HORTIN II Co Innovation Programme

Towards cost effective, high quality value chains

Effect of variety, transplant raising, net house cultivation, mulch and cropping system on hot pepper growth and yield

HORTIN-II Research Report nr. 25

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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

Hot pepper is besides shallot an important crop to farmers in Brebes, Central Java. The profitability of hot pepper is hampered by fluctuating production resulting in a strong seasonality of supply. Also quality of used seeds and varieties is variable leading to different production levels. In order to improve the cultivation of hot pepper and as a result strengthening the market position of the small holder farmers, research has been started in 2007 to increase the quality of starting material and to improve cultivation techniques.
In previous experiments the influence of transplant use and the use of hybrid varieties on yield was tested. Results from these experiments indicated that with the use of transplants seed use efficiency increase. Final yield was not influenced by using transplants since with direct sowing similar yield was present as with the use of transplants. When cultivating hybrid varieties a same or a higher yield can be obtained as with open pollinated varieties but with only half the plant population as commonly used with OP varieties. Since presence of pests and diseases during the cultivation period were influencing the results decided was too test also the effect of mulch, plant population and screen net covers on production of hot pepper.
The hybrid variety Gada and the open pollinated variety Tit Segitiga were sowed on . Seeds were either sowed directly in the field or transplants were first raised in plastic bags or plastic trays. The media used for transplant raising consisted of a mixture of goat manure and top soil in equal volume parts. Transplanting took place on ..
Plants were cultivated inside a screen net cover or in the open field. Some treatments included the application of plastic mulch. Gada and Tit Segitiga were cultivated as an intercrop with shallot. Some treatments were cultivated as a monocrop. Finally in order to increase the productivity of Gada tested was if a higher plant density would lead to a higher yield per square meter.

1 Introduction

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. Rien Rodenburg of PT 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 and 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. According to the classification by the Indonesian Soil Research Institute (1961) the soil is an alluvial soil with river and lake sediments in flat or slanting areas.

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

In February 2009 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. Soil pH-H_2O is slight acid to neutral. Phosphate content of the soil is present at an excessive level while potassium is present at an adequate medium level. Finally, both calcium and magnesium content is ranging from medium to high. An amount of 40.8 kg/ha mineral nitrogen was present in the soil just before commencing cultivation.

Table 1. Analyse results of soil samples taken in February 2009 at the experimental site.

Sample	pH-H_2O	pH-KCl	N (%) Kjeldahl	N-min (ppm) KCL 1N	P_2O_5 (ppm) Olsen	K_2O (ppm) MV	CaO (cmol/kg) Ammonium acetate 1N pH 7	MgO
I	7.0	5.7	0.11	10.0	102	215	53	16
II	7.1	5.6	0.11	8.8	93	267	55	17
III	7.1	5.7	0.10	8.7	83	248	56	18
mean	7.0	5.7	0.11	9.2	93	243	55	17

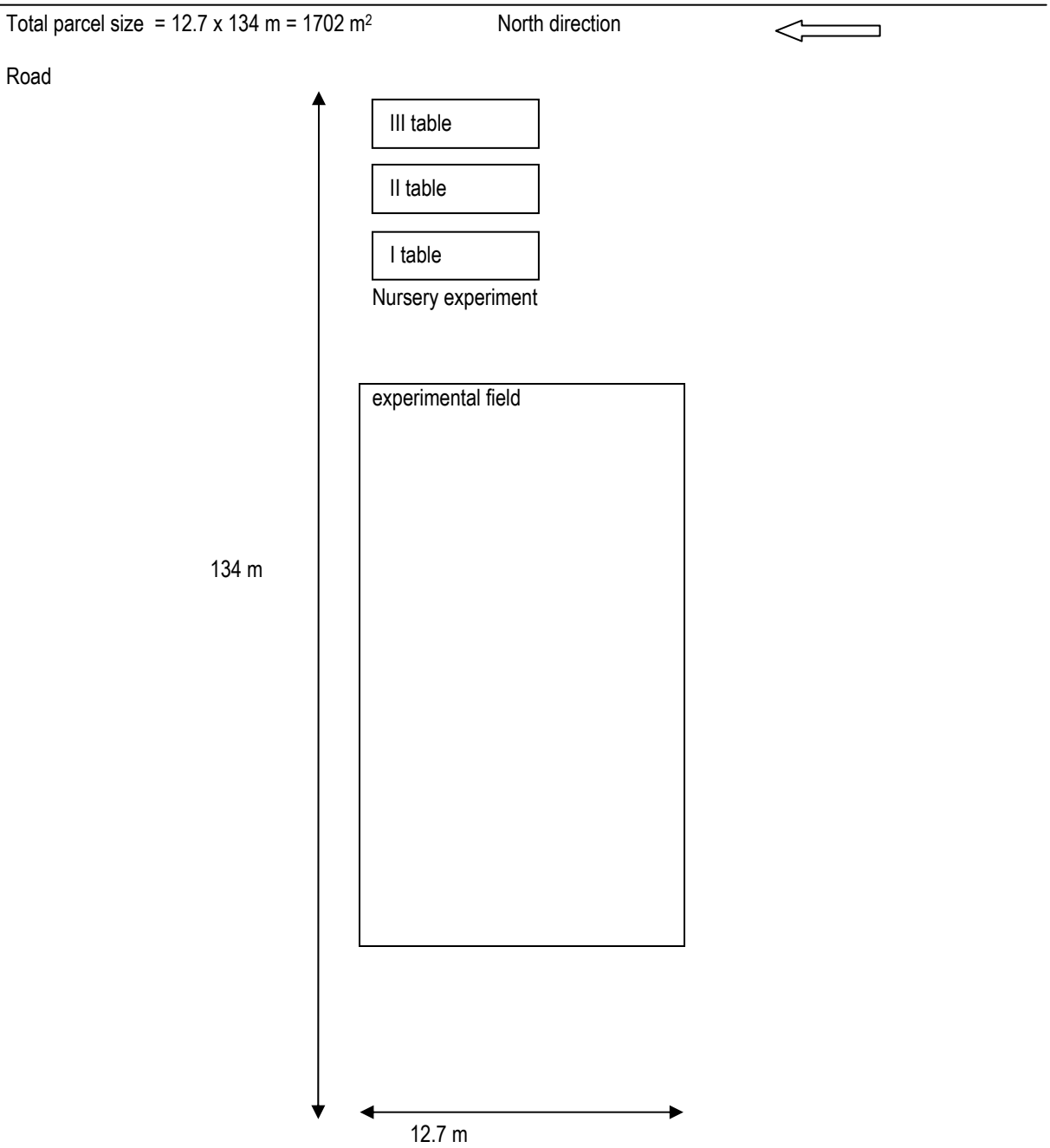


Figure 2. Layout of the experimental site.

2.1 Treatments in the experiment

Two varieties, two types of containers and three field treatments: use of screen net, use of mulch and cropping system, were tested in combinations and compared with results of direct sowing (Table 2).

Table 2. Treatment combination in the experiment.

		Variety	Container	Cover	Cultivation System
1	A1B2C1	Tit Segitiga	Plastic tray	yes	Intercropping
2	A1B6C1	Tit Segitiga	Plastic tray	yes	Monocropping + mulch
3	A2B1C1	Gada	Direct sowing	yes	intercropping
4	A2B2C1	Gada	Plastic tray	yes	Intercropping
5	A2B3C1	Gada	Plastic tray	yes	Intercropping at 100 plants/plot
6	A2B4C1	Gada	Plastic tray	yes	Intercropping + mulch
7	A2B5C1	Gada	Plastic tray	yes	Monocropping
8	A2B6C1	Gada	Plastic tray	yes	Monocropping + mulch
9	A1B2C2	Tit Segitiga	Plastic tray	no	Intercropping
10	A1B6C2	Tit Segitiga	Plastic tray	no	Monocropping + mulch
11	A2B1C2	Gada	Direct sowing	no	intercropping
12	A2B2C2	Gada	Plastic tray	no	Intercropping
13	A2B3C2	Gada	Plastic tray	no	Intercropping at 100 plants/plot
14	A2B4C2	Gada	Plastic tray	no	Intercropping + mulch
15	A2B5C2	Gada	Plastic tray	no	Monocropping
16	A2B6C2	Gada	Plastic tray	no	Monocropping + mulch
17	A1B1C2	Tit Segitiga	Direct sowing	no	Intercropping
18	A1B7C2	Tit Segitiga	Plastic bag	no	Intercropping
19	A1B5C2	Tit Segitiga	Plastic tray	no	Intercropping + rice straw 1 mnth after transplanting
20	A2B7C2	Gada	Plastic bag	no	Intercropping

2.2 Nursery for raising of seedlings

For raising seedlings a simple nursery construction was used. (Figure 3 and 4). Bamboo was used for construction of the frame and for construction of the table to place the seedlings on. The frame was covered with screen net to have a closed area in which transplants or seedlings could be raised. The nursery house was present in three replications.

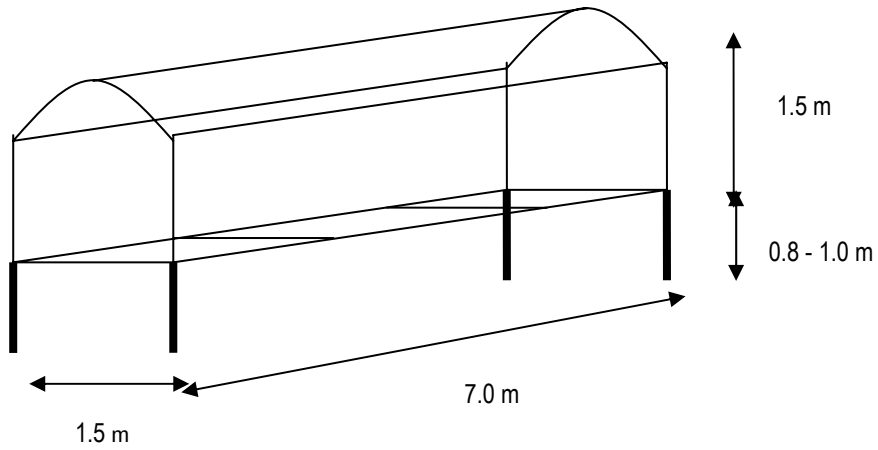


Figure 3. Schematic view of a table nursery.

Figure 4. Inside of a table nursery.

2.3 Hot pepper varieties used for the experiment

Two types of varieties were used in the experiments:

- Local open pollinated variety (Tit Segitiga)
- Hybrid variety (Gada F_1)

Seeds from Tit Segitiga were obtained locally from farmers while seeds from Gada F_1 were received from PT EWINDO located at Purwakarta.

2.4 Seedling raising treatments

For container, two types were tested namely a modular tray with 128 modules per tray and individual plastic bags (Fig. 5). At the 128 module tray the cell shape was pyramidal with a cell content of 13 cm^3. Plastic bags have a volume of 15 cm^3 and holes were punctured in the bottom to provide drainage.

Components for media were goat manure collected 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.

Figure 5. Plastic bags and modular tray with 128 cells, used for seedling raising of hot pepper.

2.5 Cultivation

2.5.1 Cropping system

Normally hot pepper is intercropped with shallot (Figure 6). In Brebes crops are grown on suats or beds surrounded by ditches. In the experiments each plot consisted of a half suat with a size of 1.5 x 5.7 m. Shallots were planted one day before hot pepper seeds were sown. Hot pepper seedlings were transplanted 4 to 5 weeks after shallot was planted.

Shallots were planted at a rate of 260 bulbs per plot. With the mulch intercropping treatment only 125 bulbs were planted. Per plot 3 complete rows of 25 plant holes were planted and 4 rows were planted with shallot and hot popper at alternating spots resulting in 12 plant holes per rows for shallot.

Population density of hot pepper for the open pollinated variety was double compared to the density of the hybrid variety (Table 3). One treatment with the hybrid treatment was with a same density of the open pollinated variety.

With the monocropping treatments only hot pepper was planted or sowed at similar positions as with intercropping but shallot was not cultivated then.

Layout of the different cropping patterns are presented in Annex I.

Table3. Number of plants per plot and planting distances for shallot and hot pepper.

	Plants per plot	Number of rows	Plants per row	Distance within a row (cm)	Distance between rows (cm)
Shallot	260	10	26	21	15
Shallot with mulch	125	7	25/12	21/41	20
Hot pepper (OP)	100	4	25	21	30/60
Hot pepper (F_1)	50	4	13	42	30/60

Figure 6. One Suat or bed containing two experimental plots.

2.5.2 Mulching

Black plastic mulch of 1.5 m wide was applied to beds and afterwards holes were punched at the plant positions (Fig. 7). With monocropping system only four rows were present, while with intercropping seven rows with plant holes were present. Four rows to plant hot pepper and shallot and three rows for planting of shallots only (Annex I).

Figure 7. Black plastic mulch.

2.5.3 Screen net covers

Screen net covers of 8 x 13 x 2 m (w x l x h) were constructed with bamboo and screen net (Fig. 8). The brand name of the used screen net for the roof was agro pro: type r12-c215trm2-80; 20% light intensity reduction, 27% IUV reduction, 59% wind speed reduction, 77 holes per cm^2, mesh/1" is 20x2, weight is 115 g/m^2. For the walls a net with a smaller mesh size was used, namely agro pro: type r12-c215trm2-73. Characteristics of this net were: 27% light intensity reduction, 37% IUV reduction, 73% wind speed reduction, 138 holes per cm^2, mesh/1" is 24x3, weight is 150 g/m^2.

