HORTIN II Co Innovation Programme

Towards cost effective, high quality value chains

Effect of variety, container, nitrogen and Regent drench on transplant raising and yield of hot pepper

HORTIN-II Research Report nr. 9

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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.

On the Indonesian side the programme is carried out by the Indonesian Centre for Horticultural Research and Development (ICHORD), Jakarta, with the Indonesian Vegetable Research Institute (IVEGRI), Lembang, and the Indonesian Centre for Agricultural Postharvest Research and Development (ICAPRD) in Bogor.

In the Netherlands the Agricultural Economics Research Institute (AEI), Den Haag, the Agrotechnology and Food Sciences Group (ASFG), Wageningen, Applied Plant Research (APR), Lelystad, and WUR-Greenhouse Horticulture (WUR-GH), Bleiswijk, all partners in Wageningen University and Research centre, are involved in the programme.

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Executive summary

From June 3 till December 24, 2008, an experiment was carried out at Brebes (Central Java) to test the effect of transplant use on emergence and yield compared to the existing practice system of direct sowing. In the experiment also tested was emergence capacity and yield of the hybrid variety Gada, the local open pollinated variety Tit Segitiga, and of the improved open pollinate varieties Balitsa 1 and 2.
Transplants were raised in a simple nursery construction and after a raising period of 5 weeks they were transplanted into the field. Transplants were raised in either plastic bags or modular trays of 128 cells. Media was a mixture of local available top soil and manure. One treatment received supplemental nitrogen at a rate of 100 mg per liter media. Tested was if this would result in more viable transplants giving higher yields and or resulting in earlier harvest periods.
In order to reduce pest pressure, tested was if drenching of seedling with 20, 40 or 100 ml per liter water Regent SC (fipronil 50 g/l) was effective in controlling pests and would result in increased yields.
Results showed that yield levels of Gada at a plant density of 5.8 plants per square meter was equal to the yield levels present at Tit Segitiga at a density of 11.6 plant per square meter. Per hectare on average a yield of 1.5 to 2 ton was present, which is low. The reason for low yield levels were water shortage and the presence of pests and diseases, especially anthracnose and heliocoverpa.
Cultivation with transplants and direct sowing showed similar yield levels.
On average more usable transplants were present with raising in plastic bags compared to raising in plastic trays. This might be caused by a higher buffer capacity present in the plastic bag for moisture retention. Plastic tryas seems more sensible to dehydration and therefore it is essential to pay attention to watering. Finally, drenching with Regent SC or amendment of supplemental nitrogen to the media did not result in higher percentages of usable transplants or in increased yield levels.

1 Introduction

HORTIN-II was initiated in 2007 to improve the supply chains of the selected crops hot pepper, shallot and sweet pepper. In the hot pepper supply chain a main constraint is the lack of regular supply of high quality product. Farmers indicated that one reason for this was the lack of good starting material. For improvement of starting material experiments have been started to test the introduction of transplant raising and introduction of hybrid varieties. A site at Kersana Brebes, located in Central Java, was selected for performing these experiments.
Brebes is an important area for hot pepper cultivation and estimated is that about 40% of the hot pepper production of 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 in April after the rice is harvested.
Currently, hot pepper is direct seeded where, per plant hole, 5 seeds are sowed to end up at least with one plant per plant hole. Seed use therefore is quite excessive since 80% of the seeds is lost in this way. Farmers' practice includes also the use of local open pollinated varieties with, at the moment the main variety Tit Segitiga. Source of seeds is in most cases seeds saved from the previous crop. Due to the high requirement of seeds, farmers' rarely use hybrid varieties since seed costs will be too high. With this research, investigated is if with transplant production seed use can be reduced and therefore the use of higher yielding hybrids can be introduced. Hence a hybrid variety is included in the experiment to test its potential on emergence and yield. Next to this it is expected that with the use of transplant the quality of plants will be improved and will show a higher productivity.
For transplant raising a number of factors influence results. Raising conditions should be optimal in order to obtain a maximum of high quality usable transplants. Nursery construction, type of container in which the seedlings are raised as well the media for filling the containers are factors with a great impact on raising results and need to be tested. Since margins of hot pepper cultivation are low, additional costs for raising transplants should be in line with prospected profits. As a result the nursery construction should be made of cheap materials and also the components for the media should be inexpensive and locally available. For preparing media in which transplant are raised, rice husk, manure and top soil were chosen as components. These components are readily available at the test site at reasonable prices. In previous experiments established was that the use of media consisting of 1 volume part top soil and 1 volume part of manure resulted in the highest usable transplants.
In 2007 and early 2008 observed was that the presence of pests, mainly thrips and *helicoverpa,* have a great impact on yield. Commonly those pests are controlled by frequent field sprayings up tot three times a week with cocktails containing two to three insecticides. However, the effect of these sprayings seems to be limited due to poor spraying techniques and resistance of insects against the used insecticides. To protect the seedlings against these pests, drenching with a novel systemic insecticide may give an effective pest control. With drenching transplants with a systemic pesticide, the active ingredient is present at the right place and time. The neo nicotinoid Actara 25 WG (thiamethoxam 25%) is a systemic insecticide which can control thrips, white fly and aphids and was already tested in previous experiments. However, results from those experiments showed that Actara in the tested rates did not have any effect on thrips, white fly and virus incidence. Therefore it was decided to test the insecticide Regent SC (fipronil 50 g/l) as a drench in rates of 20, 40 and 100 ml per litre water. Fipronil shows systemic activity and is particular effective by ingestation and has already shown effective control of pests by seed treatment application.
Besides controlling pests, the quality of seedlings is also important. A better quality lead to better transplant results where plant establishment is good, to a better crop growth and in higher yields. Improvement of quality can be obtained by adding supplemental nitrogen to the potting soil or to the irrigation water. However, it is important not to apply excessive rates of nitrogen, since this will result in excessive vegetative growth, resulting in delayed fruit set and loss of yield.

With this test the aim was to:

- Test the effect of nitrogen supplement to the potting soil
- Test the effect of nitrogen supplement to the irrigation water of seedlings
- 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

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, diretor 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 are due to Uka and Arifin. They played an important role in carrying out the field work 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. Soil type can be characterized as a fluvisol with 70% clay.

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

In 2007 on August 10th, three soil samples were taken from the experimental site. Sampling was done by taking 5 sub samples along the diagonal of three different blocks. Samples were taken from the field of the top layer of 0 – 30 cm depth. Soil pH-H_2O is slightly acid to neutral (Table 1). An excessive amount of phosphate is present in the soil, while potassium level is medium. Calcium and magnesium content are both medium to high.

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

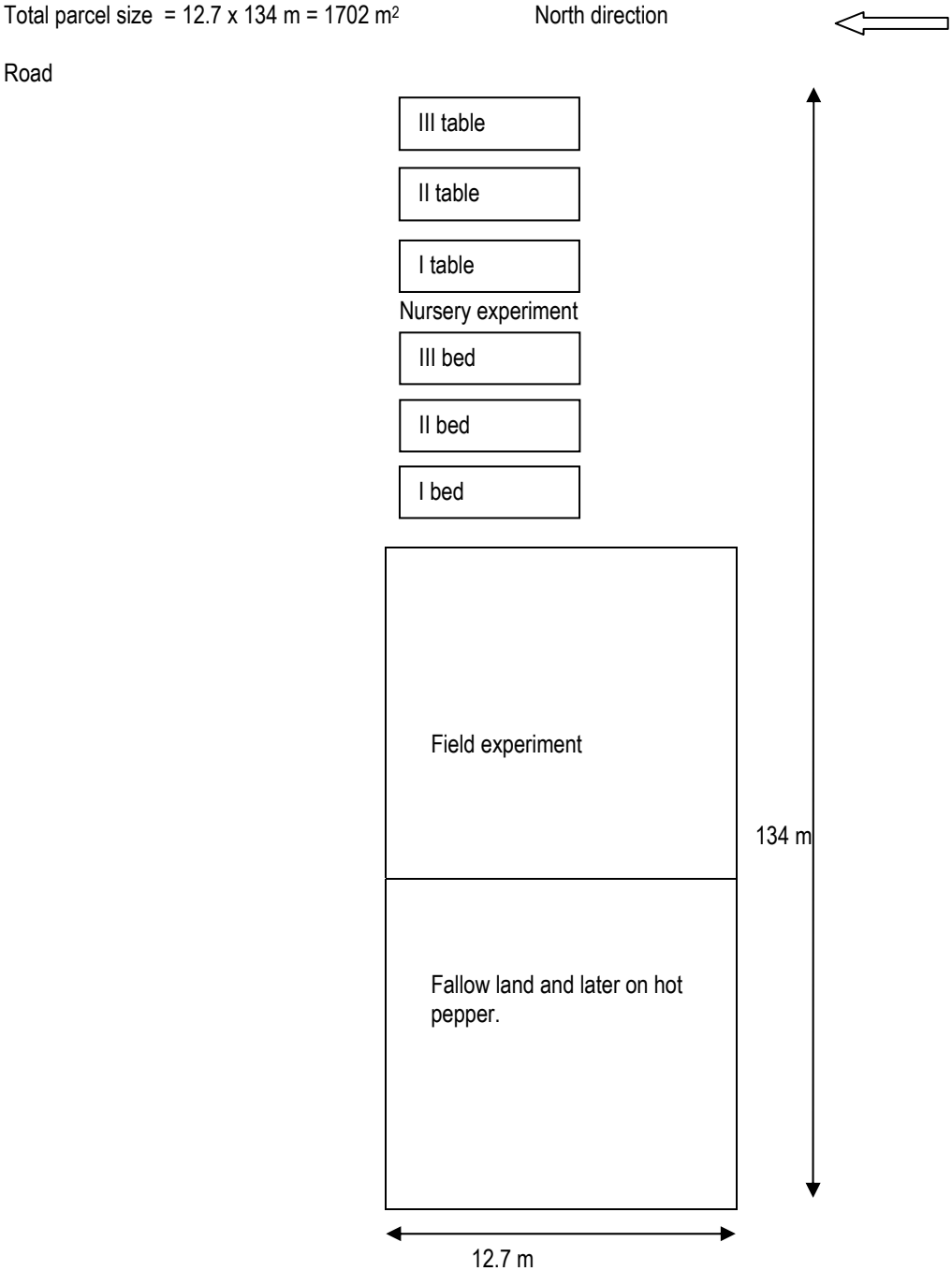


Figure 2. *Layout of the experimental site.*

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 factors 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 1
	A4:	Balitsa nr 2
Tray:	B1:	Transparent plastic bag
	B2:	Modular tray with 128 cells
N-media	Nm0:	no nitrogen supplement
	Nm1:	100 mg/l soil nitrogen supplement
N-water	Nw0:	no nitrogen added to irrigation water
	Nw1:	2 g/l NPK added to irrigation water and applied with morning irrigation every 2 days
Regent	R0:	no Regent drench
	R1:	20 ml Regent drench (after 15 days and at transplanting)
	R2:	40 ml Regent drench (after 15 days and at transplanting)
	R3:	100 ml Regent drench (after 15 days and at transplanting)
Nursery	S1:	Table nursery
	S2:	Direct sowing – 5 seeds per hole

Table 3. Treatment combinations in the experiment.

Code	Variety	Sowing systems			
		Container	Regent	Add N to media	Add N to watering
A1	Tit Segitiga	Transparent plastic bag	No	Yes	Yes
A2	Tit Segitiga	Plastic tray 128 modules	No	Yes	Yes
A3	Tit Segitiga	Transparent plastic bag	No	No	No
A4	Tit Segitiga	Transparent plastic bag	No	No	Yes
A5	Gada	Transparent plastic bag	No	Yes	Yes
A6	Gada	Plastic tray 128 modules	No	Yes	Yes
A7	Gada	Transparent plastic bag	Yes 20 ml	Yes	Yes
A8	Gada	Transparent plastic bag	Yes 40 ml	Yes	Yes
A9	Gada	Transparent plastic bag	Yes 100 ml	Yes	Yes
A10	Gada	Transparent plastic bag	No	No	No
A11	Gada	Transparent plastic bag	No	No	Yes
A12	Balitsa 1	Transparent plastic bag	No	Yes	Yes
A13	Balitsa 2	Transparent plastic bag	No	Yes	Yes
A14	Tit Segitiga	Direct sowing	No	No	No
A15	Gada	Direct sowing	No	No	No
A16	Balitsa 1	Direct sowing	No	No	No
A17	Balitsa 2	Direct sowing	No	No	No

2.1 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.

