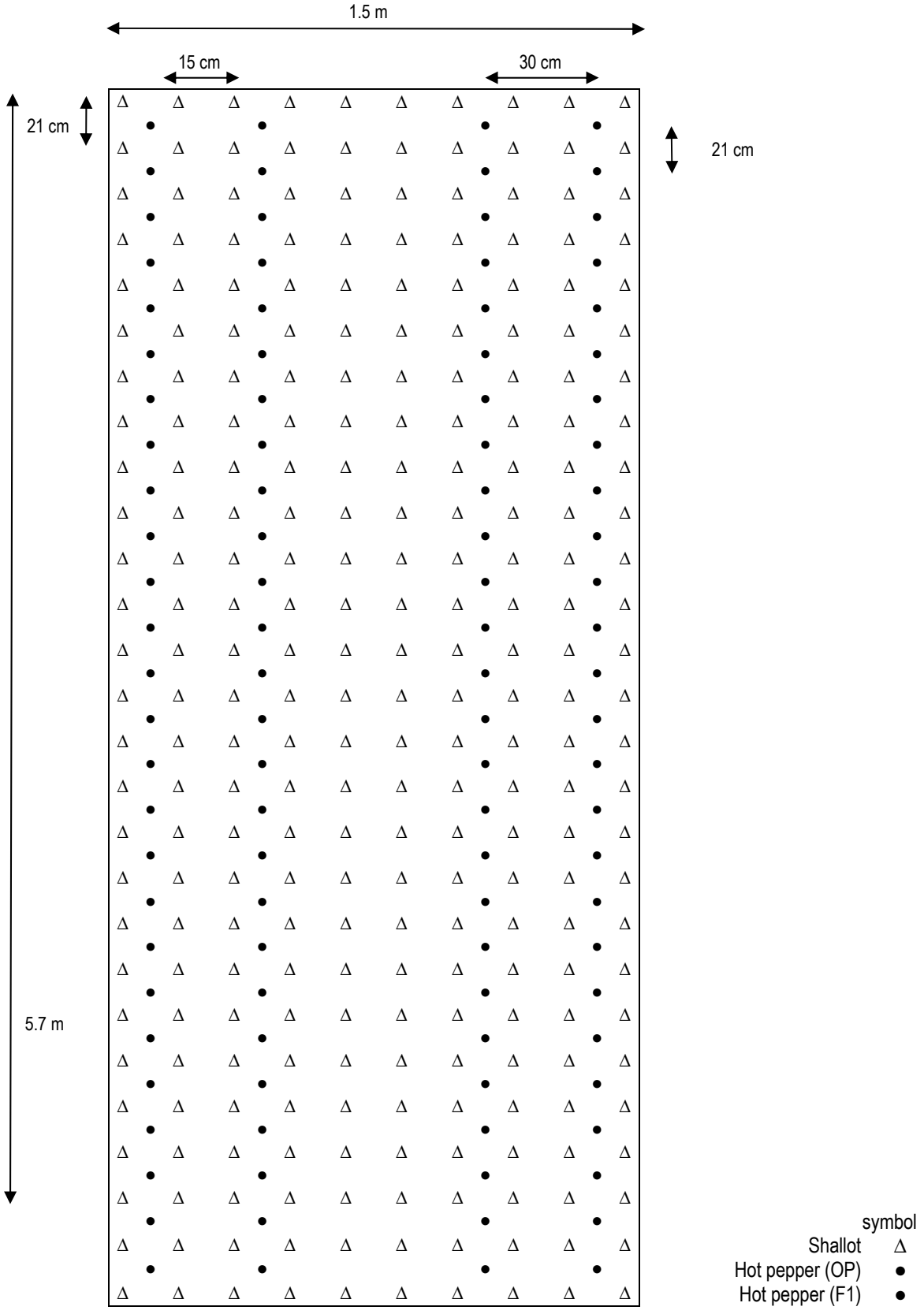