Figure 8. Screen net covers in the field .

2.5.4 Cultivation practice

Sowing of hot pepper in the field and in the nurseries took place on August 31(Table 4). Sowing for the direct sowing treatment after shallot cultivation took place on May 8th , 2009. With Gada F1 per plot 128 and 130 seeds were sown for respectively the tray and plastic bag transplant raising treatments while with direct sowing 250 seeds were sowed. Respectively 200 and 500 seeds per plot were sown for transplant raising and direct sowing with Tit Segitiga. With direct sowing of both varieties 5 seeds per planting hole were sowed.
Transplanting of hot pepper seedlings raised in the nursery into the field took place on September 28, 2009. Transplants were planted until cotyledon depth. Shallot was planted in the field on August 22 and harvest took place on October 17, 2009.

Table 4. General information on the cultivation.

Hot pepper sowing	:	August 31
Hot pepper transplanting	:	September 28
Hot pepper harvest	:	November 25 – January 21
Shallot planting	:	August 22
Shallot harvest	:	October 17
Used seeds in nursery	:	128/ 130 (Gada) and 200 (Tit Segitiga) per plot
Direct sowing seed use	:	500 seeds per plot for Tit Segitiga
(5 seeds per sowing position)		250 seeds per plot for Gada
Plant density	:	Tit Segitiga at 12.2 plants per m^2
		Gada F_1 at 6.1 and 12.2 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 (Annex V). A total of 503 kg/ha nitrogen, 169 kg/ha P_2O_5 and 268 kg/ha K_2O was applied in split applications.

2.6 Pesticide application

In both the open field spray applications were applied every 3 to 4 days. From 7 days after planting of shallot till the end of the shallot cultivation each application consisted of a mix of insecticides and fungicides. Used pesticides and total amounts are presented in Annex IV.

2.7 Observations

2.7.1 Temperature and rainfall

During the experiment air 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, two were placed inside two screen net covers and one was placed outside in the field. All 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 from the weather station based at Tegal, located 20 km east of the field, were also collected. Data of all these recordings are listed in Annex VI.

2.7.2 Soil temperature

On December 18, temperature of three positions, at the front , halfway and at the end in the middle row, of the beds was recorded by using a soil thermometer.

2.7.3 Nutrient content

From the media used for filling the trays and plastic bags a sample was taken for analyse on nitrogen, potassium, phosphate, calcium and pH level. After preparing the media the sample was taken by taking 1 kg of prepared substrate.

2.7.4 Light intensity and light interception

Light intensity in Lux was measured with a handheld Lux meter (LX93 from Nieuwkoop) inside and outside the nurseries and screen net covers. Light levels inside and outside the nurseries were measured on August 31 and September 14. On August 31 one measurement was taken before shading net was hung up above the seedlings and one measurement was taken after the net was hung up. Light levels were measured above the seedlings at two positions inside the nursery and one outside the nursery (Annex II). Measurements in the field were taken on November 25, December 29 and February 20 Readings were taken just above the crop inside the screen net cover and readings were taken just above the crop of a similar treatment in the open field.
On November 25, December 29, January 25 and February 20, light interception of the crops cultivated inside the screen net covers was measured. Per plot readings were taken according to the method described in figure 9. Readings were taken at 4 positions, 2 next to a stem and 2 in between two stems. A reading was taken at the stem base, halfway and almost at the top of a crop. On the floor readings were taken at the stem base, at 1/4th and ½ of a distance between rows. At 4 positions also a reading above the crop was taken. Per crop measurement percentage light interception was calculated: 100-(measurement – reading above top)/100. When this figure is 100% than the crop has intercepted all available light, and when the figure is zero no light was intercepted by the crop. Measurements were taken only at the treatments listed in table 5.

Table 5. Crop light measurements treatments.

code	variety	raising	cover	system
A1B1C2	Tit Segitiga	direct sowing	no	Intercropping
A1B2C1	Tit Segitiga	Plastic tray	yes	Intercropping
A1B2C2	Tit Segitiga	Plastic tray	no	Intercropping
A2B1C1	Gada	direct sowing	yes	intercropping
A2B1C2	Gada	direct sowing	no	intercropping
A2B2C1	Gada	Plastic tray	yes	Intercropping
A2B2C2	Gada	Plastic tray	no	Intercropping

A2B3C1	Gada	Plastic tray	yes	Intercropping at 100 plants/plot
A2B3C2	Gada	Plastic tray	no	Intercropping at 100 plants/plot

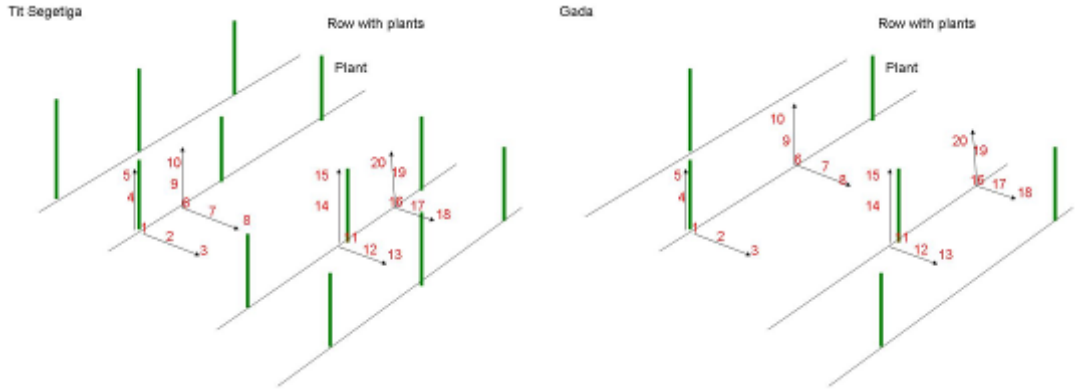


Figure 9. Method of light intensity measurements in the crop.

2.7.5 Nursery observations

Emergence was observed 10 at 20 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.

2.7.6 Shallot harvest observations

Shallots were harvested on October 17, per plot marketable production in gram was recorded.

2.7.7 Plant length and number of internodes

On December 30 plant height and total number of internodes per plant of 5 plants per treatment was observed. Average internode ratio was calculated by dividing the plant height by the total number of internodes per plant.

2.7.8 Hot pepper harvest observations

Fruits were harvested when mature, and harvesting took every two to five days place depending on the speed of fruit maturing.
At each harvest date, per plot the number and total weight of harvested fruits in gram was observed. After this fruits were graded in marketable fruits and unmarketable fruits. The number and weight of marketable fruits was then 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.

2.8 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 the cultivation of hot pepper mean temperature was on average 27 to 28°C (Fig. 10). At the end of the cultivation in January temperature showed a somewhat declining trend. Minimum temperature was just below 25°C and maximum temperature showed temperatures between 30 and 35°C.
At the start of the cultivation almost no precipitation was recorded. In the period from 16 to 23 November a high amount of precipitation was recorded with an amount of about 100 mm. From then onwards frequent showers were present and the total precipitation recorded over the whole cultivation period was 393 mm.

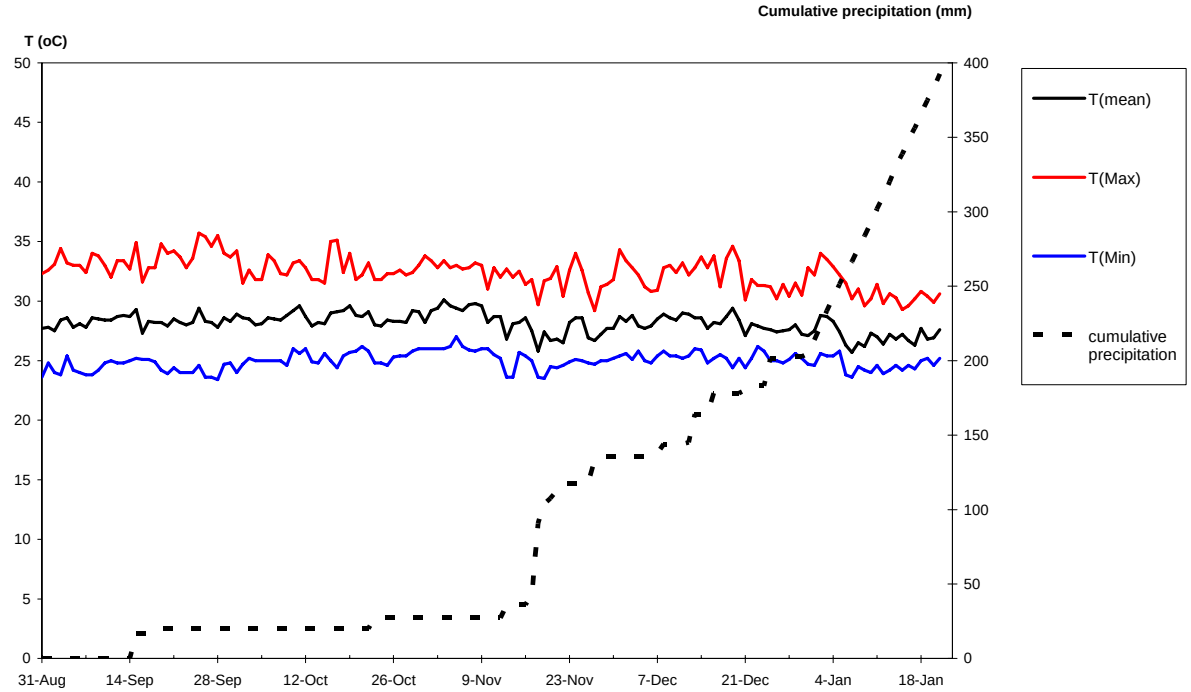


Figure 10. Rainfall, maximum and minimum temperature recorded at the Tegal weather station.

Maximum temperature recorded in the field was around 30°C (Fig. 11), which was a few degrees lower than the official recorded maximum temperature in Tegal. Minimum temperature in the field was around 20°C for the duration of the experiment. Also this reading was 5 to 4 degrees lower than the minimum temperature recorded at Tegal. Minimum temperature inside the screen net cover was similar to the temperature recorded in the open field. Maximum temperature inside the screen net covers reached temperatures higher than 40°C and was about 10 degrees higher than the recorded open field temperature. However, presumed is that the outside maximum temperature was not recorded properly. Nevertheless it seems that inside the screen net covers temperature is higher than in the open field.

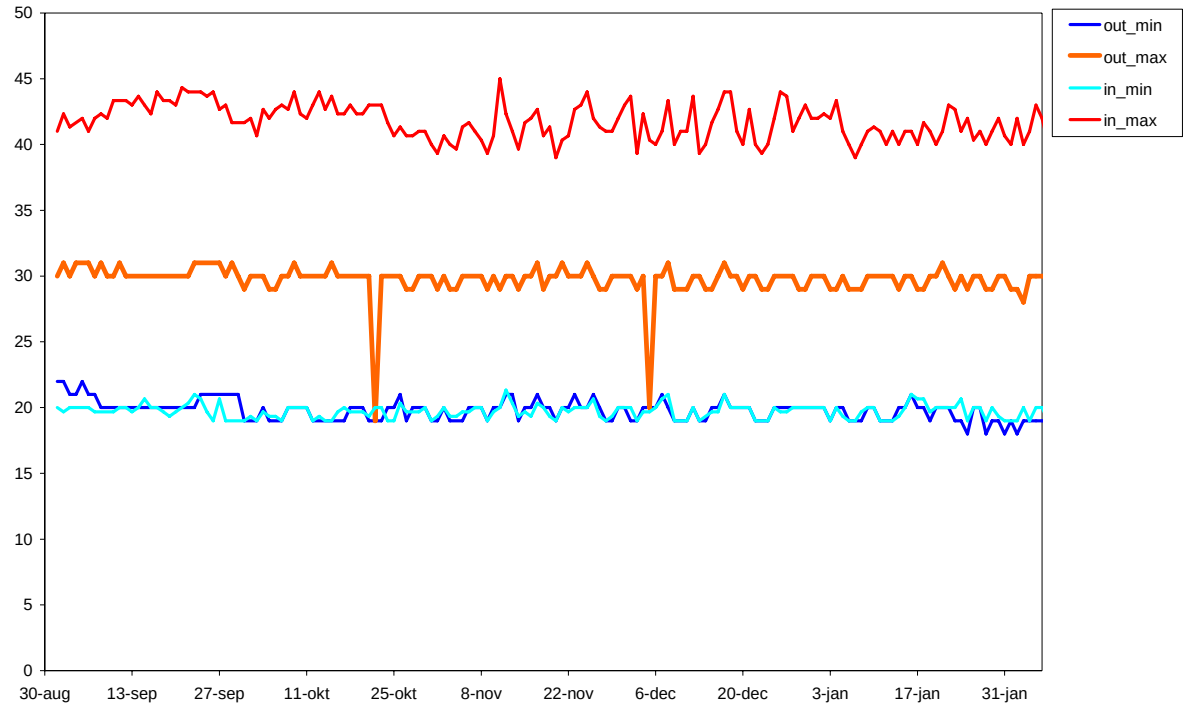


Figure 11. *Maximum and minimum temperature recorded in the open field and inside the screen net covers.*

3.2 Light levels

Before the shading net was hung up in the nurseries the light reduction was on average 17% of the outdoor light level (Table 6). After the shading net was hung up, the light reduction increased to 55.6%. On September 14, the reduction was even higher with 73.8 %.