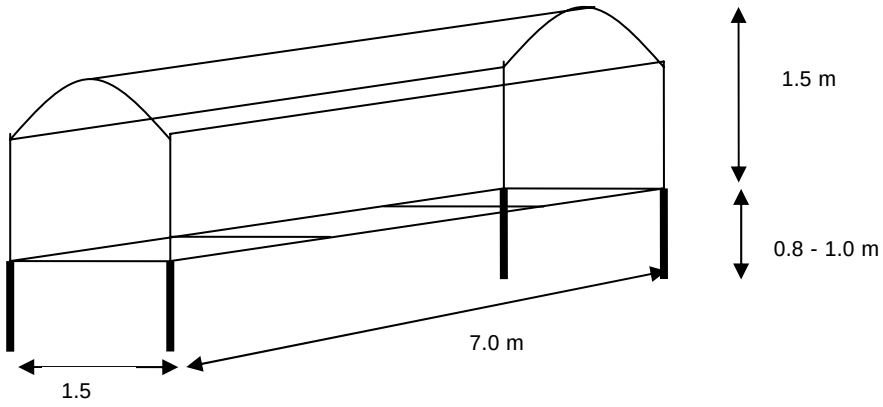


Figure 3. Schematic view of a table nursery.

Figure 4. Inside of the table nursery.

2.2 Hot pepper varieties in the experiment

Three types of varieties were used in the experiments:

- Local open pollinated variety (Tit Segitiga) (OP)
- Hybrid variety (Gada F_1) (F1)
- Improved open pollinated variety (Balitsa 1 and Balitsa 2) (IOP)

Seeds from Tit Segitiga were obtained locally from farmers and seeds from Gada F_1 were received from PT EWINDO located at Purwakarta. Seeds of the varieties Balitsa 1 and Balitsa 2 were obtained from IVEGRI.

2.3 Cultivation

2.3.1 Intercropping

Hot pepper was intercropped with shallot (Figure 4). 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 for irrigation and drainage. Half a suat with a size of 1.5 x 5.7 m was used for one plot. Shallots were planted and hot pepper seeds with direct sowing and for transplant raising were sown at a same date. Hot pepper seedlings were transplanted 3 to 4 weeks after shallot was planted. Population density of the OP and IOP hot pepper varieties was two times higher than the density present with the hybrid variety (Table 5).

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+IOP)	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.

2.3.2 Cultivation practice

Sowing of hot pepper in the field and in the nurseries took place on June 3, 2008 (Table 5). Emergence of Tit Segitiga proved to be very poor and this variety was re sown on June 13. Per nursery treatment 200 seeds were sown while with direct sowing 250 seeds at Gada to 500 seeds for the open pollinated varieties Tit Segitiga and Balitsa 1 and 2 were used to accommodate 5 seeds per planting hole.
Shallot was planted in the field on June 2. Transplanting of seedlings raised in the nursery into the field took place on July 4 for Gada and Balitsa 1 and 2 while Tit Segitiga was transplanted on July 14, 2008.

Table 5. General information on the cultivation.

Hot pepper sowing	:	June 3rd , 2008 for Gada, Balitsa 1 and 2; 13 June, 2008 for Tit Segitiga.
Hot pepper transplanting	:	July 4th , 2008 for Gada, Balitsa 1 and 2; 14 July, 2008 for Tit Segitiga.
Shallot planting	:	June 2nd , 2008.
Shallot harvest	:	July, 2008
Start hot pepper harvest	:	September 5th, 2008
End hot pepper harvest	:	December 24th, 2008
Used seeds in nursery	:	200 per plot
Direct sowing (5 seeds per sowing position)	:	500 per plot for Balitsa 1 and 2 and Tit Segitiga 250 per plot for Gada
Plant density	:	Balitsa 1 and 2 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 practice in Kersana Brebes.

2.4 Type of containers

Two types of containers were tested, namely a modular tray with 128 modules and a plastic bag (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.

2.5 Seedling raising treatments

2.5.1 Potting soil

Components for media were manure, purchased from a nearby farm and top soil, collected from the 5 cm top layer 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.

2.5.2 Regent drench

The effect of Regent SC drench was tested with the variety Gada raised in plastic bags (Table 6). Transplants were drenched with 200 ml per plant containing 20, 40 or 100 ml formulated product per litre. Drenching took place at 20 days after sowing when seedlings showed the first true leave, 2 days just before transplanting and 3 days after transplanting. The drenching took place with a knapsack sprayer.

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

	Application schedule	Method	Dosage
1	20 days after sowing	drenching	20, 40 or 100 ml/l water --- 200 ml solution/plant
2	2 days before transplanting	drenching	20, 40 or 100 ml/l water --- 200 ml solution/plant
3	3 days after transplanting	drenching	20, 40 or 100 ml/l water --- 200 ml solution/plant

2.5.3 Nitrogen applications

Nitrogen was applied to the media by mixing NPK through the already prepared media. In this way 100 mg nitrogen per litre media was applied.
Also nitrogen was applied with irrigation. For this every two days at the morning watering 2 gram of NPK was added per litre water. Seedlings were watered with this solution from sowing until transplanting.

2.6 Observations

2.6.1 Climate

During the experiment temperature was recorded by taking readings at 14.00 p.m. each day on maximum and minimum temperature. In one of the nurseries a thermometer was placed and one was placed outside in the field. Thermometers were placed in a shaded position to avoid direct exposure to sun light. 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.

2.6.2 Nutrient content

A sample of the media used for filling the trays and plastic bags was taken in August 2007,to analyse on content of total nitrogen, potassium, phosphate, calcium and pH level.

2.6.3 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 June 3, 2008 and July 3, 2008, respectively at sowing and 1 day before transplanting. Inside each nursery at two spots light intensity was measured and outside each nursery light intensity was measured at one spot. Percentage available light inside the nurseries, was calculated based on these readings.

2.6.4 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.

2.6.5 Harvest observations

Fruits were harvested when mature, and harvesting took place depending on the speed of fruit maturing. The first harvest date was on September 5th and the last harvest took place on December 24th.
At each harvest data, per plot number and total weight 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 the total yield and the average fruit weight was calculated.

2.7 Statistical information

The experiment was carried out as a factorial 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 the maximum temperature inside the nursery varied around 40°C and was not much different from the maximum outside temperature (Fig. 7). The inside minimum temperature also did not differ from the outside minimum temperature. Minimum temperature varied around 22°C. Difference between minimum and maximum temperature was about 20 degrees.

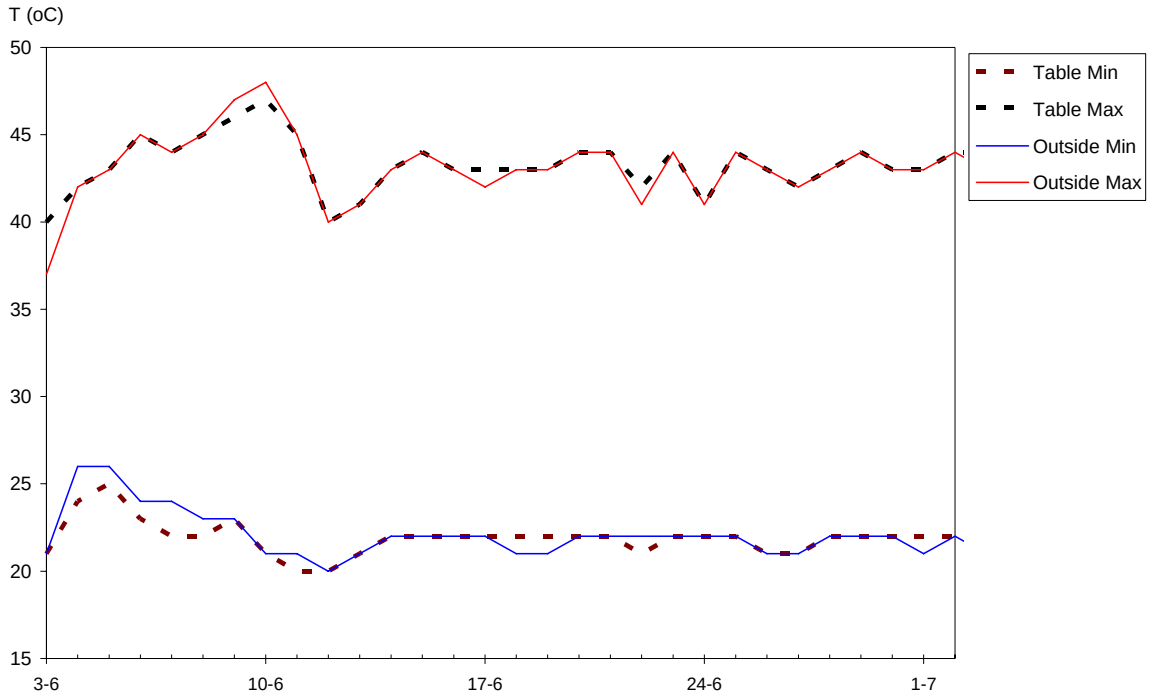


Figure 7. Maximum and minimum temperature in °C outside and inside the nursery during transplant raising.

From sowing early June till early October the maximum temperature was about 40 to 45°C, while minimum temperature ranged from 20 till 22°C (Fig. 8). In October the rainy season started and maximum temperature dropped gradually from 40-45 degrees to 35 degrees in December. Rainfall was low during the first two months of cultivation leading to sometimes water shortage for irrigation. From November onwards rainfall intensity increased resulting in a sharp rise of cumulative rainfall volume. In November a total of almost 400 mm was recorded and in December almost 500 mm was recorded.

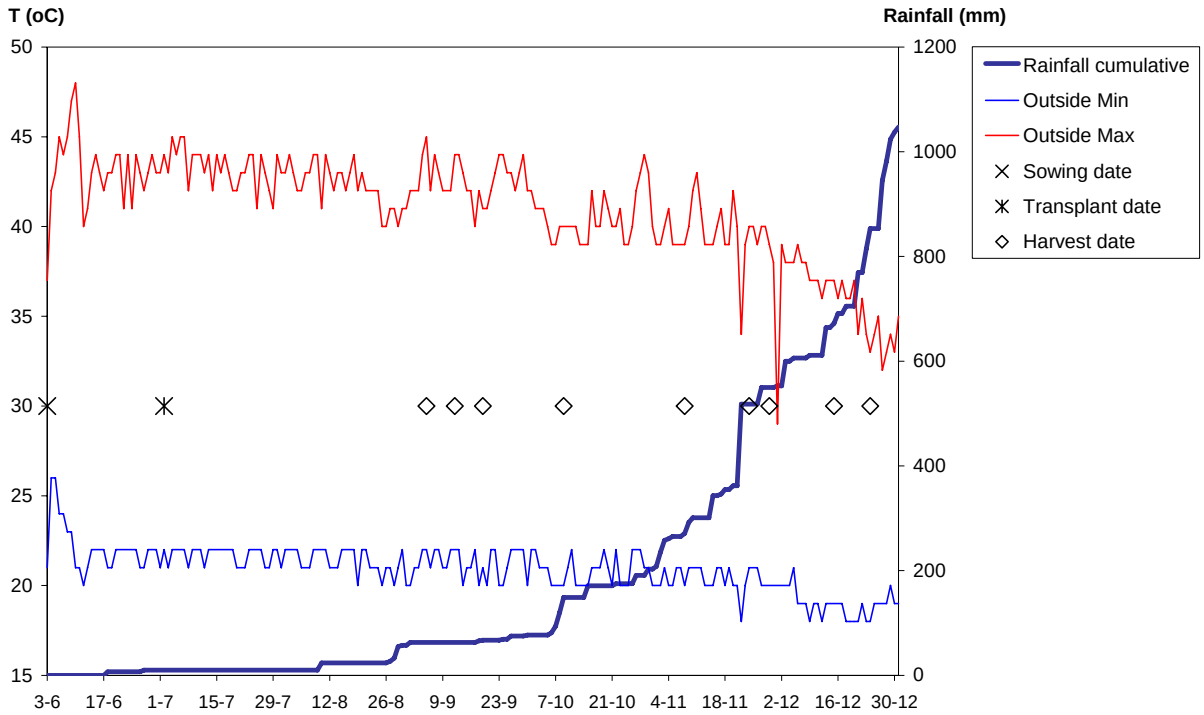


Figure 8. *Cumulative rainfall in mm and maximum and minimum temperature in ^{o}C during hot pepper cultivation from June 3rd till December 31st.*

3.2 Light levels

Light level within the nurseries was on average 70 % of the outside light intensity on June 3. On July 3 the average light level was 67% of the outside light intensity. The reduction in light level may be caused due to the deterioration of the insect net and staining of the net with dust.

3.3 Nutrient content of media

The used media in this experiment was the combination of top soil with manure (TS+M) (Table7). The pH of this media is alkaline with a pH-H_2O of 7.2. A pH of 5.6 to 6.0 is advised for potting soil used for vegetable seedling production. Total nitrogen content is about 0.5 % or 500 mg per 100 gram media. Nitrate content was not measured, but 30 to 75 mg per litre substrate is recommended. With high nitrogen content present in the media there is a risk on excessive vigorous growth of the seedlings, and might result in weak seedlings vulnerable to diseases and damping off.

Table7. 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 Regent SC drench

3.4.1 Nursery results

No significant differences were present between Regent treatments in emergence and usable seedlings (Table 8). After 10 days on average 70.8% of the seeds was emerged and after 20 days this increased to 77.5%. At transplanting on average 85.7% usable seedlings were present.