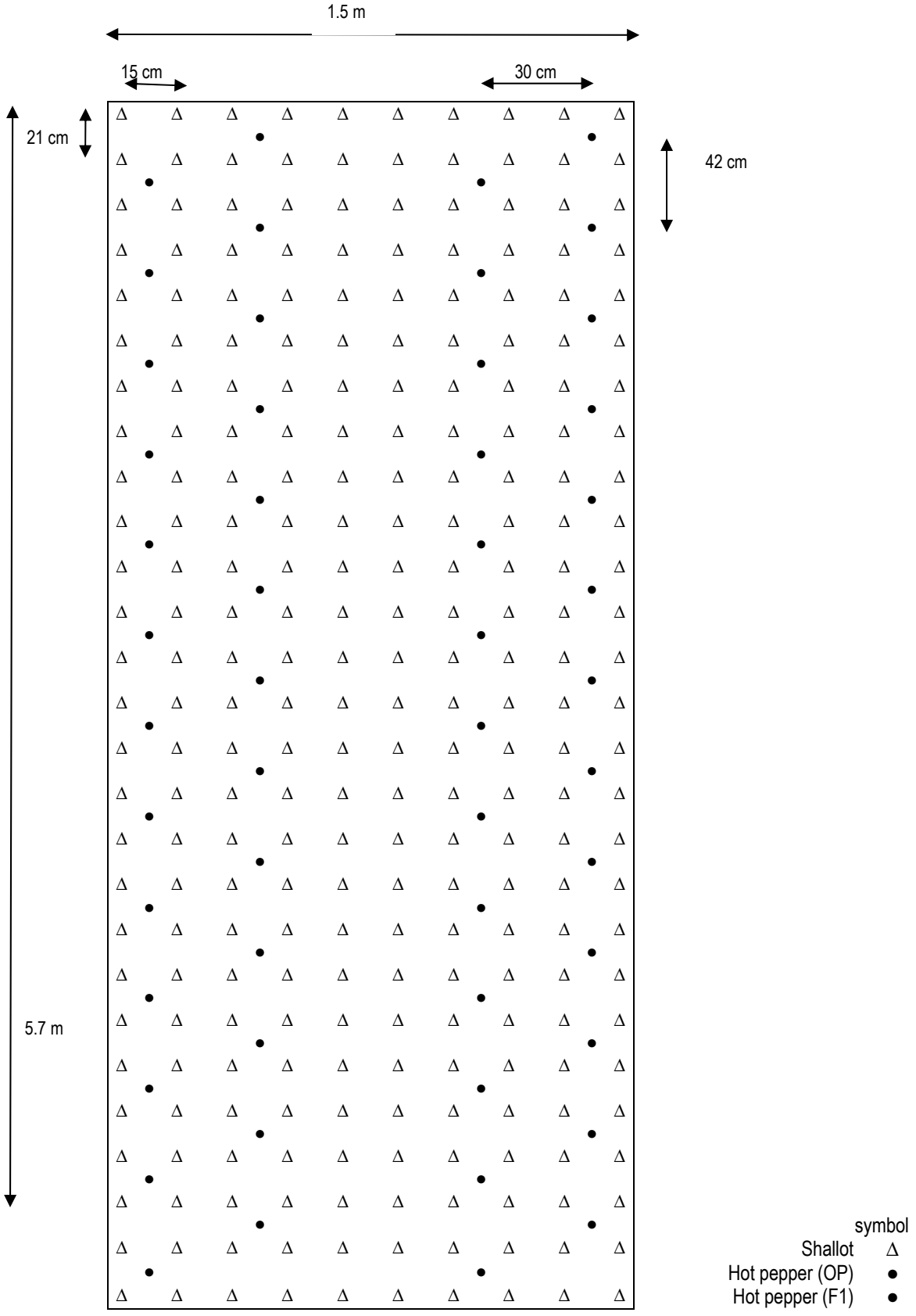
Annex I. Layout cropping pattern