Table 6. Light level reduction by the nursery net cover (%) compared to outdoor light conditions.

		Measuring position		
Observation date	Shading net in nursery	L1	L2	mean
31 August	no shading net	15.3	18.6	17.0
31 August	with shading net	56.4	54.8	55.6
14 September	with shading net	71.6	74.8	73.8

Between treatments and observation date in the field, there were no interactions in light level reduction present (Table 7).

Table 7. Light level reduction by the screen net cover (%) compared to outdoor light conditions.

System		Observation date			
variety	treatment	25 November	29 December	20 February	mean
Gada	DS+IC	38	27	32	32
Gada	PT+IC	30	25	36	30
Gada	PT+IC+100	19	21	25	22
Tit Segitiga	PT+IC	23	15	22	20
mean		28	22	29	
	lsd	p=			
System	18	0.7			
Date	21	0.5			
S*D	36	1.0			

The level of light reduction was for each observation date not significant different. Also between treatments there were no significant differences in light reduction. This is not surprising since all measurements were taken just

above the crops to measure the light reducing effect of the screen net cover on light intensity. The observed mean light intensity reduction of the screen net cover construction was 26 %. This is 6% more than the stated value by the manufacturer for the type of screen net used for the roof construction. Since the observations were done just above the crop also the side wall screen nets and the used bamboo poles influence the results. The stated light reduction of the type of net used for the side walls is 27%.

3.3 Nutrient content of media

The used media in this experiment was the combination of top soil with manure (TS+M) (Table 8). The pH of this media is slightly alkaline with a pH-H_2O of 6.9, 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 0.3 % or 300 mg per 100 gram media. N-min content of the substrate used in the experiments is 93.7 mg/kg media or 0.15 kg/m^3 based on fresh weight of the media. For transplant raising a nitrate and ammonium content of 8 – 9.5 mmol per litre is recommended by the Dutch society RHP.

Table 8. Bulk density and nutrient content of media/substrate samples taken in February 2009.

Media	kg/l	pH-H_2O	pH-KCl	N (%)	N-min (ppm)	P_2O_5 (%)	K_2O (%)	CaO (%)	MgO (%)
Rice husk (RH)	0.6	6.9	6.0	0.43	93.5	0.24	0.14	0.12	0.07
Manure (M)	0.7	8.6	8.4	0.38	52.9	0.86	1.48	2.85	1.19
Top soil (TS)	1.4	6.9	5.9	0.28	2.9	0.16	0.42	1.13	0.04
RH + M	0.7	8.4	8.2	0.48	93.7	0.66	1.39	2.18	0.86
TS + M	0.8	8.1	7.8	0.33	61.6	0.42	0.96	2.00	1.02
RH + M + TS	0.8	8.1	7.7	0.39	37.9	0.53	0.98	1.92	1.12

3.4 Effect of variety and raising method on transplant production and yield of hot pepper

3.4.1 Nursery results

Emergence after 10 days was significant higher with direct sowing (Table 9). With sowing in plastic bags or in trays the emergence was 2 to 14% while with direct sowing more than 47% of the seeds was emerged. Between varieties no differences in emergence were present with direct sowing or with sowing in plastic bags. With sowing in trays, Tit Segitiga showed a slightly higher emergence than Gada.

Table 9. Effect of variety and raising method on emergence after 10 days (%).

	Gada	Tit Segitiga	mean
Direct sowing	59	47	53
Plastic bag	2	5	4
Plastic tray	6	14	10
mean	22	22	
	lsd	p =	
Variety	4.5	1.0	
Raising	5.5	<0.001	
V*R	7.8	0.008	

After 20 days emergence was lower with direct sowing compared to sowing in plastic bags or in trays (Table 10). Emergence in plastic bag was the same than the emergence present with sowing in trays. Between Gada and Tit Segitiga no significant differences in emergence after 20 days were present.

Table 10. Effect of variety and raising method on emergence after 20 days (%).

	Gada	Tit Segitiga	mean
Direct sowing	66	61	64
Plastic bag	90	84	87
Plastic tray	79	87	83
mean	78	77	
	lsd	p =	
Variety	5.2	0.7	
Raising	6.3	<0.001	
V*R	8.9	0.06	

With sowing in trays or plastic bags a significant higher percentage of usable seedlings was present compared with direct sowing (Table 11). Between Tit Segitiga and Gada no difference in percentage of usable seedlings was present.

Table 11. Effect of variety and raising method on usable transplant (%).

	Gada	Tit Segitiga	mean
Direct sowing	34	45	40
Plastic bag	87	83	85
Plastic tray	79	85	82
mean	67	71	
	lsd	p =	
Variety	6.6	0.2	
Raising	8.0	<0.001	
V*R	11.4	0.2	

At the time of transplanting seedlings raised in trays showed a significant higher dry matter percentage than the percentage present with raising in plastic bags or with direct sowing (Table 12). Both varieties showed a same dry matter percentage at the time of transplanting.

Table 12. Effect of variety and raising method on dry matter (%).

	Gada	Tit Segitiga	mean
Direct sowing	12.4	13.6	13.0
Plastic bag	13.6	13.6	13.6
Plastic tray	15.8	16.5	16.1
mean	13.9	14.5	
	lsd	p =	
Variety	1.7	0.5	
Raising	2.1	0.016	
V*R	2.9	0.8	

Dry weight of Gada seedlings was higher than the dry weight of Tit Segitiga seedlings at time of transplanting (Table 13). Seedlings raised in a tray showed a lower dry weight than seedlings raised in plastic bag or raised with direct sowing.

Table 13. Effect of variety and raising method on dry weight (g).

	Gada	Tit Segitiga	mean
Direct sowing	0.17	0.12	0.14
Plastic bag	0.13	0.11	0.12
Plastic tray	0.07	0.06	0.07
mean	0.12	0.10	
	lsd	p =	
Variety	0.012	<0.001	
Raising	0.015	<0.001	
V*R	0.021	0.2	

Gada seedlings showed a higher fresh weight at transplanting than Tit Segitiga seedlings (Table 14). Seedlings raised in trays showed a lower fresh weight than seedlings raised in plastic bags which showed a lower fresh than seedlings with direct sowing.

Table 14. Effect of variety and raising method on fresh weight (g).

	Gada	Tit Segitiga	mean
Direct sowing	27.7	18.4	23.1
Plastic bag	19.6	15.7	17.7
Plastic tray	9.3	7.0	8.1
mean	18.9	13.7	
	lsd	p =	
Variety	3.5	0.007	
Raising	4.2	<0.001	
V*R	6.0	0.2	

The length of Gada seedlings at time of transplanting was 11.4 cm and was significant longer than the length of Tit Segitiga seedlings (Table 15). Seedlings raised with direct sowing or in plastic bags were significant taller than seedlings raised in trays.

Table 15. Effect of variety and raising method on plant length (cm)

	Gada	Tit Segitiga	mean
Direct sowing	13.2	12.1	12.7
Plastic bag	13.1	10.9	12.0
Plastic tray	7.9	6.8	7.4
mean	11.4	10.0	
	lsd	p =	
Variety	1.0	0.009	
Raising	1.2	<0.001	
V*R	1.7	0.5	

Gada seedlings showed a higher umber of leaves per seedling than Tit Segitiga (Table 16). Seedlings raised with direct sowing showed the highest number of leaves. On average direct sowing seedlings showed 8.4 leaves per plant. Seedlings raised in plastic bag showed a significant lower number than with direct sowing, but did show a higher number compared to raising in trays.

Table 16. Effect of variety and raising method on number of leaves (No.).

	Gada	Tit Segitiga	mean
Direct sowing	8.6	8.2	8.4
Plastic bag	8.4	7.5	7.9
Plastic tray	6.9	6.3	6.6
mean	7.9	7.3	
	lsd	p =	
Variety	0.3	0.001	
Raising	0.4	<0.001	
V*R	0.5	0.5	

No effect of variety and raising method was observed on percentage seedlings with virus symptoms (Table 17). In both seedlings raised with direct sowing or raised in a nursery in plastic bags or trays the percentage was low with not more than 2% of the seedlings showing virus symptoms.

Table 17. Effect of variety and raising method on plants with virus symptoms (%).

	Gada	Tit Segitiga	mean
Direct sowing	1.7	1.1	1.4
Plastic bag	1.0	1.2	1.1
Plastic tray	1.0	0.3	0.7
mean	1.2	0.9	
	lsd	p =	
Variety	1.5	0.6	
Raising	1.8	0.6	
V*R	2.5	0.8	

Seedlings raised with direct sowing showed a significant higher percentage of plants with thrips symptoms than seedlings raised in plastic bags or in trays (Table 18).

Table 18. Effect of variety and raising method on plants with thrips infection symptoms (%).

	Gada	Tit Segitiga	mean
Direct sowing	32.8	13.5	23.2
Plastic bag	0.3	0.7	0.5
Plastic tray	1.3	1.0	1.2
mean	11.5	5.1	
	lsd	p =	
Variety	4.8	0.014	
Raising	5.9	<0.001	
V*R	8.3	0.006	

3.4.2 Plant growth results

On December 30 plant length of Tit Segitiga was 67.9 cm and plants were almost significant taller than those of Gada (Table 19). Plants of direct sowing or from transplants raised in plastic bags or trays showed similar plant lengths.

Table 19. Effect of variety and raising method on plant length on December 30, 2009 (cm).

	Gada	Tit Segitiga	mean
Direct sowing	63.8	68.8	66.2
Plastic bag	64.1	66.3	65.2
Plastic tray	61.8	68.8	65.2
mean	63.2	67.9	
	lsd	p =	
Variety	5.1	0.066	
Raising	6.3	0.9	
V*R	8.8	0.7	

No significant effects of variety and raising method were present on number of internodes per stem (Table 20). Gada showed a slightly higher but not significant higher number of internodes than Tit Segitiga.

Table 20. Effect of variety and raising method on number of internodes on December 30, 2009 (No.).

	Gada	Tit Segitiga	mean
Direct sowing	17.8	17.8	17.8
Plastic bag	19.2	16.7	17.9
Plastic tray	17.6	18.1	17.8
mean	18.2	17.5	
	lsd	p =	
Variety	1.4	0.3	
Raising	1.7	1.0	
V*R	2.4	0.2	

Average internode ratio of Gada plants was lower than the ratio present with Tit Segitiga (Table 21). All raising treatments showed a same internode ratio.

Table 21. Effect of variety and raising method on internode ratio on December 30, 2009 (cm).

	Gada	Tit Segitiga	mean
Direct sowing	3.6	3.9	3.7
Plastic bag	3.4	4.0	3.7
Plastic tray	3.5	3.8	3.7
mean	3.5	3.9	
	lsd	p =	
Variety	0.38	0.038	
Raising	0.46	0.9	
V*R	0.65	0.7	

Average light interception by a crop was significant higher for Tit Segitiga compared to the interception by Gada plants (Table 22). Plants raised with direct sowing showed a higher light interception percentage than the crop cultivated from transplants raised in a tray.

Table 22. Effect of variety and raising method on average crop light interception (%).

	Gada	Tit Segitiga	mean
Direct sowing	65	66	65
Plastic tray	54	65	59
mean	59	65	
	lsd	p =	
Variety	4.0	0.004	
Raising	4.0	0.004	
V*R	5.7	0.02	

Light measurements at the row base did not show large differences in light interception by the plants between treatments (Fig. 12). With raising of Gada in plastic trays the light interception halfway the plant was quite lower than the interception halfway the plants of the other treatments. Light interception measured just below the top of the plants was with direct sowing higher than with plastic tray transplants. Tit Segitiga showed a higher percentage of light interception than Gada.