No significant differences in fresh weight were present between treatments. Dry weight of Regent treated seedlings was significant higher than the dry weight of untreated. Also plant length of Regent treated seedlings was higher but not significant different from untreated.

Table 8. Emerged seedlings after 10 and 20 days, usable transplants, and seedling characteristics at transplanting at direct sowing and at different rates of Regent drench

Rate (ml/l)	Emergence after 10 days (%)	Emergence after 20 days (%)	Usable transplants (%)	Fresh weight (g)	Dry weight (g)	Plant length (cm)	Leaf number
0	71.0	73.7	83.8	13.4	0.15	13.1	8.2
20	70.0	82.7	87.2	17.5	0.23	16.0	8.7
40	69.5	77.3	86.7	18.6	0.24	15.8	8.9
100	72.7	76.2	85.0	18.1	0.23	15.8	8.8
Average	70.8	77.5	85.7	16.9	0.21	15.2	8.7
LSD 0.05	14.5	14.6	7.2	5.6	0.05	2.7	1.0
p =	0.95	0.53	0.67	0.20	0.02	0.10	0.39

Three percent of the untreated seedlings showed virus symptoms (Table 9). With increasing rates of Regent percentage of seedlings with virus symptoms decreased. However, differences between treatments were not significant.
Seedlings raised in the nursery did not show thrips symptoms, while 22% of the seedlings in the field with direct sowing showed thrips symptoms.
Leafminer symptoms caused by *Liriomyza* spp. were present at untreated while at Regent treated seedlings no symptoms were found. Also at this observation differences were not significant.

Table 9. Percentage of seedlings at transplanting with virus incidence, thrips incidence and *Liriomyza* spp. incidence at direct sowing and at different rates of Regent drench.

Rate (ml/l)	Seedlings with virus incidence (%)	Seedlings with thrips symptoms (%)	Seedlings with leafminer symptoms (%)
direct sowing	-	21.9	-
0	3.0	0	0.17
20	1.3	0	0.0
40	1.0	0	0.0
100	0.8	0	0.0
Average	1.5	4.4	0.04
LSD 0.05	3.3	6.1	0.3
p =	0.4	<0.001	0.5

3.4.2 Yield results

Total yield per plant was on average at Gada 27.6 gram (Table 10). Per square meter the yield of direct sowing was 159 gram, meaning 1.6 t/ha was harvested of which 0.6 tonnes was marketable. No significant differences between treatments were present. Also at marketable yield per plant , and total yield and marketable yield per square meter no significant differences were present. Share of marketable yield in the total production with 100 ml Regent was significant lower compared to the other treatments. Also 40 ml showed a lower share of marketable yield compared to direct sowing. Percentage of marketable production in the total production with direct sowing was 39.0 %.

Table 10. Total yield and marketable yield per plant and per square meter and percentage of marketable fruits of total production

Rate (ml/l)	Total yield (g/plant)	Marketable yield (g/plant)	Total yield (g/m^2)	Marketable yield (g/m^2)	% Marketable yield
direct sowing	27.4	10.0	158.9	57.2	39.0
0	22.9	7.0	132.7	40.8	35.8
20	32.3	6.4	187.5	37.1	35.4
40	28.7	7.0	166.3	40.5	30.9
100	27.0	4.8	156.4	28.0	21.0
average	27.6	7.0	160.4	40.7	32.5
LSD 0.05	10.0	5.3	58.1	30.8	6.7
p =	0.4	0.4	0.4	0.4	0.002

Transplants raised with o ml or 40 ml Regent showed a faster increase in cumulative marketable yield at the first two months of harvest compared to direct sowing (Fig. 9). However, at the end of November yield of these two treatments was similar to that of direct sowing. From November onwards direct sowing showed a sharper increase in yield levels as did the regent treatments. Regent drench with 20 and 100 ml showed a similar trend in production but at a lower level as the 0 ml Regent and 40 ml drench.

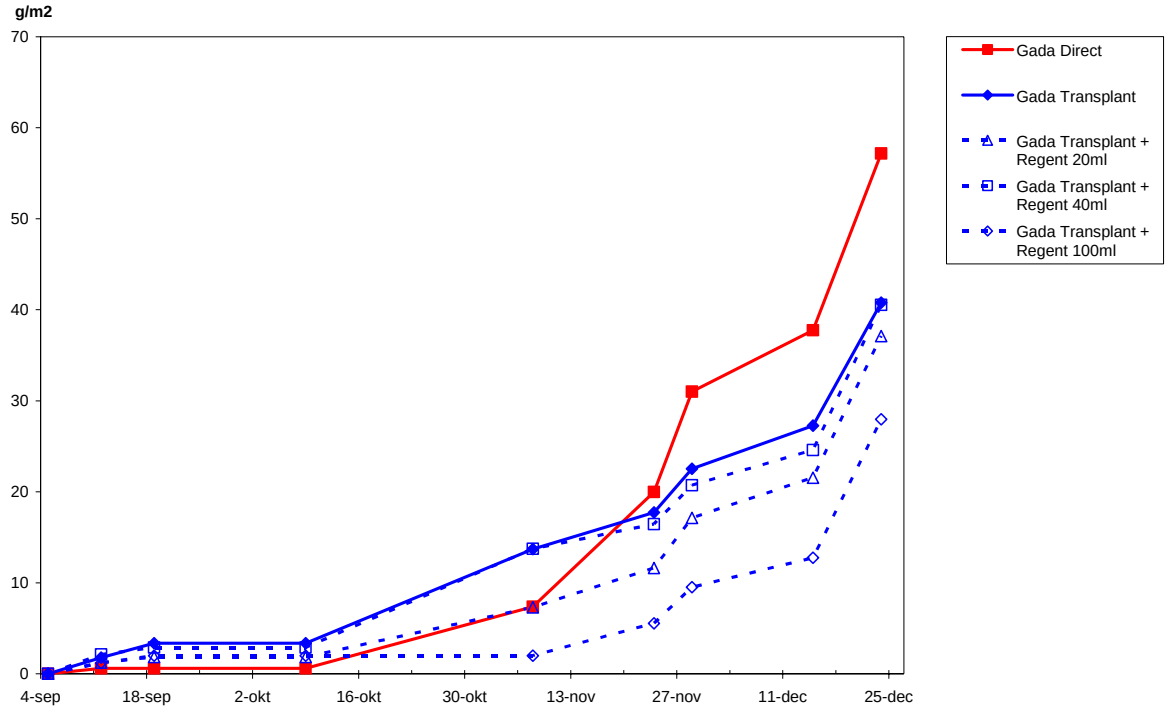


Figure 9. Cumulative marketable yield per square meter of different Regent drenching treatments at Gada.

No significant differences were present between treatments in number of harvested fruits per plant or per square meter (Table 11). With direct sowing in total 5.2 fruits were harvested of which 1.5 were marketable.

Table 11. Total fruit number and marketable fruit number per plant and per square meter and average fruit weight of total production and marketable production.

Rate (ml/l)	Total number (nr/plant)	Marketable number (nr/plant)	Total number (nr/m^2)	Marketable number (nr/m^2)	Fruit weight (g)	Marketable fruit weight (g)
direct sowing	5.2	1.5	30.0	8.8	6.5	6.7
0	5.0	1.1	28.7	6.2	6.0	6.2
20	7.1	1.0	41.1	5.9	6.1	6.1
40	5.7	1.0	33.3	6.1	6.3	6.6
100	5.3	0.7	30.6	4.3	6.0	6.2
average	5.7	1.1	32.7	6.3	6.2	6.4
LSD 0.05	2.8	0.6	16.3	3.7	0.8	1.4
p =	0.5	0.2	0.5	0.2	0.6	0.8

3.5 Results of supplemental nitrogen

3.5.1 Nursery results

Ten days after sowing a higher percentage of emerged seedlings was present at Tit Segitiga then at Gada (Table 12). After ten days 83.3 % of the seeds emerged at Tit Segitiga while at Gada 69.8 % was present. Between treatments no significant differences were present.

Table 12. Percentage emerged seedlings after 10 days.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
0	0	73.3	85.5	79.4
0	2	65.2	83.5	74.3
100	2	71.0	81.0	76.0
Average		69.8	83.3	
	LSD	p=		
Variety (V)	6.4	<0.001		
Treatment (T)	7.8	0.3		
V * T	11.1	0.5		

After 20 days the percentage of emerged seeds at Tit Segitiga was similar to that after 10 days (Table 13). The percentage emerged Gada seedlings was higher than the percentage after 10 days but still significant lower than the percentage of Tit Segitiga. Also after 20 days no differences between treatments were present.

Table 13. Percentage emerged seedlings after 20 days.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
0	0	79.0	85.0	82.0
0	2	80.3	84.3	82.3
100	2	73.7	80.2	76.9
Average		77.7	83.2	
	LSD	p=		
Variety (V)	6.6	0.09		
Treatment (T)	8.1	0.3		
V * T	11.4	0.9		

At transplanting a higher percentage of usable Gada seedlings was present than Tit Segitiga (Table 14). Treatments did not show any differences in percentage of usable seedlings.

Table 14. Percentage usable seedlings at transplanting.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
0	0	84.2	78.8	81.5
0	2	86.8	82.2	84.5
100	2	83.8	76.8	80.3
Average		84.9	79.3	
	LSD	p=		
Variety (V)	5.6	0.05		
Treatment (T)	6.9	0.4		
V * T	9.7	0.9		

Average fresh weigh of Tit Segitiga seedlings was higher than that of Gada seedlings (Table 15). With Tit Segitiga no differences between treatments were present. With Gada at the other hand, fresh weight of seedlings raised in media with 100 mg/l nitrogen added, was lower compared to media without additional nitrogen.

Table 15. Fresh weight of seedlings at transplanting in gram.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
0	0	19.0	26.0	22.5
0	2	19.3	27.7	23.5
100	2	13.4	28.7	21.1
Average		17.3	27.5	
	LSD	p=		
Variety (V)	2.4	<0.001		
Treatment (T)	2.9	0.2		
V * T	4.1	0.02		

Similar results in dry weight were present as were with fresh weight (Table 16). Tit Segitiga seedlings showed a higher dry weight and no differences between treatments were present at this variety. At Gada the seedlings raised in nitrogen enriched media showed a lower dry weight compared to the other treatments.

Table 16. Dry weight of seedlings at transplanting in gram.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
0	0	0.25	0.26	0.26
0	2	0.25	0.26	0.26
100	2	0.15	0.29	0.22
Average		0.22	0.27	
	LSD	p=		
Variety (V)	0.22	<0.001		
Treatment (T)	0.28	0.05		
V * T	0.39	<0.001		

Seedlings of Tit Segitiga were on average 4 cm and taller than Gada seedlings (Table 17). At Tit Segitiga no differences in plant length between treatments were present. Although not significant, it seemed if treatments with additional nitrogen showed a taller plant length.
Of Gada seedlings raised in media with supplemental nitrogen, plant length was significant shorter compared to the other treatments.

Table 17. Plant length of seedlings at transplanting in cm.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
0	0	16.3	18.7	17.5
0	2	16.4	19.7	18.0
100	2	13.1	19.6	16.4
Average		15.3	19.3	
	LSD	p=		
Variety (V)	1.2	<0.001		
Treatment (T)	1.5	0.08		
V * T	2.1	0.02		

Seedlings of Tit Segitiga showed with on average 0.7 leaves per seedling a higher number than Gada (Table 18). At Tit Segitiga seedlings raised in media with 100 mg/l together with nitrogen added to watering, showed almost significant more leaves than untreated, where no nitrogen was added to either the media or to the water.
At Gada seedlings raised in media with 100 mg/l N showed a lower number of leaves compared to the treatment where nitrogen was added to water only.

Table 18. Number of leaves of seedlings at transplanting.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
0	0	8.6	9.0	8.8
0	2	8.8	9.2	9.0
100	2	8.2	9.4	8.8
Average		8.5	9.2	
	LSD	p=		
Variety (V)	0.26	<0.001		
Treatment (T)	0.32	0.4		
V * T	0.45	0.03		

3.5.2 Yield results

Yield per plant was at Gada 26.9 gram while at Tit Segitiga this was about half with 15.4 gram per plant (Table 19). Between treatments no significant differences were present.

Table 19. Total yield in gram per plant.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		27.4	15.0	21.2
0	0	30.3	14.5	22.4
0	2	27.0	15.7	21.3
100	2	22.9	16.4	19.6
Average		26.9	15.4	
	LSD	p=		
Variety (V)	4.1	<0.001		
Treatment (T)	5.8	0.8		
V * T	8.1	0.4		

At Gada marketable yield was 7.7 gram per plant (Table 20). Marketable yield at Tit Segitiga was significantly lower with 3.6 gram only. Treatments did not show any effect on marketable yield.