Plant arrangement per plot for the open pollinated variety Tit Segitiga and improved open pollinated varieties Balitsa 3 and Balitsa 4 (100 plants = 11.7 pl/m2)



Plant arrangement per plot for hybrid variety Gada F1 (50 plants = 5.8 pl/m2) (recommended = 4.2)

Annex II. Layout of treatments in the nursery.

North ←

Replication 3: Nursery III

41	A10	42	A4	438 *L5*	A2	44	A12	45	A5	46 *L6*	A14	47	A6	48	A15
33	A9	34	A1	35	A16	36	A11	37	A3	38	A7	39	A8	40	A13

III

Replication 2: Nursery II

25	A5	26	A15	27 *L3*	A8	28	A13	29	A10	30 *L4*	A9	31	A4	32	A11
17	A6	18	A3	19	A2	20	A12	21	A16	22	A7	23	A14	24	A1

II

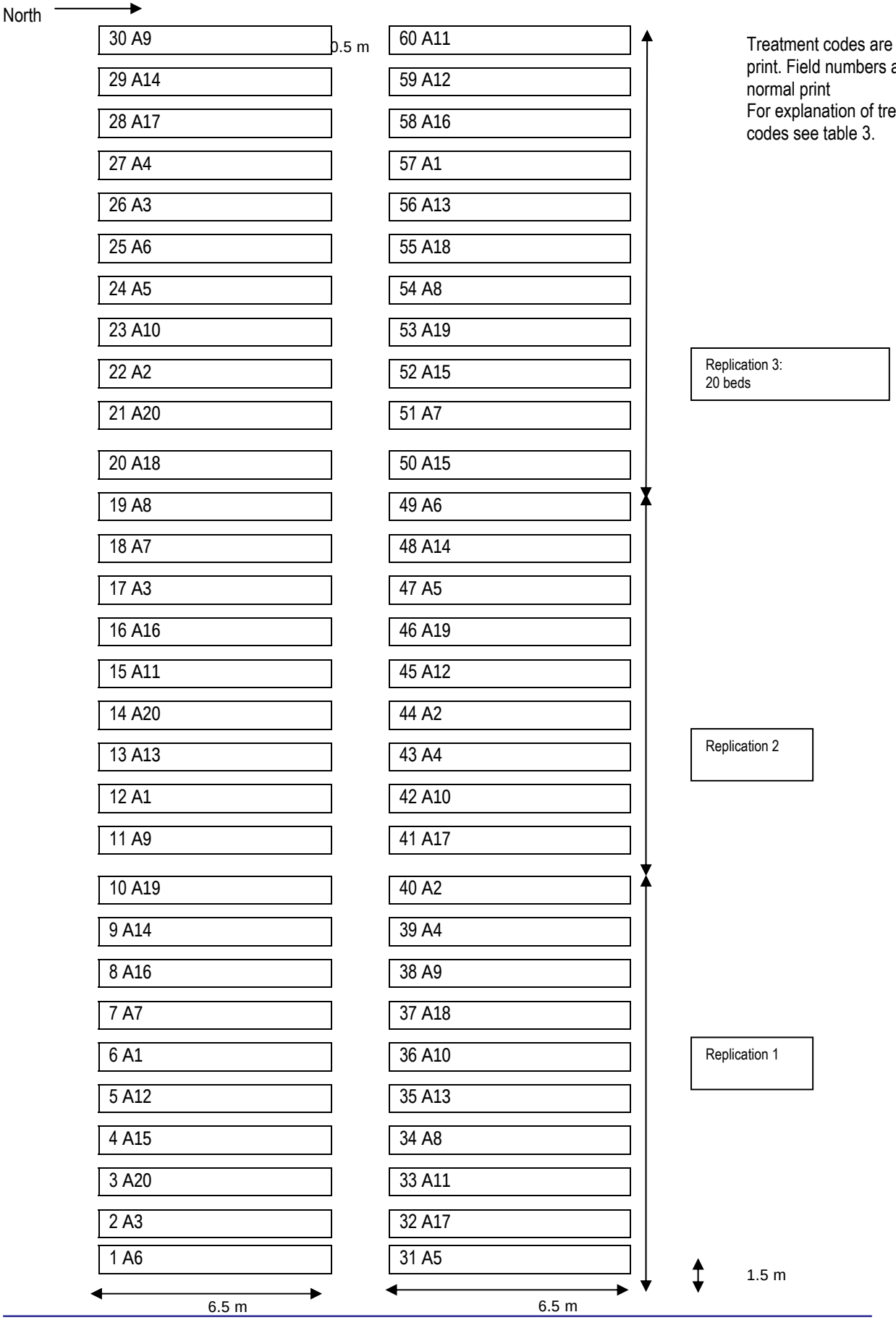
Replication 1: Nursery I

9	A14	10	A7	11 *L1*	A16	12	A8	13	A13	14 *L2*	A1	15	A12	16	A9
1	A11	2	A2	3	A10	4	A5	5	A6	6	A15	7	A4	8	A3

I

L1 till *L6* = light measurement position inside nursery
I, II, III = outdoor light measurement position

Annex III. Layout of treatments in the field.



Annex IV. Temperature and rainfall during the experiment.

	Nursery		Outside		
Date	Min T	Max T	Min T	Max T	Rainfall
16-7-2008	22	43	22	43	0
17-7-2008	22	44	22	44	0
18-7-2008	22	43	22	43	0
19-7-2008	22	43	22	42	0
20-7-2008	22	43	21	42	0
21-7-2008	22	43	21	43	0
22-7-2008	22	43	21	43	0
23-7-2008	22	44	22	44	0
24-7-2008	22	44	22	44	0
25-7-2008	21	42	22	41	0
26-7-2008	21	41	22	44	0
27-7-2008	22	43	21	43	0
28-7-2008	22	43	21	42	0
29-7-2008	21	43	22	41	0
30-7-2008	21	43	22	44	0
31-7-2008	21	42	21	43	0
1-8-2008	22	45	22	43	0
2-8-2008	22	44	22	44	0
3-8-2008	22	44	22	43	0
4-8-2008	22	45	22	42	0
5-8-2008	22	45	21	42	0
6-8-2008	21	42	21	43	0
7-8-2008	22	44	21	43	0
8-8-2008	22	44	22	44	0
9-8-2008	22	44	22	44	0
10-8-2008	21	43	22	41	14
11-8-2008	21	43	22	44	0
12-8-2008	21	42	21	43	0
13-8-2008	21	43	21	42	0
14-8-2008	22	44	21	43	0
15-8-2008	22	44	22	43	0
16-8-2008	22	43	22	42	0
17-8-2008	22	44	22	43	0
18-8-2008	22	45	22	44	0
19-8-2008	21	43	20	42	0
20-8-2008			22	43	0
21-8-2008			22	42	0
22-8-2008			21	42	0
23-8-2008			21	42	0
24-8-2008			21	42	0
25-8-2008			20	40	0
26-8-2008			21	40	0
27-8-2008			21	41	3
28-8-2008			20	41	6