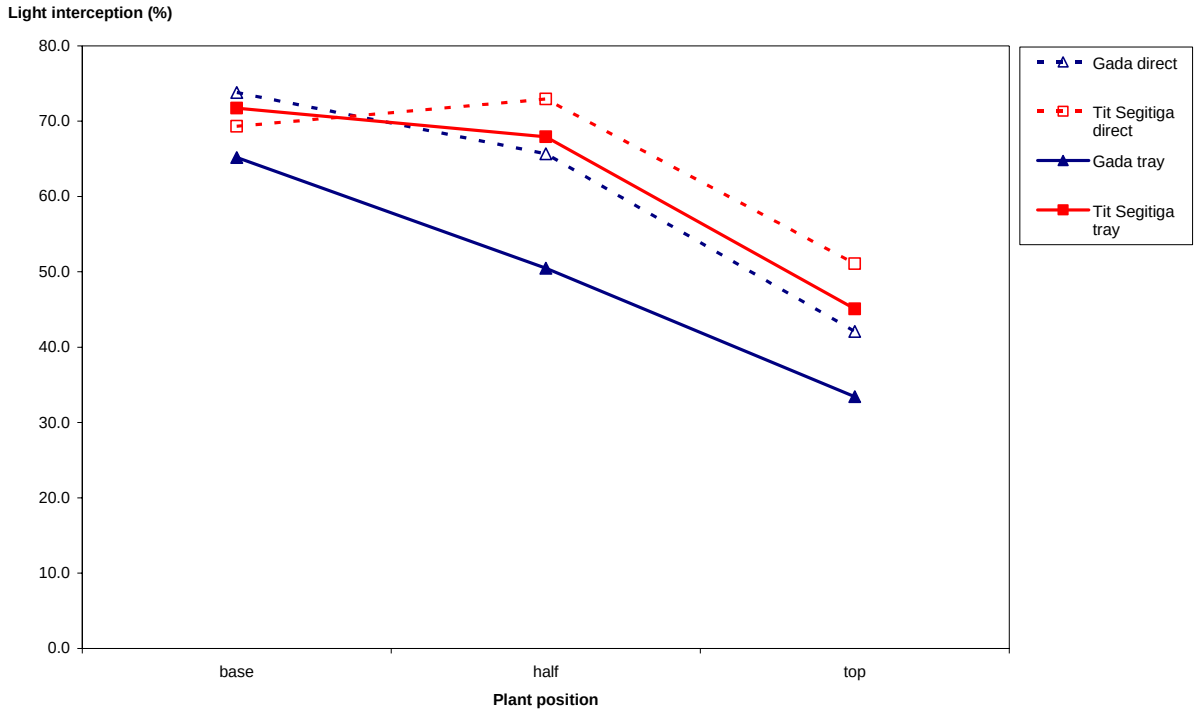


Figure 12.. Light interception measured at different heights measured in a plant row.

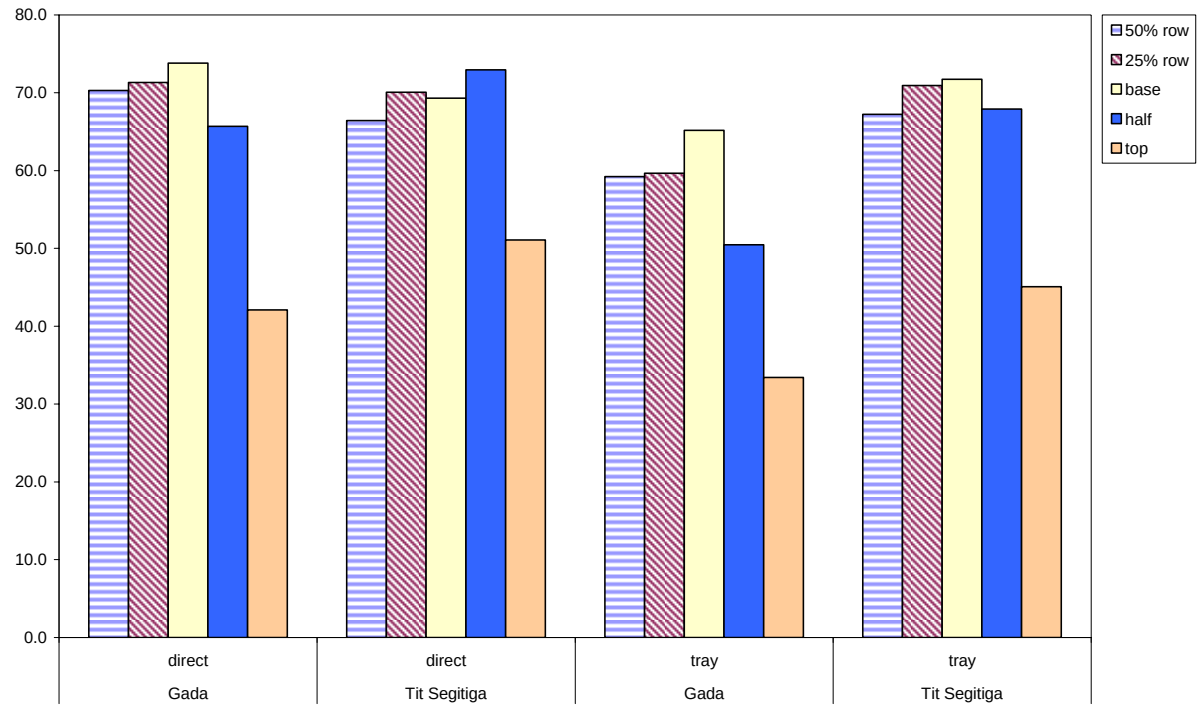


Figure 13. Light interception measured at different positions.

Average soil temperature with cultivation of Gada was 29.1°C (Table 23). This was significant higher then the temperature recorded with Tit Segitiga cultivation. No interaction was present between measuring date and treatments. Between treatments and variety also no significant differences were present in temperature. On 18 December and on 16 January average soil temperature was 27.3 and 27.9°C while on February 18 the soil temperature was 31.4°C.

Table 23. Effect of variety and raising method on average soil temperature (°C).

	Gada	Tit Segitiga	mean
Direct sowing	28.8	28.7	28.8
Plastic bag	29.1	28.7	28.9
Plastic tray	29.3	28.7	30.0
mean	29.1	28.7	
	lsd	p =	
Variety	0.3	0.03	
Raising	0.4	0.7	
V*R	0.6	0.4	

3.4.3 Yield results

No significant effect of variety and raising method was observed on the yield of the shallot intercrop (Table 24). Average yield of the shallots was 2.3 kg/m2 or 23 ton/ha.

Table 24. Effect of variety and raising method on shallot yield (kg/m^2).

	Gada	Tit Segitiga	mean
Direct sowing	2.4	2.2	2.3
Plastic bag	2.3	2.4	2.4
Plastic tray	2.3	2.2	2.3
mean	2.3	2.3	
	lsd	p =	
Variety	0.27	0.5	
Raising	0.33	0.7	
V*R	0.47	0.5	

Share of marketable fruits in the total number of fruits per plant was for all treatment not significant different (Table 25). Share of marketable fruits in the total production was on average 59%.

Table 25. Effect of variety and raising method on share of marketable number of fruits in total harvested fruits (%).

	Gada	Tit Segitiga	mean
Direct sowing	57	57	57
Plastic bag	57	62	59
Plastic tray	62	59	61
mean	59	59	
	lsd	p =	
Variety	7.6	0.9	
Raising	9.3	0.7	
V*R	13.2	0.6	

Total yield per plant was with Gada plants higher than with Tit Segitiga plants (Table 26). With Gada production per plant was 59.8 g while with Tit Segitiga a production of 29.0 g per plant was present.
Between raising treatments no significant difference in production per plant was present.

Table 26. Effect of variety and raising method on total yield per plant (g/plant).

	Gada	Tit Segitiga	mean
Direct sowing	60.0	25.8	42.9
Plastic bag	61.7	29.4	45.5
Plastic tray	57.7	31.8	44.8
mean	59.8	29.0	
	lsd	p =	
Variety	9.9	<0.001	
Raising	12.1	0.9	
V*R	17.1	0.7	

Total number of harvested fruits per plant was significant higher with cultivation of Gada plants (Table 27). Number of fruits was with Gada 8.3 per plant and with Tit Segitiga 3.9. Plants raised in trays or in plastic bags did not show a higher number of fruits per plant.

Table 27. Effect of variety and raising method on total harvested fruits per plant (No./plant).

	Gada	Tit Segitiga	mean
Direct sowing	8.7	3.5	6.1
Plastic bag	8.2	3.8	6.0
Plastic tray	7.8	4.2	6.0
mean	8.3	3.9	
	lsd	p =	
Variety	1.5	<0.001	
Raising	1.9	1.0	
V*R	2.6	0.7	

The marketable yield per plant was with cultivation of Gada significant higher than with cultivation of Tit Segitiga (Table 28). Marketable yield of Tit Segitiga was on average 18.2 gram per plant. With Gada this was on average 36.0 gram per plant. Marketable yield with direct sowing did not differ significantly from plants raised in a nursery.

Table 28. Effect of variety and raising method on marketable yield per plant (g/plant).

	Gada	Tit Segitiga	mean
Direct sowing	38.6	15.1	26.8
Plastic bag	34.4	19.4	26.9
Plastic tray	35.0	20.1	27.5
mean	36.0	18.2	
	lsd	p =	
Variety	9.6	0.002	
Raising	11.7	1.0	
V*R	16.5	0.7	

Gada yielded 4.9 marketable fruits per plant which was significant higher than the number present with Tit Segitiga (Table 29). Raising treatment had no significant effect on number of marketable fruits per plant.

Table 29. Effect of variety and raising method on marketable fruits per plant (No./plant).

	Gada	Tit Segitiga	mean
Direct sowing	5.4	2.0	3.7
Plastic bag	4.6	2.4	3.5
Plastic tray	4.7	2.5	3.6
mean	4.9	2.3	
	lsd	p =	
Variety	1.5	0.004	
Raising	1.9	1.0	
V*R	2.7	0.7	

Yield per square meter of Gada plants was on average 338 g/m^2 and was not significant different from the yield of Tit Segitiga (Table 30). Direct sowing showed a total yield of 323 g/m^2 or 3.2 ton/ha. This was not significant different from the total yield present with cultivation of plants raised in plastic bags or in trays.

Table 30. Effect of variety and raising method on total yield per square meter (g/m^2).

	Gada	Tit Segitiga	mean
Direct sowing	349	297	323
Plastic bag	340	343	342
Plastic tray	327	363	345
mean	338	335	
	lsd	p =	
Variety	60.8	0.9	
Raising	74.5	0.8	
V*R	105.4	0.4	

No significant difference in total number of fruits per square meter was present between plant raising treatments (Table 31). Between variety no significant difference in number of fruits was present either.

Table 31. Effect of variety and raising method on total harvested fruits per square meter (No./m^2).

	Gada	Tit Segitiga	mean
Direct sowing	50	40	45
Plastic bag	45	45	45
Plastic tray	44	48	46
mean	47	44	
	lsd	p =	
Variety	9.0	0.6	
Raising	11.0	1.0	
V*R	15.6	0.4	

Marketable yield per square meter was on average 210 g/m^2 (Table 32). No significant differences were present between the raising treatments. Neither was there a significant difference in marketable yield between Gada and Tit Segitiga.

Table 32. Effect of variety and raising method on marketable yield per square meter (g/m^2).

	Gada	Tit Segitiga	mean
Direct sowing	226	176	201
Plastic bag	195	227	211
Plastic tray	203	232	218
mean	208	212	
	lsd	p =	
Variety	59.5	0.9	
Raising	72.8	0.9	
V*R	103.0	0.4	

Hot pepper was harvested for the first time on December 6th (Fig. 14). However, not many fruits were harvested in the period from December 6 till December 12. Direct sowing of Gada showed a higher increase in yield in the week from 12 till 19 December while the other treatments showed low yields still. Only 2 weeks later those treatments, with the exception of direct sowing of Tit Segitiga, showed an increase in yield while Gada direct sowing showed a lower increase compared to that. Direct sowing of Tit Segitiga showed finally early January an increase in yield.

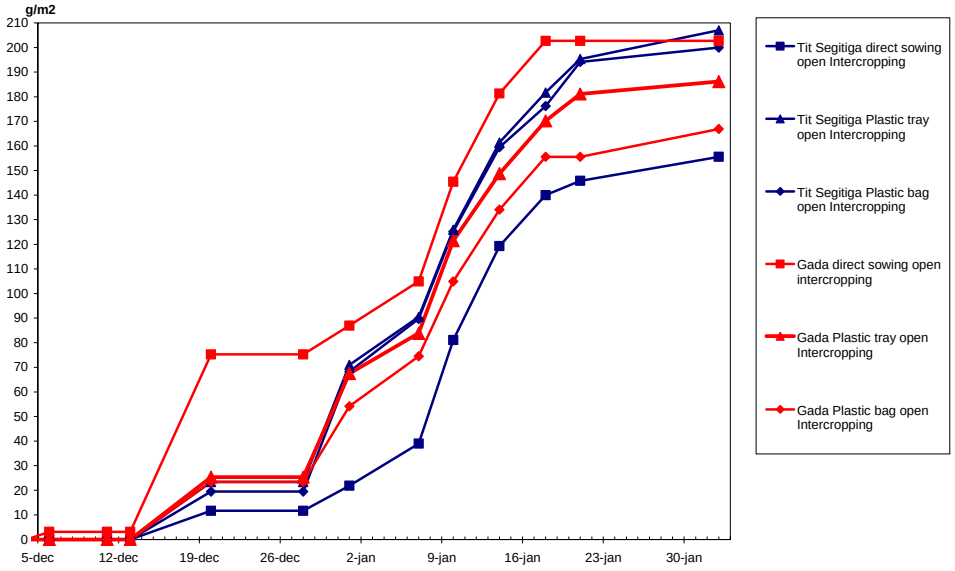


Figure 14. Cumulative marketable production of Gada and Tit Segitiga with three raising methods.

No significant differences between raising treatment were present in number of marketable fruits per square meter (Table 33). Average number of marketable fruits was 28 per square meter. No difference between variety was observed.