Table 20. Marketable yield in gram per plant.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		9.9	4.4	7.1
0	0	7.1	3.6	5.4
0	2	6.9	2.9	4.9
100	2	7.0	3.7	5.4
Average		7.7	3.6	
	LSD	p=		
Variety (V)	2.3	0.002		
Treatment (T)	3.2	0.5		
V * T	4.6	0.9		

Per square meter the total yield of Gada was 25 gram lower than the yield of Tit Segitiga (Table 21). Treatments did not show any effect on yield per square meter.

Table 21. Total yield in gram per square meter.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		158.9	175.6	167.2
0	0	175.6	169.9	172.7
0	2	156.4	183.9	170.2
100	2	132.7	191.8	162.3
Average		155.9	180.3	
	LSD	p=		
Variety (V)	26.4	0.07		
Treatment (T)	37.3	0.9		
V * T	52.8	0.3		

Marketable yield per square meter was between varieties not significant different (Table 22). Also between treatments no significant differences were present.

Table 22. Marketable yield in gram per square meter.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		57.2	51.3	54.2
0	0	41.4	41.7	41.6
0	2	39.8	33.6	36.7
100	2	40.8	43.4	42.1
Average		44.8	42.5	
	LSD	p=		
Variety (V)	14.4	0.7		
Treatment (T)	20.4	0.3		
V * T	28.8	1.0		

With supplemental nitrogen to substrate or and to the irrigation water no differences were observed in development of marketable yield of Gada compared to the use of transplants without nitrogen supplements and to direct sowing (Fig. 10).

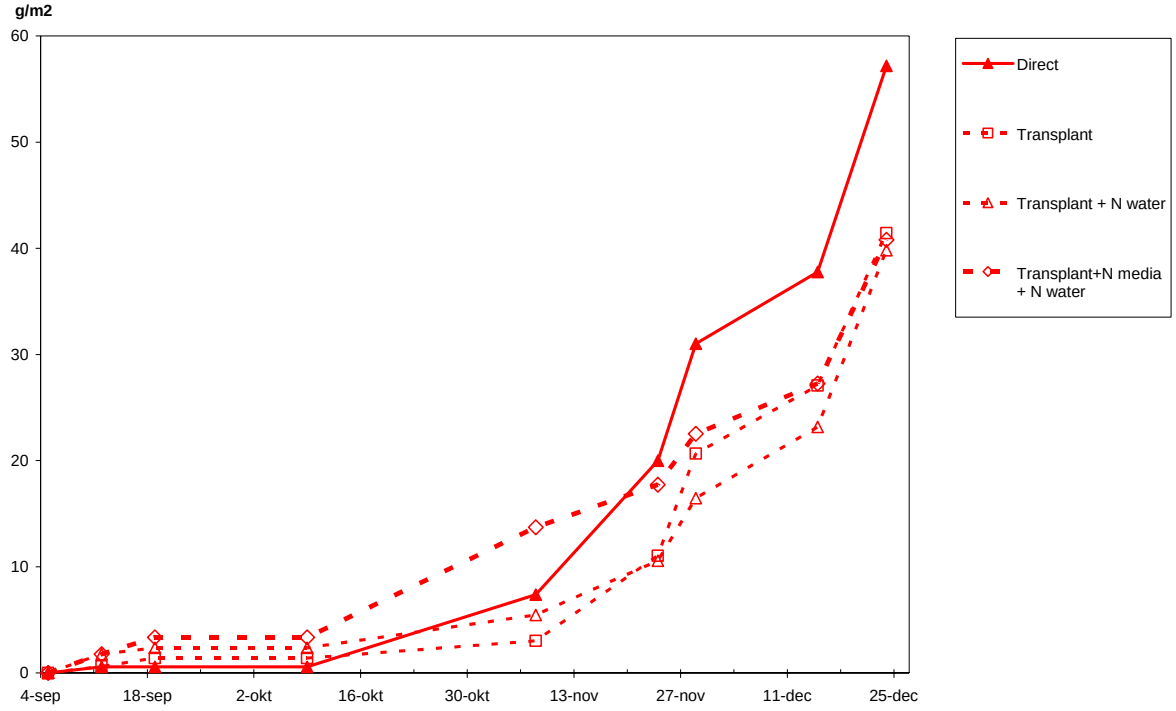


Figure 10. Influence of nitrogen supplement to substrate and to irrigation water on the marketable yield per square meter of Gada.

With Tit Segitiga however, it seems that although differences are quite limited. with nitrogen supplement to the substrate and to the irrigation water cumulative yield increase is faster a the start of the harvest period (Fig. 11). Nevertheless, at the end of November yield of this treatment is lower, but not significantly different from the direct sowing.

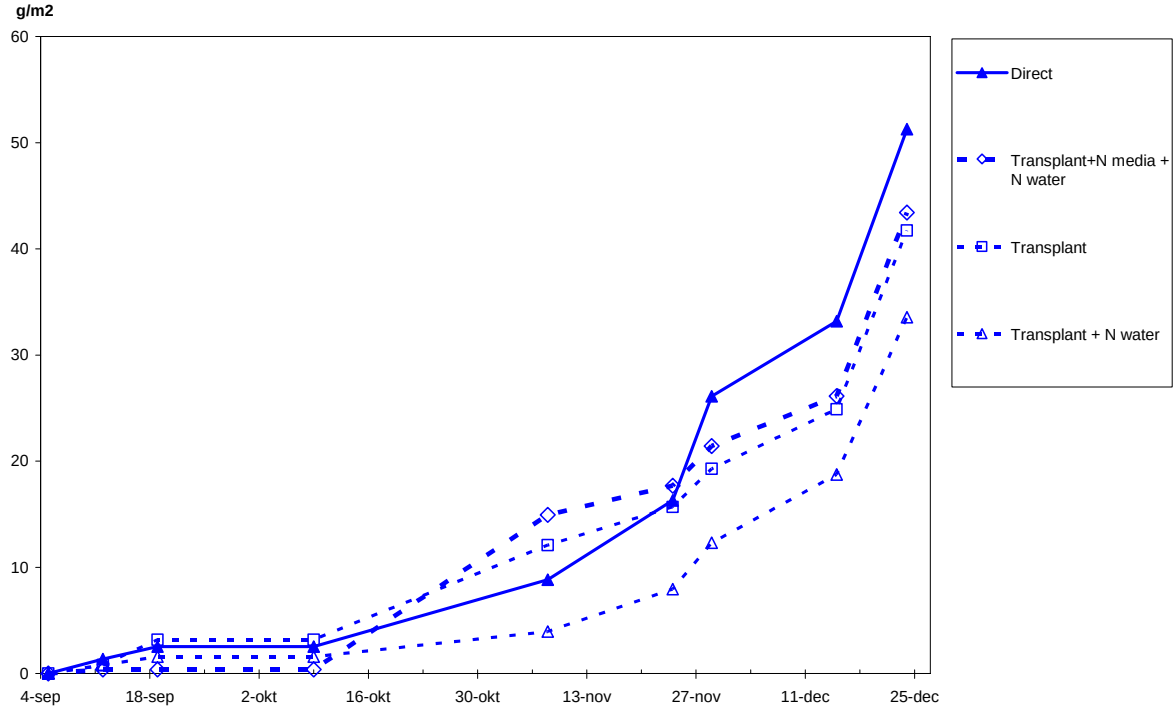


Figure 11. Influence of nitrogen supplement to substrate and to irrigation water on the marketable yield per square meter of Tit Segitiga.

Between Gada and Tit Segitiga no significant difference in percentage marketable yield was present (Table 23). At Gada and Tit Segitiga the share of marketable yield in the total production was with direct sowing the highest. Differences were not significant, although it seems that with the use of transplants percentages are lower compared to direct sowing. At Gada the treatment without any supplemental nitrogen, the percentage was the lowest. At Tit Segitiga the lowest share of marketable yield was present at the treatment where nitrogen only was applied with the daily watering.

Table 23. Share of marketable yield in total production (%).

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		34.8	29.2	32.0
0	0	22.9	24.9	23.9
0	2	25.1	17.9	21.5
100	2	30.8	22.1	26.5
Average		28.4	23.5	
	LSD	p=		
Variety (V)	5.9	0.1		
Treatment (T)	8.4	0.09		
V * T	11.8	0.5		

Gada showed a significant higher fruit number per plant than Tit Segitiga (Table 24). Between treatments no significant differences were present.

Table 24. Fruit number of total production per plant.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		5.2	2.9	4.0
0	0	6.0	2.8	4.4
0	2	5.2	3.1	4.2
100	2	5.0	3.3	4.1
Average		5.3	3.0	
	LSD	p=		
Variety (V)	0.9	<0.001		
Treatment (T)	1.3	0.9		
V * T	1.9	0.6		

Number of marketable fruits was at Gada 1.2 and significant higher than at Tit Segitiga (Table 25). Compared to direct sowing no differences were present.

Table 25. Fruit number of marketable production per plant.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		1.5	0.7	1.1
0	0	1.1	0.5	0.8
0	2	1.0	0.5	0.7
100	2	1.1	0.5	0.8
Average		1.2	0.5	
	LSD	p=		
Variety (V)	0.3	<0.001		
Treatment (T)	0.4	0.3		
V * T	0.6	0.9		

Number of produced fruits per square meter was not different between varieties (Table 26). Also between treatments no differences were present.

Table 26. Fruit number of total production per square meter.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		30.0	33.8	31.9
0	0	34.8	32.4	33.6
0	2	30.2	36.5	33.4
100	2	28.7	38.5	33.6
Average		30.9	35.3	

	LSD	p=
Variety (V)	6.6	0.2
Treatment (T)	9.3	1.0
V * T	13.2	0.6

Per square meter the number of marketable fruits was not significant different between treatments (Table 27). Also between Gada and Tit Segitiga no significant difference was present.

Table 27. Fruit number of marketable production per square meter.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		8.8	8.0	8.4
0	0	6.4	6.0	6.2
0	2	6.0	5.4	5.7
100	2	6.2	6.1	6.2
Average		6.8	6.4	

	LSD	p=
Variety (V)	1.8	0.6
Treatment (T)	2.6	0.2
V * T	3.7	1.0

Individual fruit weight of Gada fruits was 0.6 gram lower than the weight of Tit Segitiga fruits (Table 28). Compared to direct sowing, fruit weight of the transplant treatments did not differ significantly from that. Also applying nitrogen to transplants did not show different fruit weights.

Table 28. Individual fruit weight in gram of total production.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		6.5	6.5	6.5
0	0	6.3	7.7	7.0
0	2	6.4	6.4	6.4
100	2	6.0	7.1	6.5
Average		6.3	6.9	

	LSD	p=
Variety (V)	0.5	0.02
Treatment (T)	0.7	0.3
V * T	1.1	0.1

At marketable fruit weight, no difference was present between Gada and Tit Segitiga (Table 29). Also between treatments no differences were present.

Table 29. Individual fruit weight in gram of marketable production.

Treatment		Variety		
N media (mg/l)	N watering (g/l)	Gada	Tit Segitiga	Average
direct sowing		6.7	6.3	6.5
0	0	6.4	7.2	6.8
0	2	6.6	6.1	6.3
100	2	6.2	6.8	6.5
Average		6.5	6.6	

	LSD	p=
Variety (V)	0.7	0.7
Treatment (T)	1.0	0.7
V * T	1.4	0.4

3.6 Results of variety and raising system

3.6.1 Nursery results

No significant differences in percentage of emerged seedlings was present between varieties per raising system (Table 30). On average a higher percentage was present with seedling raising in plastic bags then at direct sowing. Only at Tit Segitiga this difference was significant.

Table 30. Percentage emerged seedlings after 10 days.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	61.1	68.2	58.9	60.4	62.1
Plastic bag	63.7	63.2	81.0	71.0	69.7
Average	62.4	65.7	69.9	65.7	

	LSD	p=
Variety (V)	10.8	0.5
Treatment (T)	7.6	0.05
V * T	15.3	0.09

After 20 days percentage of emergence was similar for all varieties and no significant differences were present (Table 31). The emergence of direct sowing was significant lower than that of seedlings raising in plastic bags. While the percentage of seedlings in plastic bags showed an increased percentage compared to the percentage after 10 days, with direct sowing a decline in this percentage was observed. Especially the percentage oft Balitsa 1 and Balitsa 2 showed an increased emergence percentage with raising in plastic bags.

Table 31. Percentage emerged seedlings after 20 days.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	53.8	59.2	52.1	55.1	55.0
Plastic bag	79.3	80.7	80.2	73.7	78.5
Average	66.6	69.9	66.1	64.4	

	LSD	p=
Variety (V)	8.4	0.6
Treatment (T)	6.0	< 0.001
V * T	11.9	0.6

At transplanting, the percentage of usable seedling of all varieties was similar (Table 32). With raising in plastic bags in a nursery the percentage was on average 81% and significant higher than with direct sowing where only 42.2 % usable seedlings was present.