	Nursery		Outside		
Date	Min T	Max T	Min T	Max T	Rainfall
29-8-2008			21	40	22
30-8-2008			22	41	2
31-8-2008			20	41	0
1-9-2008			20	42	6
2-9-2008			21	42	0
3-9-2008			21	42	0
4-9-2008			22	44	0
5-9-2008			22	45	0
6-9-2008			21	42	0
7-9-2008			22	44	0
8-9-2008			22	43	0
9-9-2008			21	42	0
10-9-2008			21	42	0
11-9-2008			22	42	0
12-9-2008			22	44	0
13-9-2008			22	44	0
14-9-2008			20	43	0
15-9-2008			21	42	0
16-9-2008			21	42	0
17-9-2008			22	40	0
18-9-2008			20	42	3
19-9-2008			21	41	1
20-9-2008			20	41	0
21-9-2008			22	42	0
22-9-2008			22	43	0
23-9-2008			20	44	0
24-9-2008			20	44	2
25-9-2008			21	43	0
26-9-2008			22	43	6
27-9-2008			22	42	0
28-9-2008			22	43	0
29-9-2008			22	44	0
30-9-2008			20	42	2
1-10-2008			22	42	0
2-10-2008			22	41	0
3-10-2008			21	41	0
4-10-2008			21	41	0
5-10-2008			21	40	0
6-10-2008			20	39	4
7-10-2008			20	39	13
8-10-2008			20	40	26
9-10-2008			20	40	29
10-10-2008			21	40	0
11-10-2008			22	40	0
12-10-2008			20	40	0
13-10-2008			20	39	0
14-10-2008			20	39	0
15-10-2008			20	39	22

	Nursery		Outside		
Date	Min T	Max T	Min T	Max T	Rainfall
16-10-2008			21	42	0
17-10-2008			21	40	0
18-10-2008			21	40	0
19-10-2008			22	42	0
20-10-2008			21	41	0
21-10-2008			20	40	0
22-10-2008			22	40	4
23-10-2008			20	41	0
24-10-2008			20	39	0
25-10-2008			20	39	0
26-10-2008			22	40	0
27-10-2008			22	42	16
28-10-2008			22	43	0
29-10-2008			21	44	0
30-10-2008			21	43	12
31-10-2008			20	40	0
1-11-2008			20	39	5
2-11-2008			20	39	27
3-11-2008			21	40	23
4-11-2008			20	41	3
5-11-2008			20	39	4
6-11-2008			21	39	0
7-11-2008			21	39	0
8-11-2008			20	39	6
9-11-2008			21	40	21
10-11-2008			21	42	9
11-11-2008			21	43	0
12-11-2008			21	41	0
13-11-2008			20	39	0
14-11-2008			20	39	0
15-11-2008			20	39	42
16-11-2008			21	40	0
17-11-2008			21	41	3
18-11-2008			20	39	9
19-11-2008			21	39	0
20-11-2008			20	42	7
21-11-2008			20	40	0
22-11-2008			18	34	156
23-11-2008			20	39	0
24-11-2008			21	40	0
25-11-2008			21	40	0
26-11-2008			21	39	0
27-11-2008			20	40	32
28-11-2008			20	40	0
29-11-2008			20	39	0
30-11-2008			20	38	0

	Nursery		Outside		
Date	Min T	Max T	Min T	Max T	Rainfall
1-12-2008			20	29	3
2-12-2008			20	39	0
3-12-2008			20	38	47
4-12-2008			20	38	0
5-12-2008			21	38	6
6-12-2008			19	39	0
7-12-2008			19	38	0
8-12-2008			19	38	0
9-12-2008			18	37	5
10-12-2008			19	37	0
11-12-2008			19	37	0
12-12-2008			18	36	0
13-12-2008			19	37	53
14-12-2008			19	37	0
15-12-2008			19	37	8
16-12-2008			19	36	19
17-12-2008			19	37	0
18-12-2008			18	36	14
19-12-2008			18	36	0
20-12-2008			18	37	0
21-12-2008			18	34	64
22-12-2008			19	36	0
23-12-2008			18	34	46
24-12-2008			18	33	38
25-12-2008			19	34	0
26-12-2008			19	35	0
27-12-2008			19	32	92
28-12-2008			19	33	37
29-12-2008			20	34	42
30-12-2008			19	33	13
31-12-2008			19	35	10