Table 33. Effect of variety and raising method on marketable fruits per square meter (No./m^2).

	Gada	Tit Segitiga	mean
Direct sowing	32	23	27
Plastic bag	26	28	27
Plastic tray	28	29	28
mean	28	27	
	lsd	p =	
Variety	9.1	0.7	
Raising	11.1	1.0	
V*R	15.8	0.5	

Average fruit weight of Tit Segitiga fruits was 7.9 grams (Table 34). The weight of these fruits was significant more than the weight of Gada fruits which showed an average weight of 7.5 grams. Method of raising did not show different fruit weight.

Table 34. Effect of variety and raising method on average fruit weight of marketable fruits (g).

	Gada	Tit Segitiga	mean
Direct sowing	7.5	7.7	7.6
Plastic bag	7.6	8.0	7.8
Plastic tray	7.5	8.0	7.7
mean	7.5	7.9	
	lsd	p =	
Variety	0.4	0.04	
Raising	0.5	0.6	
V*R	0.7	0.7	

3.5 Effect of screen net cover and cultivation on growth and yield of hot pepper cv. Gada

3.5.1 Plant results

Hot pepper plants cv. Gada cultivated in a screen net cover construction were significant taller than plants cultivated in the open field (Table 35). Monocropping with mulch showed shorter plants compared to intercropping with mulch. In the open field monocropping without mulch showed shorter plants than present with mulch. In the screen net cover construction plants with mulch showed a shorter plant length compared to plants grown without mulch. Gada plants cultivated with 11.7 pl/m^2 showed a longer plant length than plants cultivated with 5.8 pl/m^2.

Table 35. Effect of screen net cover and cultivation method on plant length of Gada on December 30, 2009 (cm).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	64	100	82
Tray	intercropping	62	98	80
	intercropping + mulch	63	90	77
	intercropping + 11.7 pl/m^2	70	104	87
	monocropping	47	94	70
	monocropping + mulch	55	70	63
mean		60	93	
	lsd	p =		
Cover	5.4	<0.001		
System	9.4	<0.001		
C*S	13.2	0.037		

Number of internodes was higher with plants cultivated inside a screen net cover construction (Table 36). In the open field the average number of internodes was 16.8 while inside the screen net cover plants showed 19.6 internodes. With tray transplants and intercropping the average number of internodes was 19. This number was not significant different from that present with direct sowing. Plants cultivated as a monocrop with mulch showed a significant lower number of internodes compared to intercropping without mulch. Compared with monocropping without mulch it showed an almost significant lower number of internodes too.

Table 36. Effect of screen net cover and cultivation method on number of internodes of Gada on December 30, 2009 (No./plant).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	17.8	19.8	18.8
Tray	intercropping	17.6	20.3	19.0
	intercropping + mulch	17.0	20.8	18.9
	intercropping + 11.7 pl/m^2	18.8	20.0	19.4
	monocropping	15.0	19.8	17.4
	monocropping + mulch	14.8	17.0	15.9
mean		16.8	19.6	
	lsd	p =		
Cover	1.0	<0.001		
System	1.8	0.004		
C*S	2.5	0.4		

When plants were grown inside a screen net cover construction, the average internode ratio was significant higher than the internode ratio of plants grown in the open field (Table 37). Inside the screen net cover the average internode ratio was 4.7 cm while in the open field this was 3.6 cm. Between method of cultivation no significant different internode ratios were present.

Table 37. Effect of screen net cover and cultivation method on internode ratio of Gada on December 30, 2009 (cm).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	3.8	5.1	4.4
Tray	intercropping	3.5	4.9	4.2
	intercropping + mulch	3.7	4.3	4.0
	intercropping + 11.7 pl/m^2	3.7	5.2	4.5
	monocropping	3.1	4.7	3.9
	monocropping + mulch	3.8	4.2	4.0
mean		3.6	4.7	
	lsd	p =		
Cover	0.37	<0.001		
System	0.64	0.4		
C*S	0.90	0.2		

Between the three observation dates no interaction with cultivation system or cover was present. Soil temperature was in the open field not significant different from the soil temperature recorded inside the screen net cover (Table 38). Average soil temperature of three observation dates was 29^{o}C.

Table 38. Effect of screen net cover and cultivation method on soil temperature (^{o}C).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	28.8	28.9	28.9
Tray	intercropping	29.3	28.7	29.0
	intercropping + mulch	29.2	28.6	28.9
	intercropping + 11.7 pl/m^2	28.5	28.5	28.5
	monocropping	28.9	28.8	28.9
	monocropping + mulch	29.8	29.9	29.8
mean		29.1	28.9	
	lsd	p =		
Cover	0.30	0.2		
System	0.52	<0.001		
C*S	0.74	0.5		

Light conditions inside a screen net cover were 28% lower compared to open field conditions (Table 6). Light use efficiency of plants were similar for plants in the open field and inside the screen net cover. The plants inside the

screen net cover had a same light interception of the available light than the crop grown in the open field (Table 39). Of the available light plants intercepted on average 62.5%. Between cultivation system a significant difference in light interception was present. When cultivated inside a screen net cover, plants of direct sowing showed a significant lower light interception than tray plants grown at 11.7 pl/m^2 and an almost significant lower interception than tray plants grown at 5.8 pl/m^2. In the open field direct sowing showed a higher light interception than tray plants grown at 5.8 pl/m^2 and was not significant different from the interception observed with plants grown at 11.7 pl/m^2.

Table 39. Effect of screen net cover and cultivation method on average crop light interception of Gada plants (%).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	64.6	57.8	61.2
Tray	intercropping	53.6	64.1	58.8
	intercropping + 11.7 pl/m^2	68.1	66.7	67.4
mean		62.1	62.9	
	lsd	p =		
Cover	4.2	0.7		
System	5.1	0.004		
C*S	7.2	0.004		

Light interception at the base of plants was with direct sowing lower in the screen net cover than in the open field (Fig. 14). Light interception of tray plants was higher in the screen net cover than in the open field. With 11.7 pl/m^2 no difference in light interception at the base was present between open field and screen net cover. Light interception halfway the plant was, except for tray transplants in the open field, for all treatments the same. Tray transplants in the open field showed a lower light interception. Light interception observed just below the top of the plants was inside the screen net cover lower than in the open field. Tray transplants cultivated at 5.8 pl/m^2 did not show different light interceptions between the open field and screen net cover.

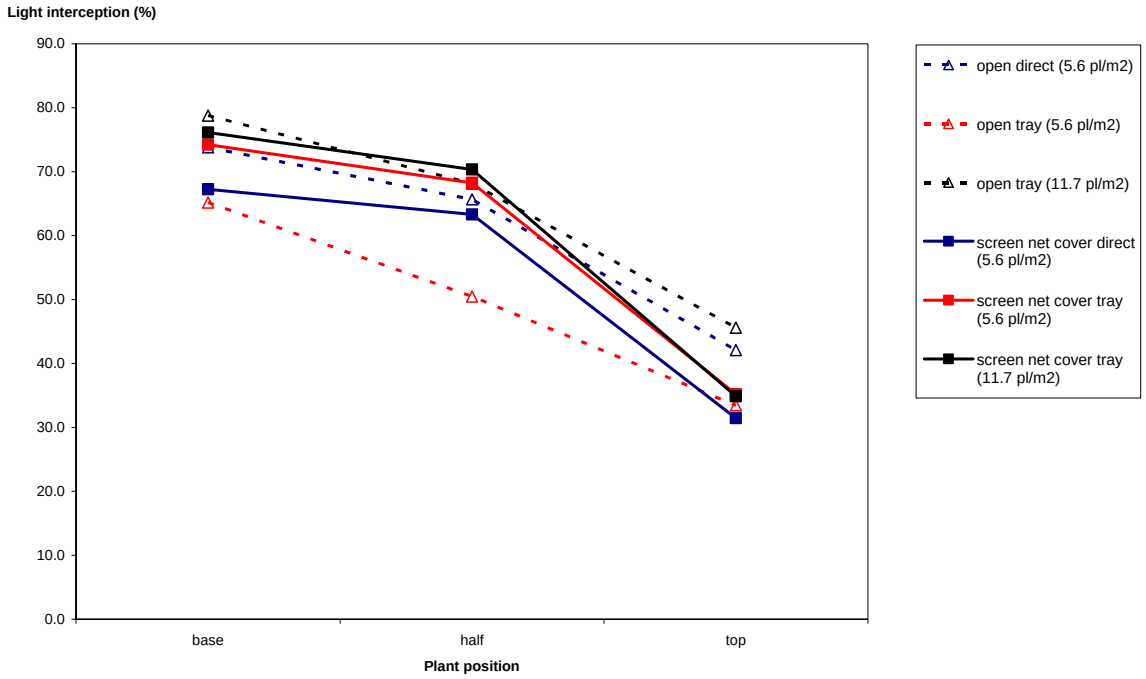


Figure 14 . Light interception measured at different heights of a plant row.

Light interception measured at the bottom next to the plant row, at 25% of the row distance and at 50% of the row distance showed almost the same light interception at each treatment (Fig. 15). The difference in light interception observed at the base and at halfway of the plants in the open field was slightly more than that observed in the screen net cover. The light interception just below the top of plant inside the screen net cover was lower than that

observed in the open field. This means also that the decrease in light interception from halfway the plant to the top was bigger with plants grown inside a screen net cover than in the open field.

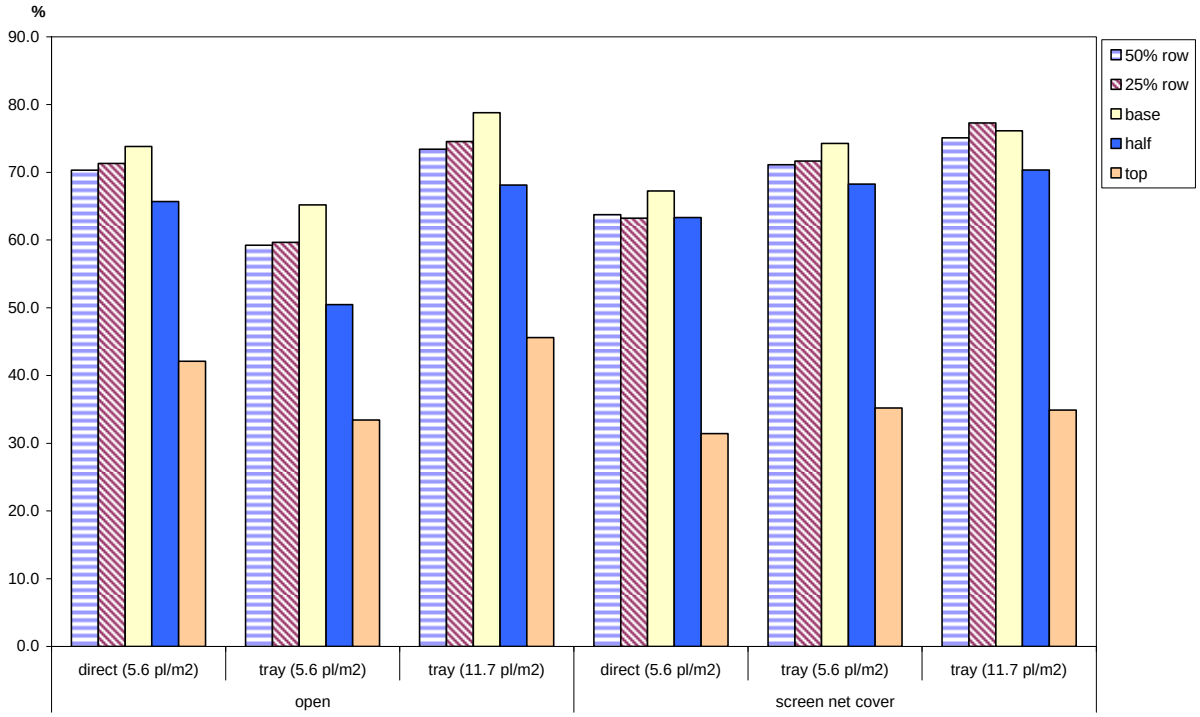


Figure 15. Light interception measured at different positions.

3.5.2 Yield results

With monocropping cultivation of hot pepper, shallot was not cultivated and therefore no yield was observed (Table 40). With the different hot pepper cultivation systems, shallot yield inside a screen net cover was not significant higher than the yield in the open field. With the application of plastic mulch the yield of shallot was significant lower compared to the other treatments. However, with this system also the plant density of shallot was lower with 14.6 bulbs/m^2 compared to 30.4 bulbs/m^2 present with the other treatments. Yield of shallot cultivated as an intercrop with Gada planted with 11.7 pl/m^2, did not differ from yield present with Gada planted with 5.8 pl/m^2.

Table 40. Effect of screen net cover and cultivation method on shallot yield (kg/m^2).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	2.4	2.7	2.5
Tray	intercropping	2.3	2.6	2.5
	intercropping + mulch	1.8	1.5	1.7
	intercropping + 11.7 pl/m^2	2.2	2.8	2.5
	monocropping	-	-	-
	monocropping + mulch	-	-	-
mean		2.2	2.4	
	lsd	p =		
Cover	0.29	0.1		
System	0.42	0.001		
C*S	0.60	0.2		

A higher percentage of healthy fruits was present when plants were cultivated inside a screen net cover construction (Table 41). Inside the screen net cover, percentage healthy fruits was 86% of the total number harvested from a plant. Cultivation system had no effect on percentage healthy fruits.