Table 32. Percentage usable seedlings at transplanting.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	40.3	39.7	49.4	39.5	42.2
Plastic bag	83.3	79.8	76.8	83.8	81.0
Average	61.8	59.8	63.1	61.6	
	LSD	p=			
Variety (V)	9.4	0.9			
Treatment (T)	6.6	<0.001			
V * T	13.3	0.2			

On average, the fresh weight of seedlings present with direct sowing was higher than with raising in a nursery in plastic bags (Table 33). However, fresh weight of Tit Segitiga seedlings was the same with both direct sowing and with raising in plastic bags.
Between varieties, with direct sowing no differences were present. With seedling raising in plastic bags, the fresh weight of the variety Tit Segitiga was significant higher than the fresh weight of seedlings of the other three varieties.

Table 33. Fresh weight (g) of seedlings at transplanting.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	29.7	26.4	25.6	29.8	27.9
Plastic bag	17.0	18.6	28.7	13.4	19.5
Average	23.4	22.5	27.2	21.6	
	LSD	p=			
Variety (V)	4.3	0.06			
Treatment (T)	3.0	<0.001			
V * T	6.0	0.001			

With the exception of Tit Segitiga, the dry weight of seedlings with direct sowing was higher than the dry weight of seedlings raised in a plastic bag (Table 34). With direct sowing no differences in dry weight were present between varieties. With raising in plastic bags the dry weight of Tit Segitiga seedlings was higher compared to that of the other three varieties. Also dry weight of Gada seedlings was lower than the dry weight of the two Balitsa varieties.

Table 34. Dry weight (g) of seedlings at transplanting.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	0.30	0.26	0.26	0.32	0.29
Plastic bag	0.21	0.21	0.29	0.15	0.22
Average	0.25	0.24	0.28	0.24	
	LSD	p=			
Variety (V)	0.04	0.2			
Treatment (T)	0.03	<0.001			
V * T	0.06	0.002			

Plant length of seedlings with direct sowing was shorter than that of seedlings raised in plastic bags (Table 35). With direct sowing the plant length of Balitsa 1 seedlings was taller than that of Tit Segitiga and Gada. With seedling raising in plastic bag, length of Gada seedlings was shorter than Tit Segitiga, Balitsa 1 and Balitsa 2. The length of Balitsa 1 and Baltisa 2 seedlings was shorter than that of Tit Segitiga.

Table 35. Plant length (cm) of seedlings at transplanting.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	15.4	13.4	12.6	12.9	13.6
Plastic bag	16.2	16.1	19.6	13.1	16.3
Average	15.8	14.7	16.1	13.0	
	LSD	p=			
Variety (V)	1.5	0.002			
Treatment (T)	1.1	<0.001			
V * T	2.1	<0.001			

With the exception of Tit Segitiga, number of leaves was higher with direct sowing compared to transplant raising (Table 36). With direct sowing, number of leaves of Balitsa 1 seedlings was higher compared to the number present at Tit Segitiga and Balitsa 2. With seedling raising in plastic bags, the plant length of Gada seedlings is shorter than the number of leaves of Balitsa 1 and Tit Segitiga seedlings.

Table 36. Number of leaves of seedlings at transplanting.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	11.5	10.1	10.0	10.8	10.6
Plastic bag	9.0	8.7	9.4	8.2	8.8
Average	10.2	9.4	9.7	9.4	
	LSD	p=			
Variety (V)	0.5	0.014			
Treatment (T)	0.4	<0.001			
V * T	0.7	0.002			

Gada and Balitsa 1 showed the lowest percentage of seedlings with virus incidence (Table 37). Virus incidence at Tit Segitiga seedlings was the highest.

Table 37. Percentage of seedlings at transplanting infected with virus.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Plastic bag	3.0	6.8	8.3	3.0	5.3
	LSD	p=			
Variety (V)	2.6	0.09			

Percentage of seedlings with thrips incidence was with direct sowing on average 21.6% (Table 38). With seedlings raised in plastic bags no thrips symptoms were present. With direct sowing, a significant higher incidence was present at Balitsa 2. Tit Segitiga showed a significant lower thrips incidence compared to the other varieties.

Table 38. Percentage of seedlings at transplanting with thrips incidence.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	21.0	29.6	14.0	21.9	21.6
Plastic bag	0.0	0.0	0.0	0.0	0.0
Average	10.5	14.8	10.9	7.0	
	LSD	p=			
Variety (V)	4.1	0.01			
Treatment (T)	2.9	<0.001			
V * T	5.8	0.01			

3.6.2 Yield results

Gada showed the highest yield per plant (Table 39). Between Balitsa 1 and 2 and Tit Segitiga no differences in yield per plant was present. No difference between yield per plant was present between direct sowing and transplant production in plastic bags.

Table 39. Total yield in gram per plant..

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	13.5	13.8	15.0	27.4	17.4
Plastic bag	15.2	13.2	16.4	22.9	17.0
Average	14.4	13.5	15.7	25.1	
	LSD	p=			
Variety (V)	3.7	<0.001			
Treatment (T)	2.6	0.7			
V * T	5.2	0.3			

A significant higher marketable yield was present at Gada compared to the yield observed at Tit Segitiga and Balitsa 2 (Table 40). Balitsa 1 showed an almost significant higher marketable yield than present at Tit Segitiga.

Between direct sowing and use of transplants raised in plastic bags no difference in yield was present. Although yield of Balitsa 1 and 2 was respectively 1.8 and 1 gram higher this was not significant.

Table 40. Marketable yield in gram per plant..

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	6.0	5.3	4.4	9.9	6.4
Plastic bag	7.8	6.3	3.7	7.0	6.2
Average	6.9	5.8	4.1	8.5	
	LSD	p=			
Variety (V)	2.8	0.03			
Treatment (T)	2.0	0.8			
V * T	3.9	0.3			

Per square meter no significant differences were present between varieties in total yield levels (Table 41). Also between direct sowing and transplants raised in plastic bag no differences were present.

Table 41. Total yield in gram per square meter.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	158.4	161.3	175.6	158.9	163.5
Plastic bag	177.9	154.7	191.8	132.7	164.3
Average	168.1	158.0	183.7	145.8	
	LSD	p=			
Variety (V)	34.2	0.2			
Treatment (T)	24.2	0.9			
V * T	48.4	0.5			

Balitsa 1 showed a significant higher marketable yield per square meter than Tit Segitiga and Gada (Table 42). Between Gada and Tit Segitiga no difference was present. With transplants raised in plastic bags no higher marketable yield was observed compared to direct sowing.

Table 42. Marketable yield in gram per square meter.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	70.4	62.5	51.3	57.2	60.3
Plastic bag	91.0	73.5	43.4	40.8	62.2
Average	80.7	68.0	47.3	49.0	
	LSD	p=			
Variety (V)	21.2	0.01			
Treatment (T)	15.0	0.8			
V * T	30.0	0.3			

Till halfway November cumulative marketable yield increase of all treatments and varieties was more or less the same (Fig. 12). After that Balitsa 1 and 2 cumulative yield showed a sharp increase, where transplants showed a higher but not significant different yield than with direct sowing. Gada and Tit Segitiga showed an sharp increase in yield as well, but to a lesser extend as observed at Balitsa 1 and 2. Yield of direct sowing was higher but not significant different from the yield observed at transplants.

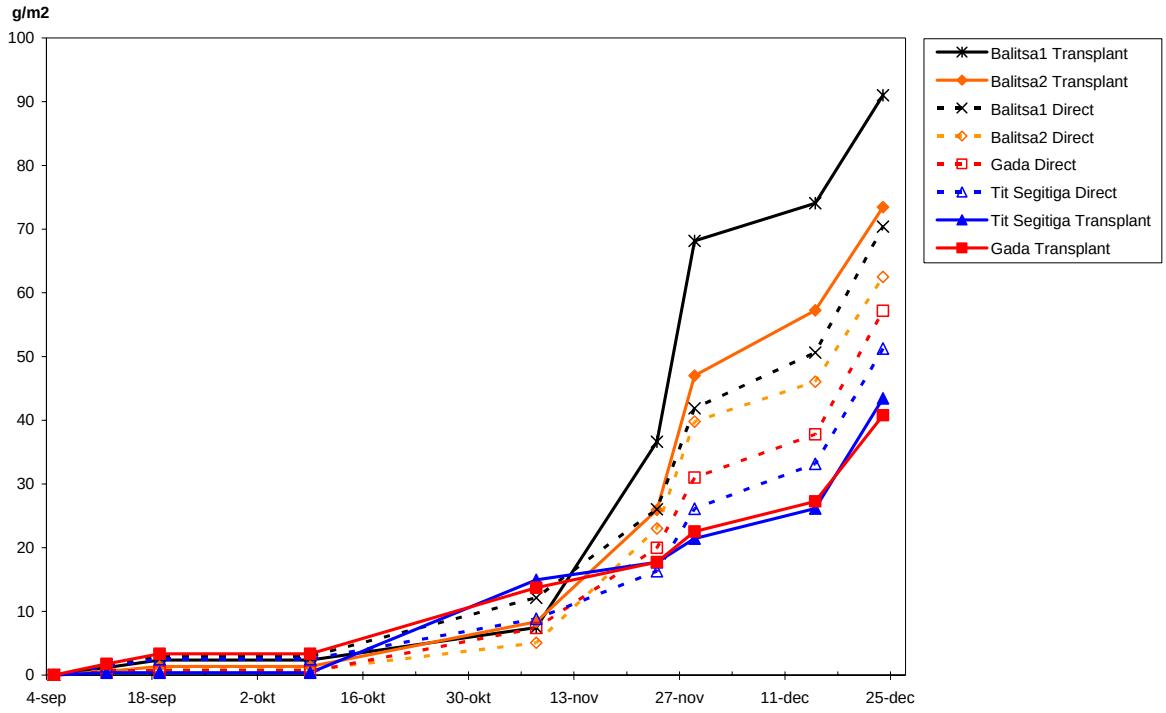


Figure 12.. Cumulative marketable yield per square meter of four varieties.

At Balitsa 1 the share of marketable yield was significant higher than at the other tested varieties (Table 43). However, also at Balitsa 1, less then half of the production was graded as marketable. Between the other varieties no differences were present and share of marketable yield was about 36 till 38 % of the total production.

Table 43. Share of marketable yield in total production (%).

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	44.4	37.3	38.4	39.1	39.8
Plastic bag	47.8	39.2	34.4	35.8	39.3
Average	46.1	38.3	36.4	37.4	
	LSD	p=			
Variety (V)	4.8	0.003			
Treatment (T)	3.4	0.8			
V * T	6.8	0.3			

Per plant the total fruit number was at Gada significant higher compared to the number present at the other varieties (Table 44). In total 5.1 fruits were harvested at Gada. Between direct sowing and transplants raised in plastic bags no difference was present in total fruit number.

Table 44. Fruit number of total production per plant.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	2.4	2.3	2.9	5.2	3.2
Plastic bag	2.8	2.6	3.3	5.0	3.4
Average	2.6	2.5	3.1	5.1	
	LSD	p=			
Variety (V)	0.8	<0.001			
Treatment (T)	0.6	0.5			
V * T	1.2	0.9			

Number of marketable fruits was at Gada 1.3 and significant higher then the number present at Balitsa 2 and Tit Segitiga (Table 45). Between direct sowing and transplant use no difference in marketable fruit number production was present.

Table 45. Fruit number of marketable production per plant.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	0.9	0.8	0.7	1.5	1.0
Plastic bag	1.0	0.8	0.5	1.1	0.9
Average	1.0	0.8	0.6	1.3	
	LSD	p=			
Variety (V)	0.4	0.01			
Treatment (T)	0.3	0.4			
V * T	0.5	0.4			

Per square meter the total fruit number was not significant different for the tested varieties (Table 46). Also between transplant use and direct sowing no difference was observed.

Table 46. Fruit number of total production per square meter.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	28.4	27.3	33.8	30.0	29.9
Plastic bag	32.2	30.1	38.5	28.7	32.4
Average	30.3	28.7	36.1	29.3	
	LSD	p=			
Variety (V)	6.8	0.1			
Treatment (T)	4.8	0.3			
V * T	9.7	0.8			

At Balitsa 1, a higher number of marketable fruits was present then at Tit Segitiga and Gada (Table 47). Between Balitsa 2, Gada and Tit Segitiga no significant difference in fruit number was present. At transplants raised in plastic bags the number of fruits was not different from the number present at direct sowing.

Table 47. Fruit number of marketable production per square meter.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	10.6	9.4	8.0	8.8	9.2
Plastic bag	12.2	9.8	6.1	6.2	8.6
Average	11.4	9.6	7.0	7.5	
	LSD	p=			
Variety (V)	3.0	0.03			
Treatment (T)	2.1	0.5			
V * T	4.2	0.4			

No significant differences were observed between varieties or raising system in average fruit weight of the total production (Table 48). Average fruit weight was 6.4 gram.

Table 48. Individual fruit weight in gram of total production.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	6.2	6.2	6.5	6.5	6.3
Plastic bag	6.9	6.1	7.1	6.0	6.5
Average	6.5	6.2	6.8	6.2	
	LSD	p=			
Variety (V)	0.7	0.2			
Treatment (T)	0.5	0.5			
V * T	1.0	0.2			

In marketable production the average fruit weight of transplants raised in a plastic bag was higher than that of direct sowing, but this difference was not significant (Table 49). Between varieties average fruit weight was not different either.