Table 41. Effect of screen net cover and cultivation method on percentage healthy fruit of total harvested number (%)

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	57	85	71
Tray	intercropping	62	85	74
	intercropping + mulch	54	88	71
	intercropping + 11.7 pl/m^2	57	86	72
	monocropping	51	85	68
	monocropping + mulch	58	85	72
mean		57	86	
	lsd	p =		
Cover	4.6	<0.001		
System	8.0	0.8		
C*S	11.3	0.7		

The total yield was significant higher when plants were cultivated inside a screen net cover (Table 42). Average total yield inside the screen net cover was 472 g/m^2 or 4.7 t/ha/. When cultivation took place in the open field the total yield was 3.2 t/ha. Between cultivation systems were no significant differences present in total yield. Nevertheless it seemed that lower yields were present with intercropping and mulch cultivation and with monocropping cultivation. Although not significant with intercropping cultivation, the total yield was lower when applying mulch compared to intercropping without mulch, while with monocropping cultivation the total yield was higher when applying mulch.

Table 42. Effect of screen net cover and cultivation method on total yield per square meter(g/m^2).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	349	558	454
Tray	intercropping	327	483	405
	intercropping + mulch	291	403	347
	intercropping + 11.7 pl/m2	338	460	399
	monocropping	244	439	342
	monocropping + mulch	339	491	415
mean		315	472	
	lsd	p =		
Cover	64.0	<0.001		
System	110.8	0.3		
C*S	156.7	0.9		

Per plant a total of 66 fruits were harvested with cultivation inside a screen net cover (Table 43). In the open field per plant 43 fruits were harvested. Between treatments no significant differences were present. However, intercropping with mulch showed a lower number than intercropping without mulch. With monocropping the mulch treatment showed a higher number compared to the number present without mulch.

Table 43. Effect of screen net cover and cultivation method on total fruit number per square meter (No./m^2).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	50.4	76.3	63.4
Tray	intercropping	44.1	67.0	55.6
	intercropping + mulch	39.5	59.6	49.6
	intercropping + 11.7 pl/m^2	47.5	64.3	55.9
	monocropping	33.4	59.9	46.6
	monocropping + mulch	43.9	69.2	56.6
mean		43.1	66.0	
	lsd	p =		
Cover	8.8	<0.001		
System	15.3	0.3		
C*S	21.6	1.0		

Marketable yield of cultivation inside a screen net cover was significant higher than the yield of open field cultivation (Table 44). With cultivation inside a screen net cover the marketable yield was 4.2 t/ha (417 g/m^2). With open field cultivation this was 1.9 t/ha (191 g/m^2). With direct sowing the average marketable yield was 364 g/m^2. The other cultivation systems did not show a significant different marketable yield although they and especially the monocropping cultivation system, showed lower yields.

Table 44. Effect of screen net cover and cultivation method on marketable yield per square meter (g/m^2).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	226	503	364
Tray	intercropping	203	415	309
	intercropping + mulch	169	382	276
	intercropping + 11.7 pl/m^2	209	398	304
	monocropping	133	379	256
	monocropping + mulch	204	424	314
mean		191	417	
	lsd	p =		
Cover	60	<0.001		
System	105	0.3		
C*S	148	1.0		

A higher number of marketable fruits was present with plants cultivated inside a screen net cover (Table 45). Average number was 57 in the screen net cover and in the open field this number was 25. Method of cultivation did not influence the number of marketable fruits.

Table 45. Effect of screen net cover and cultivation method on number of marketable fruits per square meter (No./m^2).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	31.5	65.0	48.3
Tray	intercropping	27.5	56.7	42.1
	intercropping + mulch	21.7	52.4	37.1
	intercropping + 11.7 pl/m^2	28.2	55.6	41.9
	monocropping	17.2	51.0	34.1
	monocropping + mulch	26.1	59.6	42.9
mean		25.4	56.7	
	lsd	p =		
Cover	8.5	<0.001		
System	14.6	0.5		
C*S	20.7	1.0		

Total yield per plant was inside the screen net cover 84.3 gram (Table 46). This was significant higher than the yield per plant in the open field. With 11.7 pl/m^2 the total yield per plant was on average 37.4 gram which was significant lower than the yield of cultivation with 5.8 pl/m^2 where the yield was 75.7 gram per plant. Monocropping did not show a significant lower yield than the cultivation system with intercropping. However, monocropping without mulch showed a lower yield than monocropping with mulch.

Table 46. Effect of screen net cover and cultivation method on total yield per plant(g).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	60.0	96.0	78.0
Tray	intercropping	57.7	93.7	75.7
	intercropping + mulch	50.1	71.9	61.0
	intercropping + 11.7 pl/m2	29.2	45.7	37.4
	monocropping	43.3	78.7	61.0
	monocropping + mulch	60.6	119.7	90.0
mean		50.2	84.3	
	lsd	p =		
Cover	12.4	<0.001		
System	21.5	<0.001		
C*S	30.4	0.4		

A total number of fruits per plant of 11.9 was harvested from plants cultivated inside a screen net cover (Table 47). This was significant higher than the number per plant harvested in the open field. The number of fruits harvested with direct sowing was on average 10.9 The number of fruits harvested with intercropping, intercropping with mulch and monocropping with mulch did not differ significantly from this number. Intercropping with 11.7 pl/m^2 showed a significant lower number than the number present with 5.8 pl/m^2. Monocropping with mulch showed a significant higher number than monocropping without mulch.

Table 47. Effect of screen net cover and cultivation method on total fruit number per plant (No.).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	8.7	13.1	10.9
Tray	intercropping	7.8	13.5	10.7
	intercropping + mulch	6.8	10.6	8.7
	intercropping + 11.7 pl/m^2	4.1	6.5	5.3
	monocropping	5.9	10.8	8.4
	monocropping + mulch	7.9	17.0	12.4
mean		6.9	11.9	
	lsd	p =		
Cover	1.8	<0.001		
System	3.2	0.002		
C*S	4.5	0.4		

Average marketable yield in the open field was 30.0 gram per plant (Table 48). A significant higher yield was present with cultivation inside a screen net cover construction were 69.9 gram per plant was harvested. When cultivating Gada with 11.7 pl/m^2, the yield per plant was lower than the yield present with 5.8 pl/m^2.

Table 48. Effect of screen net cover and cultivation method on marketable yield per plant (g).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	38.6	86.2	62.4
Tray	intercropping	35.0	71.2	53.1
	intercropping + mulch	28.9	67.6	48.2
	intercropping + 11.7 pl/m^2	17.9	34.3	26.1
	monocropping	23.2	66.9	45.1
	monocropping + mulch	36.6	93.1	64.9
mean		30.0	69.9	
	lsd	p =		
Cover	12.8	<0.001		
System	22.2	0.02		
C*S	31.4	0.6		

Number of marketable fruits per plant was significant higher with cultivation inside a screen net cover compared to the number present with open field cultivation (Table 49). The highest number was present with monocropping

cultivation with mulch where on average 8.9 marketable fruits per plant were harvested. This number was almost significant more than the number present with monocropping cultivation without mulch. Number of fruits present with intercropping without mulch was not significant different from the number present with intercropping with mulch. The number present with direct sowing was not significant higher than the number present with tray transplants. Number of marketable fruits per plant with 11.7 pl/m^2, was significant lower than the number present with 5.8 pl/m^2.

Table 49. Effect of screen net cover and cultivation method on number of marketable fruits per plant (No.).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	5.4	11.2	8.3
Tray	intercropping	4.7	9.7	7.2
	intercropping + mulch	3.7	9.2	6.5
	intercropping + 11.7 pl/m^2	2.4	4.8	3.6
	monocropping	3.0	9.0	6.0
	monocropping + mulch	4.7	13.2	8.9
mean		4.0	9.5	
	lsd	p =		
Cover	1.8	<0.001		
System	3.1	0.03		
C*S	4.4	0.5		

Average fruit weight of marketable fruits was 7.5 gram (Table 50). No differences in fruit weight were present between cultivation inside a screen net cover or cultivation in the open field. Cultivation system also did not show significant differences in fruit weight between treatments.

Table 50. Effect of screen net cover and cultivation method on average fruit weight of marketable fruits (g).

		Field		mean
Raising system	Cultivation	open field	screen net cover	
Direct sowing	intercropping	7.5	7.7	7.6
Tray	intercropping	7.5	7.3	7.4
	intercropping + mulch	7.8	7.3	7.5
	intercropping + 11.7 pl/m^2	7.5	7.1	7.3
	monocropping	7.7	7.5	7.6
	monocropping + mulch	7.8	7.2	7.5
mean		7.6	7.4	
	lsd	p =		
Cover	0.3	0.1		
System	0.5	0.9		
C*S	0.8	0.6		

3.6 Effect of screen net cover and cultivation on growth and yield of hot pepper cv. Tit Segitiga

3.6.1 Plant results

Plants cultivated inside a screen net cover showed a taller plant length on December 18 than similar treatments cultivated in the open field (Table 51). Length of plants with intercropping showed in the open field a length of 69 cm while inside the screen net cover the plant length was 102 cm. With monocropping cultivation in the open field plant length was 62 cm and inside a screen net cover this was 82 cm. In the open field no significant difference between cultivation systems in plant length were present. Inside the screen net cover , plant length of intercropping was significant taller than the length of monocropping with mulch.
No significant differences in number of internodes per plant were present. On average the number of internodes per plant was 17.2.
The internode ratio (total number of internodes per plant divided by the plant length) was on average 4.3 (Table 51). The ratio of plants cultivated inside a screen net cover was significant higher than the ratio of plants cultivated in the open field. Plants in the open field showed a similar ratio for all treatments.

Soil temperature inside the screen net cover was not significant different from the temperature observed in the open field with similar treatments. Average soil temperature was 28.8°C. Monocropping cultivation with mulch showed higher soil temperature values than intercropping cultivation without mulch. Intercropping with straw mulch showed the lowest soil temperature.

Table 51. Effect of screen net cover and cultivation method on plant length (cm), number of internodes (No.) and average internode length (cm) on December 30, 2009 and average soil temperature (°C).

Raising system	Cultivation	Plant length (cm)	Internodes (no.)	Internode ratio	Soil temperature (°C)
Direct sowing	intercropping	69	17.8	3.9	28.7
Plastic bag	intercropping	66	16.7	4.0	28.7
Tray	intercropping	69	18.1	3.8	28.7
	intercropping + screen net	102	18.5	5.7	28.5
	intercropping + straw mulch	68	16.7	4.1	28.3
	monocropping + mulch	62	16.0	3.9	29.0
	monocropping + mulch + screen net	82	16.6	5.0	29.3
mean		74	17.2	4.3	28.8
lsd		12.6	2.5	1.20	0.5
p =		<0.001	0.3	0.033	0.003

Light interception of the available light at the base of plants is on average 70% for both cultivation in the open field as inside a screen net cover (Fig. 16). Light interception halfway the plant and at 25% and 50% of the distance between rows is almost the same as the interception at the plant base. No big differences are present between cultivation inside a screen net cover or in the open field. Light interception measured just below the top of the plant is about 45% and clearly lower than the interception measured at the other positions.

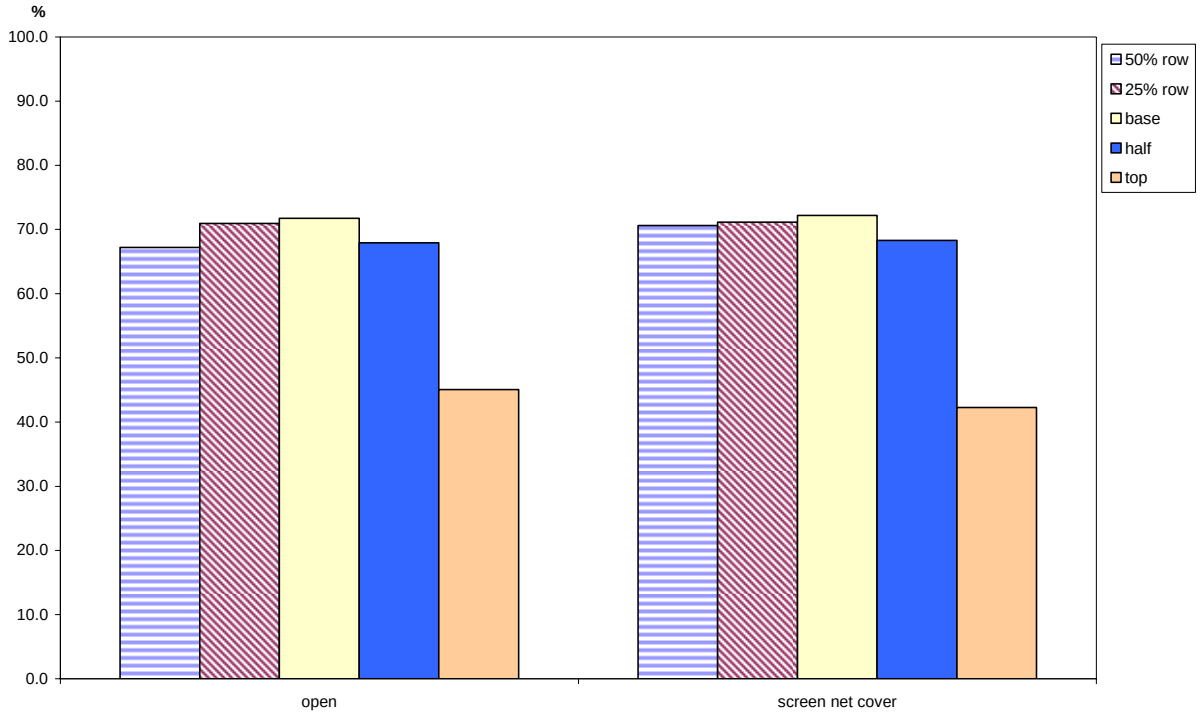


Figure 16. Light interception measured at different positions of plastic tray transplants.