Table 49. Individual fruit weight in gram of marketable production.

Treatment	Balitsa 1	Balitsa 2	Tit Segitiga	Gada	Average
Direct sowing	6.5	6.4	6.3	6.7	6.5
Plastic bag	7.3	7.3	6.8	6.2	6.9
Average	6.9	6.8	6.6	6.5	
	LSD	p=			
Variety (V)	0.7	0.5			
Treatment (T)	0.5	0.08			
V * T	1.0	0.2			

3.7 Results of tray and variety

3.7.1 Nursery results

Emergence after 10 days was at Gada at tray seedling raising lower then at Tit Segitiga (Table 50). Emergence of direct sowing was for both varieties the same. At Gada the emergence at direct sowing and plastic bag was similar while emergence in the tray was lower as compared to those two treatments. At Tit Segitiga the emergence at direct sowing was lower as compared to the emergence at seedling raising in plastic bag or tray.

Table 50. Percentage emerged seedlings after 10 days.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	60.4	58.9	59.6
Plastic bag	71.0	81.0	76.0
Tray 128 cells	40.3	82.8	61.6
Average	57.2	74.2	
	LSD	p=	
Variety (V)	7.8	<0.001	
Treatment (T)	9.5	0.006	
V * T	13.5	0.001	

At 20 days after sowing the emergence of Gada was not different from Tit Segitiga (Table 51). Emergence of direct sowing was significant lower as compare to the mergence of seedlings raised in plastic bag and tray. Between seedling raising in plastic bag or tray no difference in emergence was present.

Table 51. Percentage emerged seedlings after 20 days.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	55.1	52.1	53.6
Plastic bag	73.7	80.2	76.9
Tray 128 cells	75.0	84.8	79.9
Average	67.9	72.4	
	LSD	p=	
Variety (V)	7.8	0.2	
Treatment (T)	9.5	<0.001	
V * T	13.5	0.3	

At transplanting, the percentage of usable seedlings was not different between variety (Table 52). At direct sowing 44.4% of the sowed seeds resulted in a healthy usable seedling while the percentage at seedling raising in plastic bag or tray resulted in more then 80%. This was significant higher than that of direct sowing.

Table 52. Percentage usable seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	39.5	49.4	44.4
Plastic bag	83.8	76.8	80.3
Tray 128 cells	80.0	84.5	82.2
Average	67.8	70.2	
	LSD	p=	
Variety (V)	6.8	<0.001	
Treatment (T)	8.3	0.4	
V * T	11.8	0.1	

Fresh weight at transplanting of Gada seedlings raised in plastic bags or trays, was significant lower than that of Tit Segitiga (Table 53). With direct sowing the fresh weigh was not different between the two varieties.
At Gada the fresh weight of seedlings raised in plastic bag and tray was significant lower than the fresh weight of Gada seedlings at direct sowing. At Tit Segitiga the fresh weight of seedlings raised in tray was lower than the weight of seedlings raised in plastic bag and that of direct sown seedlings.

Table 53. Fresh weight (g) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	29.8	25.6	27.7
Plastic bag	13.4	28.7	21.1
Tray 128 cells	9.4	15.4	12.4
Average	17.5	23.2	
	LSD	p=	
Variety (V)	2.6	<0.001	
Treatment (T)	3.2	<0.001	
V * T	4.6	<0.001	

At transplanting the dry weight of Gada was higher then that of Tit Segitiga with direct sowing (Table 54). At the other treatments the fresh weight was lower compared to the respective Tit Segitiga treatments. Dry weight of Gada seedlings raised in plastic bag or tray was lower than of Gada seedlings with direct sowing. At Tit Segitiga the dry weight of tray seedlings was lower compared to dry weight of direct sowing and transplants raised in plastic bags.

Table 54. Dry weight (g) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	0.32	0.26	0.29
Plastic bag	0.15	0.29	0.22
Tray 128 cells	0.11	0.18	0.14
Average	1.9	2.4	
	LSD	p=	
Variety (V)	0.028	0.003	
Treatment (T)	0.035	<0.001	
V * T	0.049	<0.001	

Plant length of Gada transplants raised in bags and trays was shorter than that of Tit Segitiga (Table 55). With direct sowing no difference in plant length between varieties was present.
With Gada the plant length of seedlings raised in trays was significant shorter than the length of direct sowing, while at Tit Segitiga plant length of tray transplants was taller than the length with direct sowing. Plant length of Gada and Tit Segitiga seedlings raised in a plastic bag was taller than the length of seedlings raised in trays. With Tit Segitiga the length of seedlings raised in plastic bags was also taller than of those raised with direct sown. This was not present with Gada where no significant difference in plant length was present between direct sowing and plastic bag treatment.

Table 55. Plant length (cm) of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	12.9	12.5	12.7
Plastic bag	13.1	19.6	16.4
Tray 128 cells	8.9	13.5	11.2
Average	11.6	15.2	
	LSD	p=	
Variety (V)	0.3	<0.001	
Treatment (T)	0.4	<0.001	
V * T	0.6	<0.001	

At direct sowing, Gada showed a higher leaf number than Tit Segitiga seedlings, while at the other treatments Tit Segitiga showed a higher number (Table 56).Gada seedlings raised in plastic bag or tray showed no difference in leaf number. The leaf number of transplants raised in bags and trays was significant lower than the number of direct sowing.
With direct sowing of Tit Segitiga the highest leaf number was present. This number was significant higher than the number present at transplants raised in bags and trays. Number of leaves present with plastic bag raising was significant higher than the number present with transplant raising in trays.

Table 56. Number of leaves of seedlings at transplanting.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	10.8	10.0	10.4
Plastic bag	8.2	9.4	8.8
Tray 128 cells	7.7	8.3	8.0
Average	8.9	9.3	
	LSD	p=	
Variety (V)	0.3	0.045	
Treatment (T)	0.4	<0.001	
V * T	0.6	<0.001	

3.7.2 Yield results

Gada showed a significant higher yield per plant compared to the yield of Tit Segitiga (Table 57). Yield of transplants raised in plastic bags or in a tray was not significant different from the yield observed at direct sowing.

Table 57. Total yield in gram per plant..

Treatment	Gada	Tit Segitiga	Average
Direct sowing	27.4	15.0	21.2
Plastic bag	22.9	16.4	19.6
Tray 128 cells	24.6	13.9	19.3
Average	25.0	15.1	
	LSD	p=	
Variety (V)	3.4	<0.001	
Treatment (T)	4.1	0.6	
V * T	5.9	0.3	

The marketable yield per plant was significant higher at Gada with 7.7 gram compared to 3.7 gram present at Tit Segitiga (Table 58). Between raising treatments no significant differences were present.

Table 58. Marketable yield in gram per plant..

Treatment	Gada	Tit Segitiga	Average
Direct sowing	9.9	4.4	7.1
Plastic bag	7.0	3.7	5.4
Tray 128 cells	6.1	3.1	4.6
Average	7.7	3.7	
	LSD	p=	
Variety (V)	2.5	0.005	
Treatment (T)	3.0	0.2	
V * T	4.3	0.6	

Per square meter the total yield of Tit Segitiga was on average 30 gram higher compared to the yield observed at Gada (Table 59). Although the yield of transplants raised in a tray was 15 gram less than with direct sowing, this difference was not significant.

Table 59. Total yield in gram per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	158.9	175.6	167.2
Plastic bag	132.7	191.8	162.3
Tray 128 cells	142.6	162.7	152.6
Average	144.7	176.7	
	LSD	p=	
Variety (V)	25.8	0.02	
Treatment (T)	31.6	0.6	
V * T	44.6	0.3	

The marketable yield per square meter was for both varieties the same (Table 60). Also between raising treatments no significant differences in marketable yield were observed.

Table 60. Marketable yield in gram per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	57.2	51.3	54.2
Plastic bag	40.8	43.4	42.1
Tray 128 cells	35.6	36.1	35.9
Average	44.5	43.6	
	LSD	p=	
Variety (V)	16.3	0.9	
Treatment (T)	20.0	0.2	
V * T	28.3	0.9	

Cumulative yield of transplants raised in plastic bags or tray showed a similar trend (Fig. 13). Direct sowing showed a similar trend until the end of November. After that the yield of direct sowing showed a faster increase compared to the yield increase of transplants. Differences between direct sowing and transplants however, were not significant.

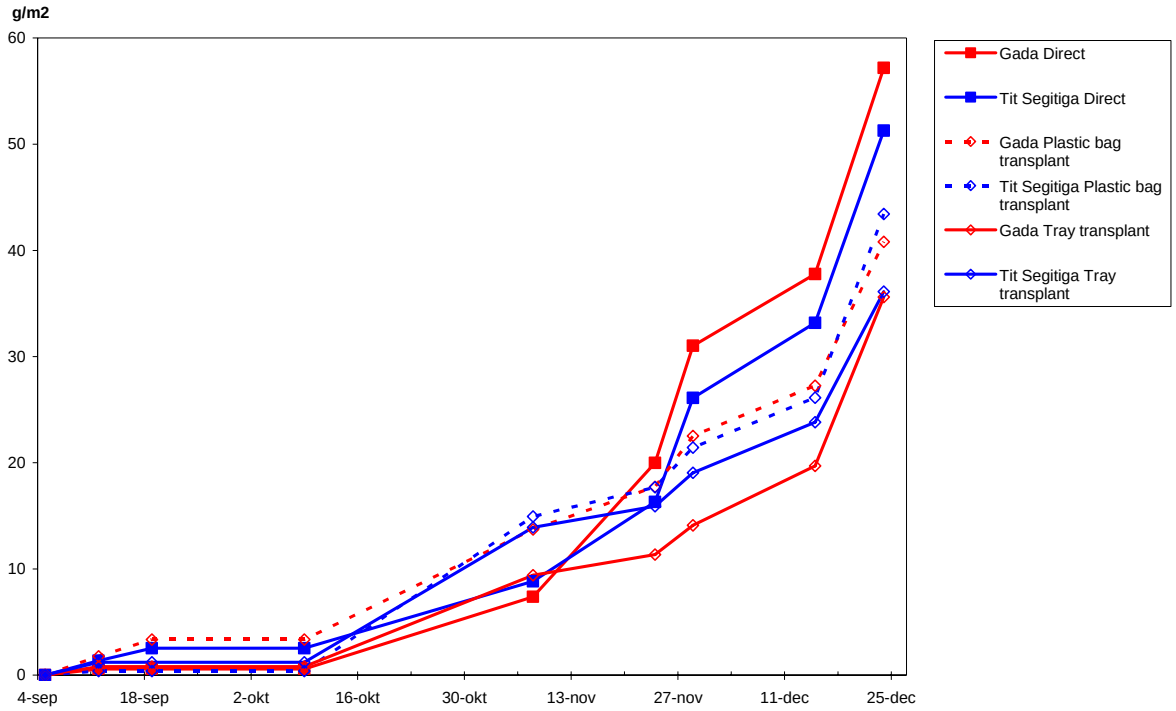


Figure 13. *Cumulative marketable yield per square meter of Gada and Tit Segitiga transplants raised in either plastic bag or tray or cultivated with direct sowing.*

The share of marketable product was with direct sowing significant higher than with transplants raised in trays (Table 61). Between direct sowing and transplants raised in plastic bags no significant difference was present. Also between transplant raising in plastic bag or in tray no difference was present in share of marketable yield in the total prodcution.

Table 61. Share of marketable yield in total production (%).

Treatment	Gada	Tit Segitiga	Average
Direct sowing	39.1	38.4	38.7
Plastic bag	35.8	34.4	35.1
Tray 128 cells	30.5	30.2	30.4
Average	35.1	34.3	
	LSD	p=	
Variety (V)	4.4	0.7	
Treatment (T)	5.4	0.02	
V * T	7.7	1.0	

Percentage of marketable yield in the total production was at the first four harvest dates very low (Fig. 14). At the fifth harvest, the beginning of November, at all treatments, of the total production 100 % was marketable product. From November till the end of December only 20 to 50% of the harvested hot peppers was marketable. At this period it is that with direct sowing the percentage marketable product was higher compared to the share present with transplant treatments.

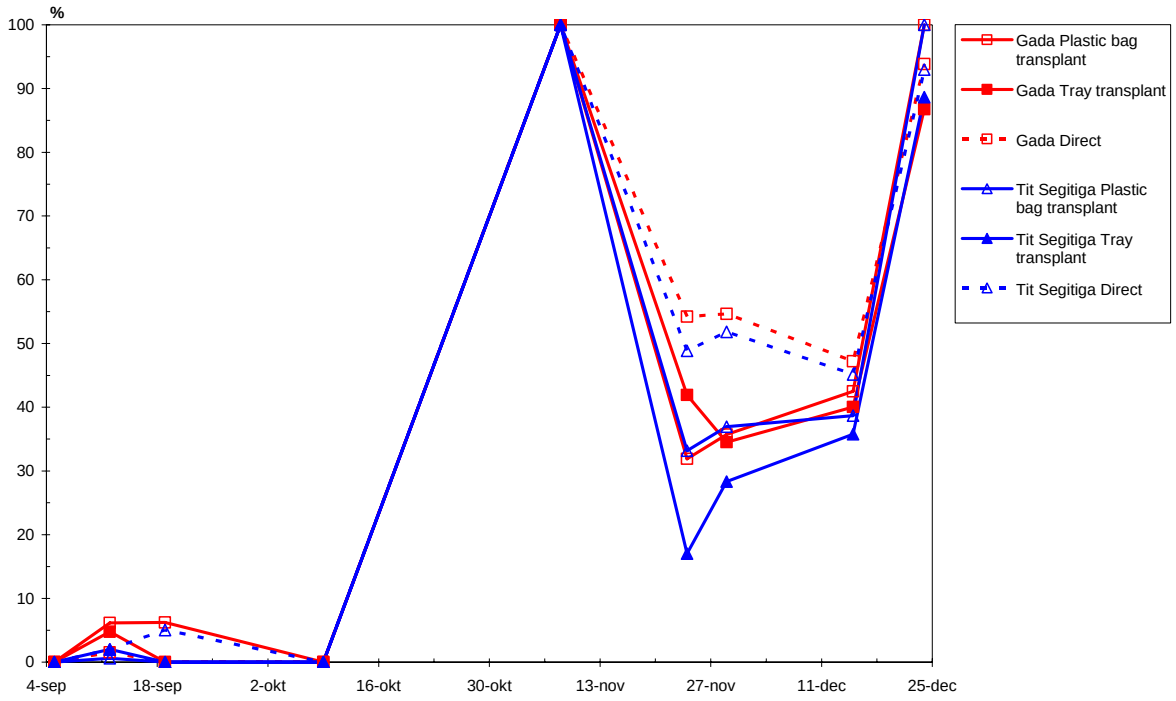


Figure 14. *Percentage marketable production per harvest date of Gada and Tit Segitiga transplants and at direct sowing.*

Per plant the number of harvested fruits was significant higher at Gada (Table 62). On average a number of 4.8 was harvested while at Tit Segitiga 2.9 fruits per plant were harvested. Between treatments no significant differences were present.

Table 62. Fruit number of total production per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	5.2	2.9	4.0
Plastic bag	5.0	3.3	4.1
Tray 128 cells	4.3	2.5	3.4
Average	4.8	2.9	
	LSD	p=	
Variety (V)	0.8	<0.001	
Treatment (T)	1.0	0.2	
V * T	1.4	0.8	

Between treatments no significant differences were present in number of marketable fruits per plant (Table 63). Gada showed a higher number of fruits at direct sowing compared to that observed at Tit Segitiga. At transplants no significant difference between variety was present.

Table 63. Fruit number of marketable production per plant.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	1.5	0.7	1.1
Plastic bag	1.1	0.5	0.8
Tray 128 cells	1.0	0.5	0.7
Average	1.2	0.6	
	LSD	p=	
Variety (V)	0.3	0.6	
Treatment (T)	0.4	0.1	
V * T	0.6	0.002	

In number of fruits per square meter no significant differences were present between variety or treatment (Table 64).

Table 64. Fruit number of total production per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	30.0	33.8	31.9
Plastic bag	28.7	38.5	33.6
Tray 128 cells	25.0	29.0	27.0
Average	27.9	33.8	
	LSD	p=	
Variety (V)	5.4	0.04	
Treatment (T)	6.7	0.1	
V * T	9.4	0.5	

Average marketable fruit number per square meter was the lowest but not significantly lower at transplants raised in trays (Table 65). Between variety no difference in marketable fruit number per square meter was present.

Table 65. Fruit number of marketable production per square meter.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	8.8	8.0	8.4
Plastic bag	6.2	6.1	6.2
Tray 128 cells	5.5	5.5	5.5
Average	6.9	6.5	
	LSD	p=	
Variety (V)	2.0	0.7	
Treatment (T)	2.5	0.07	
V * T	3.5	0.9	

Individual fruit weight of peppers was on average 6.5 gram (Table 66). No significant difference was present between treatments.

Table 66. Individual fruit weight in gram of total production.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	6.5	6.5	6.5
Plastic bag	6.0	7.1	6.5
Tray 128 cells	6.5	6.3	6.4
Average	6.3	6.6	
	LSD	p=	
Variety (V)	0.5	0.2	
Treatment (T)	0.7	0.9	
V * T	0.9	0.1	

Of the marketable production the individual fruit weight was on average 6.5 gram (Table 67). No difference was present between Gada and Tit Segitiga. Also the use of transplants did not show different fruit weights compared to direct sowing.

Table 67. Individual fruit weight in gram of marketable production.

Treatment	Gada	Tit Segitiga	Average
Direct sowing	6.7	6.3	6.5
Plastic bag	6.2	6.8	6.5
Tray 128 cells	6.4	6.2	6.3
Average	6.4	6.5	
	LSD	p=	
Variety (V)	0.8	1.0	
Treatment (T)	0.9	0.9	
V * T	1.3	0.5	

4 Discussion

In general yield levels were low with only 1.6 ton/ha harvested product . Marketable yield was even lower with 0.6 ton per hectare. A yield of 5-6 tonnes per hectare is a normal yield . During cultivation, pest and disease pressure was high. Especially *anthracnose* and *heliocoverpa* caused a lot of damage. Besides, during the first stage of the cultivation water shortage occurred causing wilting, which resulted in flower abortion.

4.1 Variety

Between varieties differences are present in yield.
Three open pollinated varieties, Balitsa 1, Balitsa 2 and Tit Segitiga, were compared with the hybrid variety Gada. Balitsa 1 and 2 are improved open pollinated varieties where selection has been applied.
Plant population of Gada was 50% of the open pollinated varieties plant density. Yield per plant of Gada was twice as much as the yield of the open pollinated varieties. Per square meter this resulted in similar yields of all varieties. At Gada a marketable yield of 8.5 gram per plant was present and marketable fruit number was 1.3. At Tit Segitiga this was respectively 4.1 gram and 0.6 fruits. A harvest of only 1, or not even 1 marketable fruit per plant, is extremely low.
Average fruit weight of all varieties was quite similar. The harvested product was sold at the local market and traders were willing to pay a same price for fruits of all varieties leading to the conclusion that the fruits of Gada are suitable for the local market.
Balitsa 1 and Balitsa 2 showed a higher marketable yield per square meter than Tit Segitiga, while total yield was about the same for all varieties. Since Balitsa 1 and 2 are improved by selection, it seems that with those two varieties, due to a better seed quality more healthy plants are present which resulted in a higher percentage of marketable fruits compared to Tit Segitiga.

4.2 Container

Yield of transplants was similar to the yield obtained with direct sowing. It seems however, that with the use of transplants start of production is faster compared to direct sowing. Later on, direct sowing showed a steep increase in production while production levels at transplants showed a lower increase in production. Probably water shortage has a stronger effect on production of transplants than on that of direct sowing. Tray transplants were somewhat smaller at transplanting than plants with direct sowing, and this resulted probably in a slightly lower yield compared to direct sowing.

4.3 Regent drench

Application of Regent did not result in a higher yield or in a higher percentage of marketable product compared to transplants without Regent drench. It might be possible that amount of applied Regent or timing was not optimal enough in order to provide a good protection against insect pests. Finally it is estimated that the effect of a drench lasts only for a month. After that other means of pest control are required. It might be possible then that due to resistance of insects to the used pesticides and the high pest pressure early effects in pest control by the drench were diminished.
Between the used rates of Regent no differences were present either.

4.4 Nitrogen supplement

The aim of supplemental nitrogen to the media and or water was to obtain a better higher yielding transplant. However, in this experiment with supplemental nitrogen earlier harvest period, higher yield, higher fruit number or bigger fruits were not observed. It might be possible that the used media already contains sufficient nitrogen to raise a good seedling and therefore additional nitrogen has no effect.

5 Conclusions

5.1 General

Field conditions in this experiment influenced greatly the results of the treatments. Due to water shortage and the presence of pests and diseases the plant growth was not optimal. Yield levels were extremely low with only 0.6 ton per hectare marketable product. Therefore positive effects of transplant use and supplemental nitrogen treatments and drenching of transplants did not result in positive effects compared to direct sowing.
In order to improve the situation attention needs to be given to the field conditions. Especially measures to reduce pest and disease pressure need to be developed. With the current practice where a lot of pesticides are applied pests an diseases are not controlled effectively. Besides the economical loss due to ineffectiveness of the pesticides and purchasing costs of the pesticides, also a negative impact on the environment is present. Water and soils are contaminated, and also populations of beneficial insects, which could have a controlling effect on pests, are possible reduced with the use of those pesticides.

5.2 Variety

Yield of the hybrid variety Gada is higher than the yield of the open pollinated variety Tit Segitiga. Production per plant of the variety Gada was double of the yield of Tit Segitiga. Since Gada was cultivated at 50% of the plant population of Tit Segitiga this resulted in a same yield per square meter.
Taking into account the risk of crop failure the use of hybrid varieties by farmers is limited. When planting an open pollinated variety investment costs are low and when a crop is lost not much money is lost. Also with the use of a hybrid variety at a lower plant density when plants are lost due to pests or diseases the effect on final yield is much higher than when planting an open pollinated variety where the effect of losing one plant is smaller compared to the use of the hybrid variety. Yield per plant with the open pollinated variety is lower. One plant lost with the open pollinated variety is only 1% per plot while with the hybrid variety this is 2%.
The use of improved open pollinated varieties such as Balitsa 1 and Balitsa 2, can result in a higher marketable production. Seeds are of better quality and might result in a lower disease pressure. Also since the best seeds are kept with the selection procedure, fruit production and fruit size may be positively influenced compared to farmers saved seeds of Tit Segitiga where mostly seeds are kept from non marketable fruits.

5.3 Container

Yield of plants grown in plastic bags is higher than those raised in a tray. This is mainly due to the better start of transplants in plastic bags compared to tray transplants. Raising in trays takes more care and minor mistakes for instance in watering, already results in big effects regarding plant growth and final production. Seedlings in a tray are more sensitive to water regimes, both stress as overwatering then seedlings in plastic bags. This is due to the smaller cell volume of the tray in combination with a lower height of the cells which leads to a higher risk on dehydration and to probably higher temperatures in the substrate compared to the plastic bag.

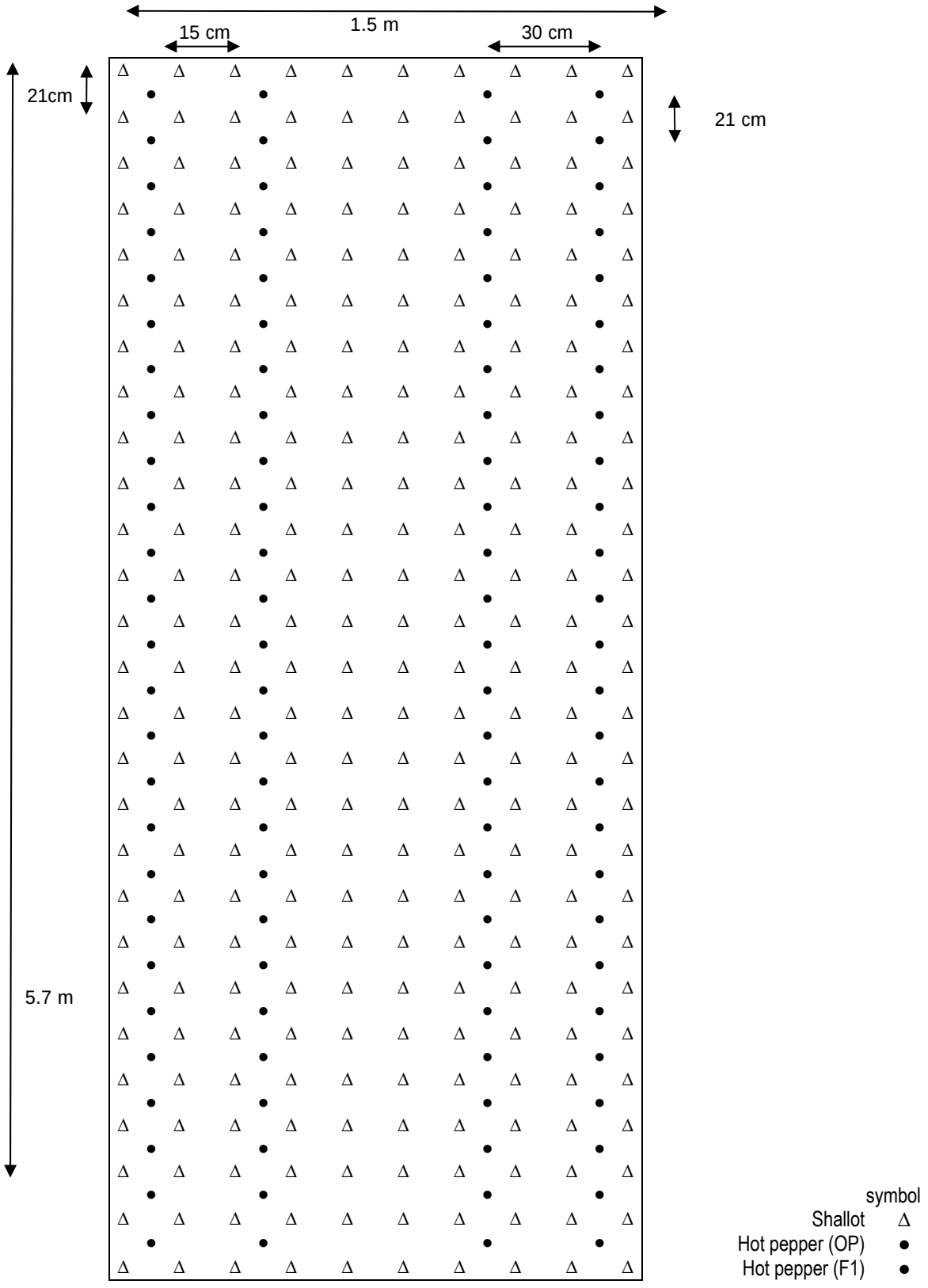
5.4 Regent drench

Application of Regent at rates of 20 ml, 40 ml and 100 ml per liter water did not increase marketable yield. However, yield was greatly reduced by water stress and presence of anthracnose. Therefore the effect of Regent could not be established clearly.