3.6.2 Yield results

Shallot yield was on average 2.4 kg/m^2 or 24 t/ha (Table 52). No significant differences in shallot yield between cultivation treatments were present.

With cultivation inside a screen net cover the percentage of marketable fruits in the total number of harvested fruits is significant higher than the share present with similar treatments in the open field. No significant differences in share of healthy fruits were present between treatments cultivated in the open field.

Individual fruit weight of marketable fruits was on average 7.7 gram. No significant differences in fruit weight were present.

Table 52. Effect of screen net cover and cultivation method on shallot yield (g/m^2), percentage healthy hot pepper fruits in total harvested fruit number and average hot pepper fruit weight of marketable fruits.

Raising system	Cultivation	Shallot yield (kg/m^2)	Healthy share (%)	Individual fruit weight (g)
Direct sowing	intercropping	2.2	57	7.7
Plastic bag	intercropping	2.4	62	8.0
Tray	intercropping	2.2	59	8.0
	intercropping + screen net	2.7	85	7.7
	intercropping + straw mulch	2.5	58	7.3
	monocropping + mulch	-	60	7.8
	monocropping + mulch + screen net	-	79	7.5
mean		2.4	66	7.7
lsd		0.55	11.8	0.6
p =		0.2	<0.001	0.1

Total yield of hot pepper with direct sowing was 297 g/m^2 and was not significant different from the total yield present with the other treatments (Table 53). Tray transplants cultivated as an intercrop showed a total yield of 363 g/m^2. When cultivated inside a screen net cover this was higher with 455 g/m^2, but this was not different from the yield present in the open field.
Yield per plant was on average 31.5 gram. No significant differences were present in yield per plant between treatments. With cultivation inside a screen net the yield per plant was higher than the yield of similar treatments in the open field, but this difference was not significant.
Marketable yield of direct sowing was 176 g/m2 and not significant lower than the yield present with other cultivation methods (Table 53). Also yield inside screen net covers was higher but not significant, than the yield of similar treatments in the open field.
Marketable yield per plant was on average 21.7 gram per plant. Between treatments no significant differences were present.

Table 53. Effect of screen net cover and cultivation method on total yield and marketable yield per plant en per square meter.

Raising system	Cultivation	Total yield (g/m^2)	Total yield (g/plant)	Marketable yield (g/m^2)	Marketable yield (g/plant)
Direct sowing	intercropping	297	25.8	176	15.1
Plastic bag	intercropping	343	29.4	227	19.4
Tray	intercropping	363	31.8	232	20.1
	intercropping + screen net	455	41.0	395	34.3
	intercropping + straw mulch	317	27.7	186	16.1
	monocropping + mulch	332	28.8	214	18.5
	monocropping + mulch + screen net	341	36.2	277	28.6
mean		350	31.5	244	21.7
lsd		146	16.0	155	16.0
p =		0.4	0.4	0.1	0.2

Total number of fruits was on average 47 per m^2 and 4.2 per plant (Table 54). No significant differences between treatments were present although with cultivation inside a screen net cover a higher number was present.
Number of marketable fruits was on average 32 per square meter and 2.8 per plant. Intercropping of tray transplants inside a screen net showed a higher marketable number per square meter than intercropping of tray transplants in the open field.

Table 54. Effect of screen net cover and cultivation method on percentage of healthy fruits in total fruit number(%), total fruit number and marketable number of fruits per plant en per square meter.

Raising system	Cultivation	Total yield		Marketable yield	
		(No./m^2)	(No./plant)	(No./m^2)	(No./plant)
Direct sowing	intercropping	40	3.5	23	2.0
Plastic bag	intercropping	45	3.8	28	2.4
Tray	intercropping	48	4.2	29	2.5
	intercropping + screen net	60	5.5	51	4.4
	intercropping + straw mulch	44	3.8	26	2.2
	monocropping + mulch	44	3.8	27	2.3
	monocropping + mulch + screen net	46	5.0	37	3.8
mean		47	4.2	32	2.8
lsd		17.9	2.0	18.5	2.0
p =		0.4	0.4	0.08	0.1

4 Discussion and conclusions

4.1 Variety

Gada was planted at 5.8 plants per square meter while Tit Segitiga was planted at 11.7 plants per square meter. For cultivation of the variety Gada, the breeding company PT Ewindo, recommends to plant even a lower number of plants per square meter than tested in this experiment.
Light interception measurements in the field showed that with Gada a slightly lower light use efficiency was present than with Tit Segitiga. This is most likely caused by the wider planting distance of Gada plants. Also plant height of Gada was lower than the height of Tit Segitiga.
Marketable yield per plant was with Gada twice as much than the yield of Tit Segitiga plants. Per square meter where Gada had half the number of plants than Tit Segitiga, the yield was for both varieties the same.
Individual weight of Gada fruits was slightly lower than the fruit weight of tit Segitiga. However, both varieties could be sold at the market for a same price.
Seed quality of Gada is in general better than that of Tit Segitiga resulting in a better emergence. Tit Segitiga seeds are mostly kept by the farmers from their previous crops and seeds are prone to seed borne diseases. However, for this experiment seed batches were tested first before using them to sow the different treatments. As a result the emergence of Tit Segitiga was not different from the emergence of Gada.

4.2 Raising system

In the area of Brebes hot pepper is directly sown with 5 seeds per plant hole.
With transplant raising seed efficiency is much higher than with direct sowing. Percentage of usable transplants at the time of transplanting was with raising in trays and plastic bags more than 80%, while with direct sowing the percentage was 40%. With transplant raising the percentage of plants infected with thrips was lower than 1.5% while with direct sowing almost 25% of the seedlings showed thrips damage.
Seedlings with direct sowing showed a higher dry weight and fresh weight and a higher number of leaves than transplants raised in trays Differences in dry and fresh weight with plastic bags was not present. Based on these results concluded can be that the cell size of the tray is too low to accommodate good transplants. The volume of the plastic bag is large enough to obtain seedlings comparable in weight and size as with direct sowing.
Two months after transplanting no differences in plant length and number of internodes could be observed between direct sowing and transplanting. Light interception of transplants raised in trays was lower than the interception by plants with direct sowing. Plants raised from transplants were probably less dense than with direct sowing resulting in a lower light use efficiency.
Nevertheless the final marketable yield was for all treatments the same. With direct sowing a marketable yield of 201 g/m^2 was present while with plastic bag transplant the yield was 211 g/m^2 and with tray transplants it was 218 g/m^2. These yields were a bit low compared to the official yield figures for the area. Official figures indicate that average yield for the region is about 6 t/ha. This is 4 tons more than the results observed in this experiment. However, data collection for statistical purposes are less reliable than real observed harvest data. Also data collected from small experimental plots can differ from data collected from a practice field.

4.3 Mulch

Application of plastic mulch did not result in better yields. Gada cultivated as an intercrop showed with mulch lower yields than the cultivation without mulch. Cultivated as a monocrop higher yields were observed.
Soil temperature of mulch treatment was higher than with cultivation without mulch with monocropping while with intercropping no difference was observed in soil temperature. With intercropping more holes were punched in the mulch and therefore more ventilation is present which could leaded to a lower soil temperature than compared to monocropping with mulch. During cultivation also noted was that the soil was too moist and irrigation had to be reduced from twice a day to three times per two days. Plants cultivated with mulch, especially with monocropping, showed a shorter plant length and also light interception was lower than the percentage present at treatments without mulch.

4.4 Screen net

The influence of screen net cover on marketable yield and share of healthy production in the total production is highly significant. Temperature inside the screen net cover seems quite higher than the open field temperature. However, soil temperature is lower than the temperature in the open field soil. The construction reduces the available light with 25 to 30% and etiolation of plants takes place to a certain extend. Plants were taller but showed also a higher number of internodes. Nevertheless the internode ratio of plants cultivated inside the screen net cover was higher than the ratio of plants grown in the open field indicating a longer internode length of plants grown inside a screen net cover. Light interception efficiency of plants inside the screen net cover was the same as for plants cultivated in the open field. Of the available light an average of 62.5% was intercepted by the plants.

With cultivation inside a screen net the total production was 4.7 t/ha while in the open field the production was 3.2 t/ha. In the open field only 57% of the production gives a marketable fruit while inside the screen net cover this percentage was 86%. Marketable yield inside the screen net cover was almost 4.2 t/ha while in the open field the yield was 1.9 t/ha.

Aphids, thrips and mite pressure was higher inside the screen net cover compared to the open field as a result of a too late start with the first pesticide applications inside the screen net cover. In h open field routinely spraying with a pesticide cocktail took place every three days starting 5 days after planting of shallots. During this experiment fruitfly (Dacus spp.) and bollworm (Helicoverpa spp.) were not observed. These pests are quite big and can be excluded from the crop by using screen net covers. Mesh size of the used net is not small enough to exclude thrips, aphids and mites. When using net with mesh size small enough to prevent these pests the ventilation inside the construction will be too low. Even with the larger mesh size used in this experiments temperature inside the construction was above 40^{o}C. Inside the screen net cover disease pressure was lower than that present in the open field.

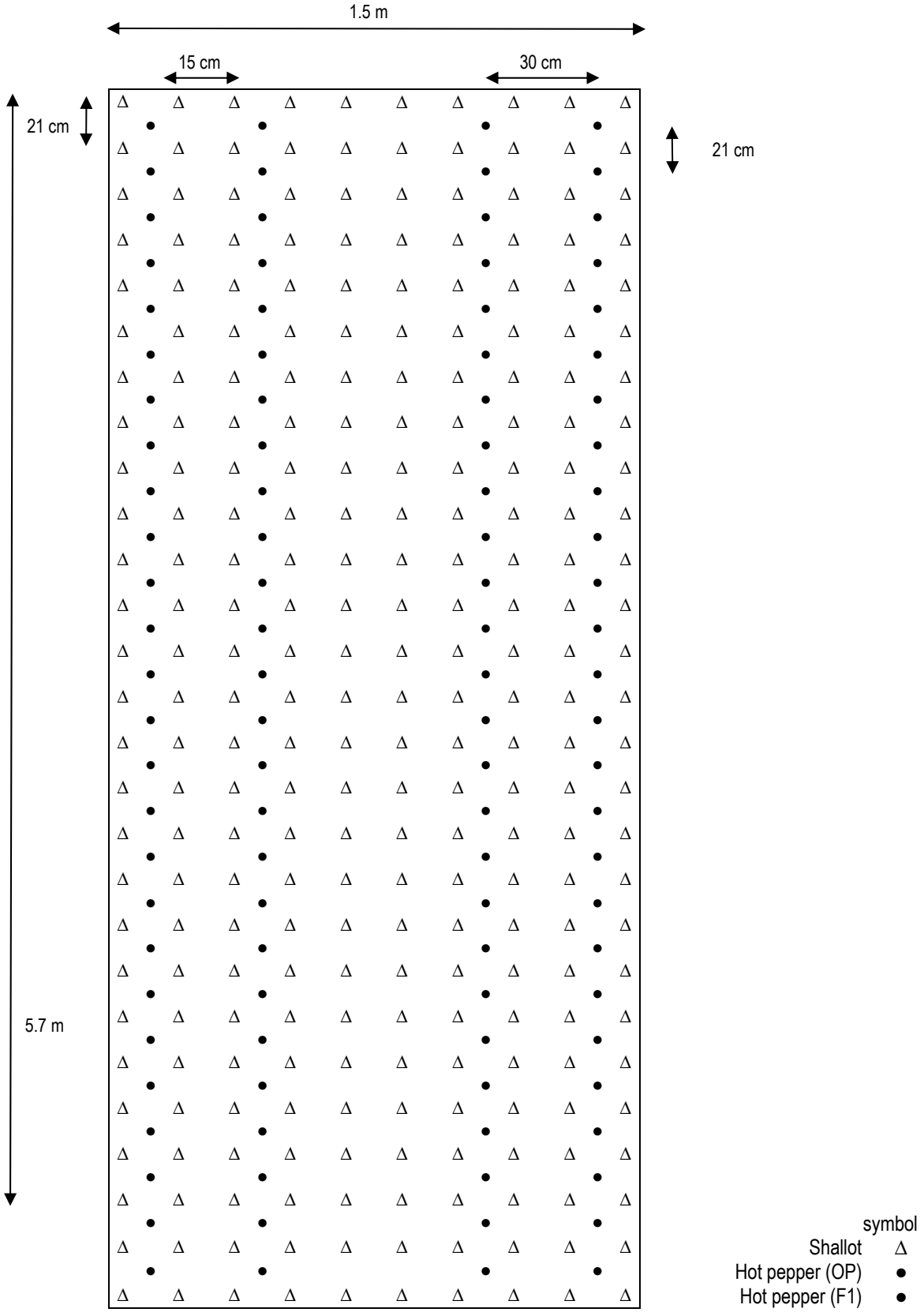
4.5 Cropping system

In Brebes hot pepper is cultivated as an intercrop with mainly shallot. Theoretically a monocrop cultivation of the two crops separately should give higher a higher yield than when cultivated as an intercrop together. This is because with an intercrop there is competition between the two crops fro space, water and nutrition. Also with harvest of shallots roots of the remaining hot pepper plants can be damaged. However, with this experiment higher yields were present with intercropping of hot pepper with shallot.