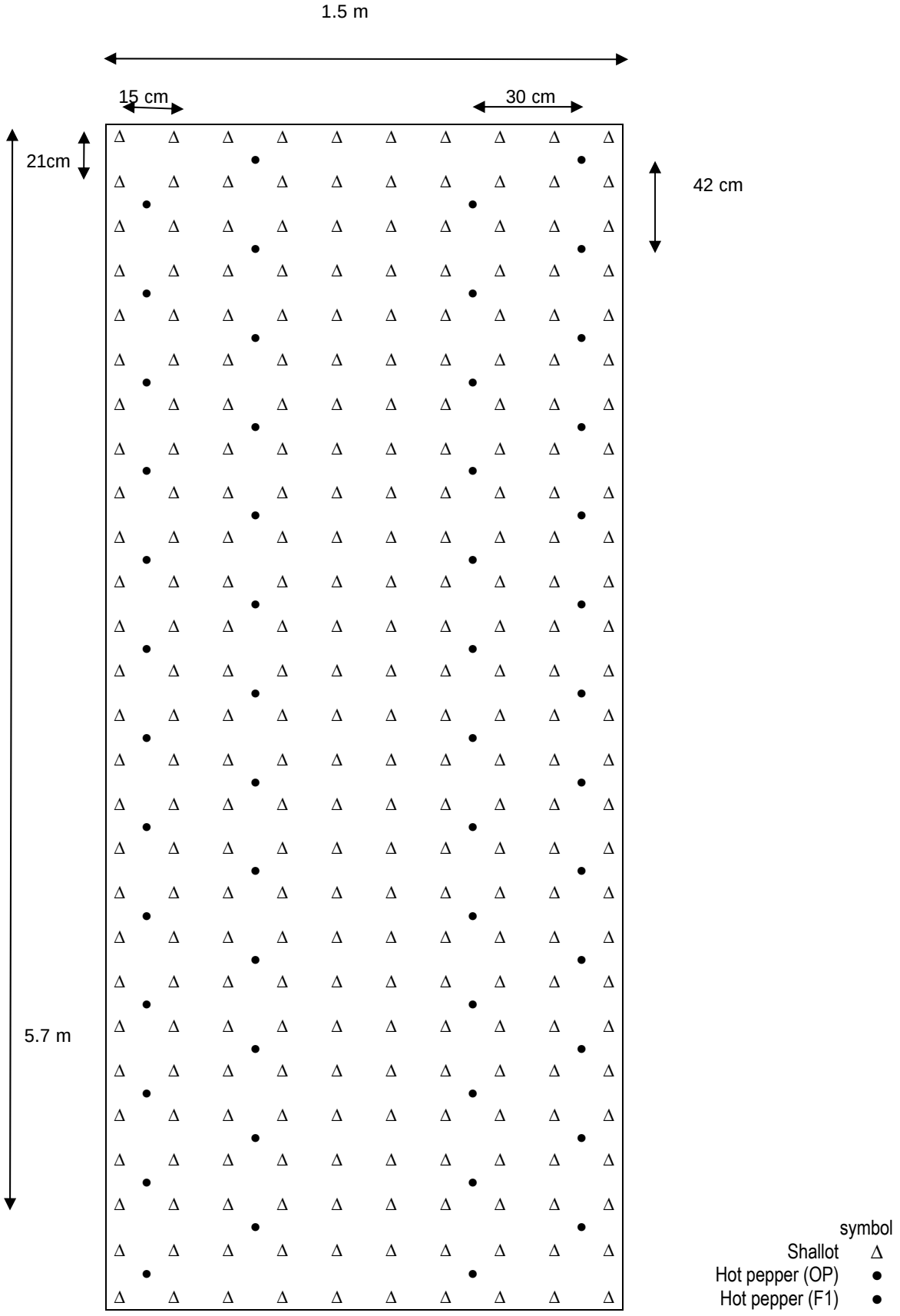
5.5 Nitrogen supplement

Nitrogen supplement to the substrate and nitrogen amendment through irrigation water to the seedlings did not result in a higher marketable yield, earliness of harvest or bigger fruits. Since yield was limited due to water stress, the effect of nitrogen could not be established clearly.

Annex I. Plant arrangement per plot.



Plant arrangement per plot for the open pollinated variety Tit Segitiga and improved open pollinated varieties Balitsa 1 and Balitsa 2 (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

34	A10	35	A4	36 *L5*	A2	37	A12	38	A5	39 *L6*	A6		
27	A9	28	A1	29	A13	30	A11	31	A3	32	A7	33	A8

III

Replication 2: Nursery II

21	A5	22	A4	23 *L3*	A8	24	A13	25	A10	26 *L4*	A9		
14	A6	15	A3	16	A2	17	A12	18	A1	19	A7	20	A11

II

Replication 1: Nursery I

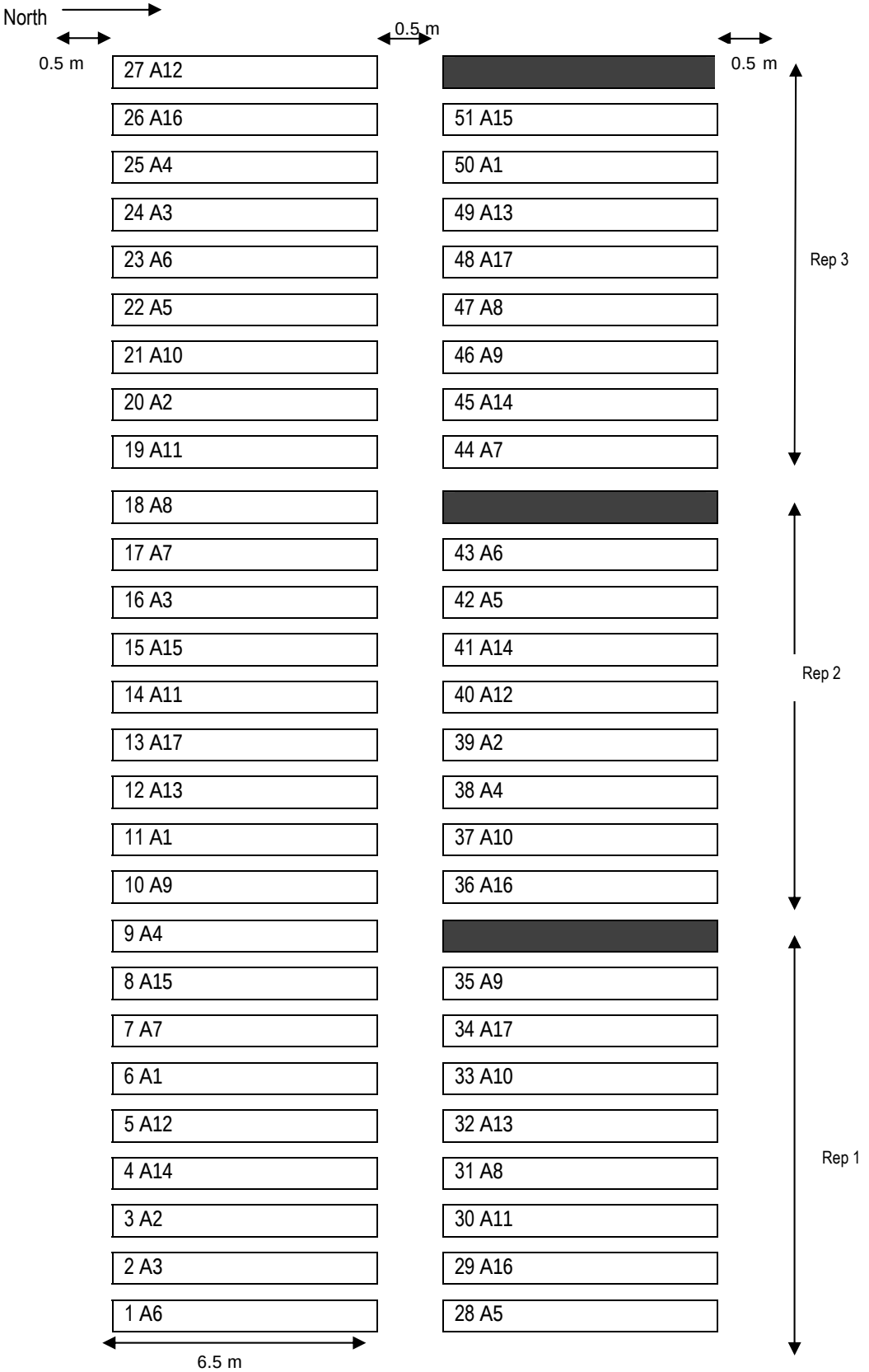
8	A12	9	A7	10 *L1*	A9	11	A8	12	A13	13 *L2*	A1		
1	A11	2	A2	3	A10	4	A5	5	A6	6	A3	7	A4

I

L1 till *L6* = positions for measuring light intensity inside the nursery
I, II, III = positions for measuring light intensity outside the nursery

Treatment codes are in bold print. Field numbers are in normal print
For explanation of treatment codes see table 4.

Annex III. Layout of treatments in the field.



Treatment codes are in bold print. Field numbers are in normal print
For explanation of treatment codes see table 4.

Annex IV. Temperature and rainfall during the experiment.

Temperature in ^{o}C and rainfall in mm.

Date	Inside Temperature of Table Nursery		Outside Temperature		Rainfall
	Min T	Max T	Min T	Max T	
3-6-2008	21	40	21	37	0
4-6-2008	24	42	26	42	0
5-6-2008	25	43	26	43	0
6-6-2008	23	45	24	45	0
7-6-2008	22	44	24	44	0
8-6-2008	22	45	23	45	0
9-6-2008	23	46	23	47	0
10-6-2008	21	47	21	48	0
11-6-2008	20	45	21	45	0
12-6-2008	20	40	20	40	0
13-6-2008	21	41	21	41	0
14-6-2008	22	43	22	43	0
15-6-2008	22	44	22	44	0
16-6-2008	22	43	22	43	0
17-6-2008	22	43	22	42	0
18-6-2008	22	43	21	43	7
19-6-2008	22	43	21	43	0
20-6-2008	22	44	22	44	0
21-6-2008	22	44	22	44	0
22-6-2008	21	42	22	41	0
23-6-2008	22	44	22	44	0
24-6-2008	22	41	22	41	0
25-6-2008	22	44	22	44	0
26-6-2008	21	43	21	43	0
27-6-2008	21	42	21	42	3
28-6-2008	22	43	22	43	0
29-6-2008	22	44	22	44	0
30-6-2008	22	43	22	43	0
1-7-2008	22	43	21	43	0
2-7-2008	22	44	22	44	0
3-7-2008	22	44	21	43	0
4-7-2008	22	44	22	45	0
5-7-2008	Transplanting		22	44	0
6-7-2008			22	45	0
7-7-2008			22	45	0
8-7-2008			21	42	0
9-7-2008			22	44	0
10-7-2008			22	44	0
11-7-2008			22	44	0
12-7-2008			21	43	0
13-7-2008			22	44	0
14-7-2008			22	42	0
15-7-2008			22	44	0

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

Date	Inside Temperature of Table Nursery		Outside Temperature		Rainfall
	Min T	Max T	Min T	Max T	
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

Date	Inside Temperature of Table Nursery		Outside Temperature		Rainfall
	Min T	Max T	Min T	Max T	
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

Date	Inside Temperature of Table Nursery		Outside Temperature		Rainfall
	Min T	Max T	Min T	Max T	
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