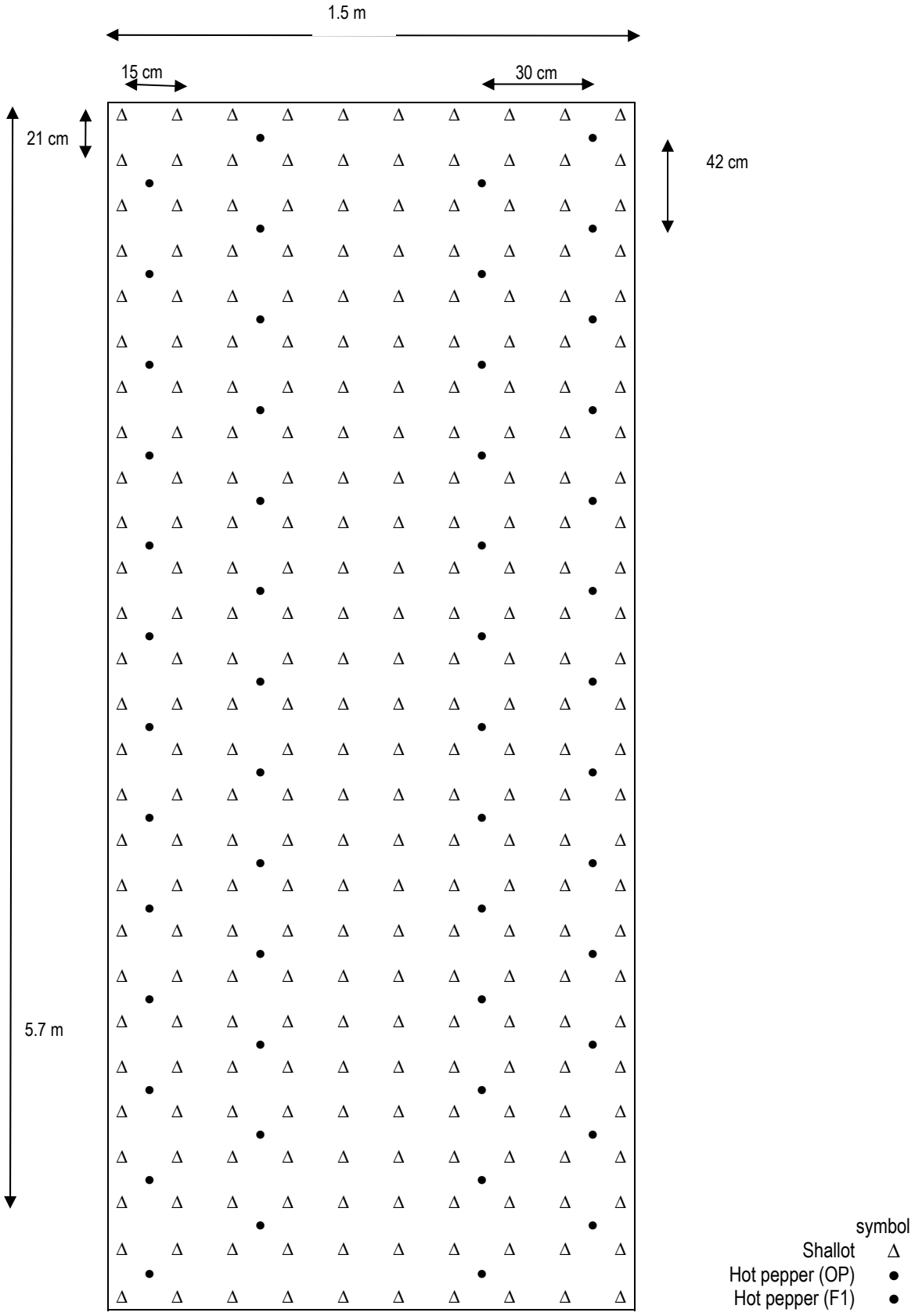
An explanation can be that with shallots as an intercrop the conditions during transplanting of the transplants are more favorable than with a monocrop system, like providing shade to the young hot pepper seedlings, and thus reduce transplant shock.

Increasing the plant density of Gada did not result in a higher yield per square meter. Number of fruits and weight per plant was lower with a higher plant density.

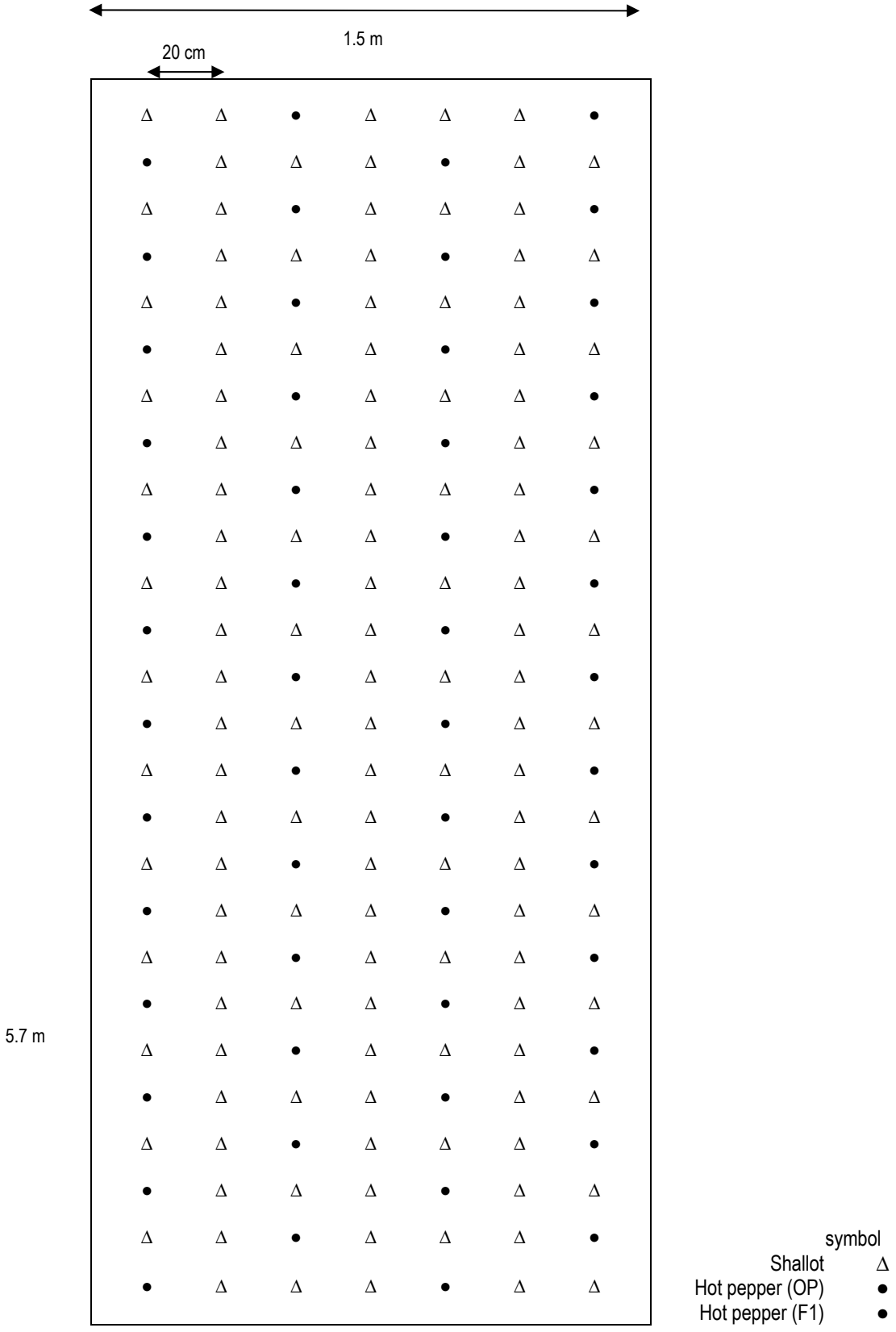
Annex I. Layout of intercropping pattern



Plant arrangement per plot for the open pollinated variety Tit Segitiga and Gada F_1 with 100 plants (11.7 pl/m^2)

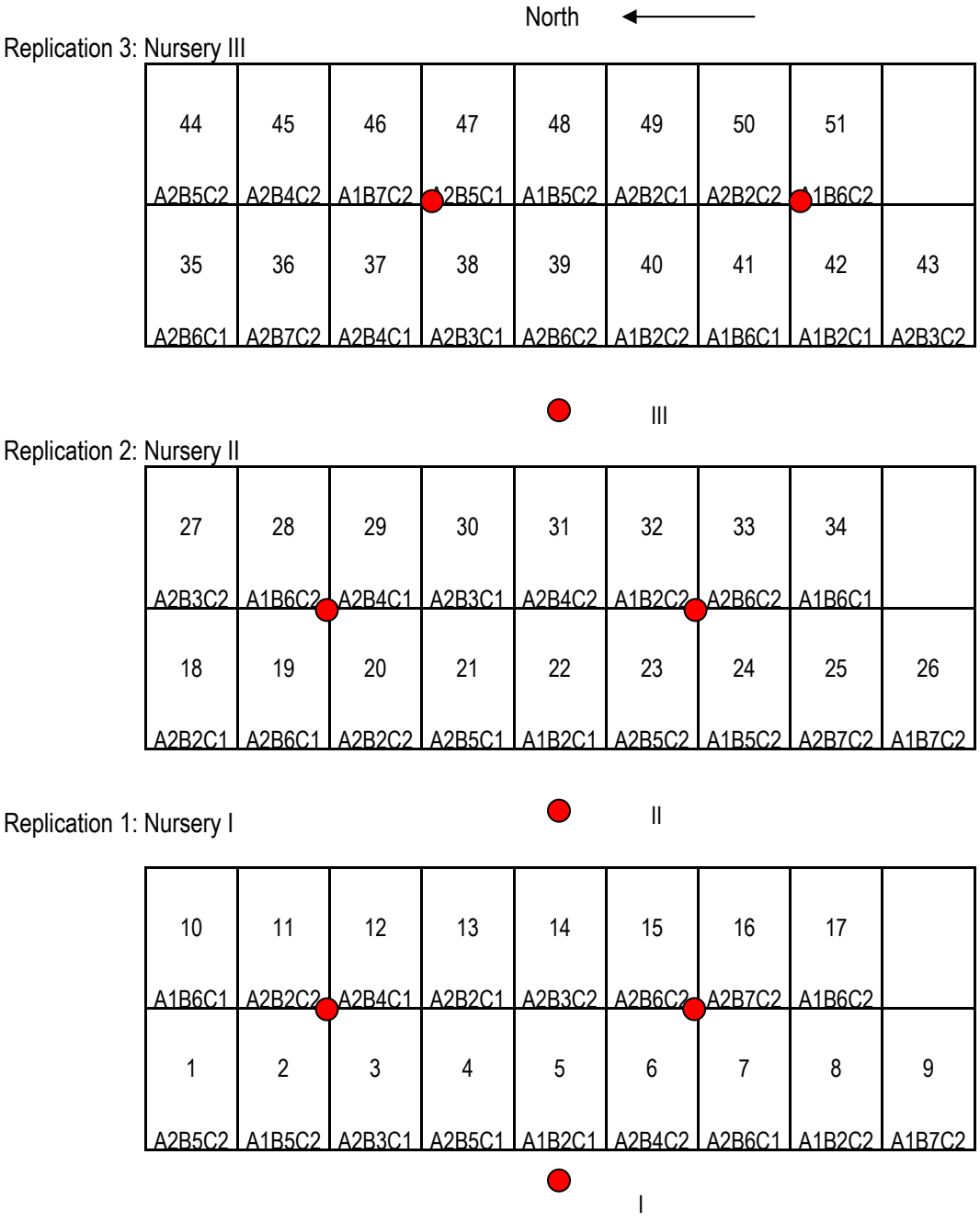


Plant arrangement per plot for hybrid variety Gada F_1 with 50 plants (5.8 pl/m^2)



Plant arrangement per plot for hybrid variety Gada F_1 with 50 plants (5.8 pl/m^2) and shallot with mulch treatment

Annex II. Layout of treatments in the nursery.



L1 TILL *L6* = positions for measuring light intensity inside the nursery

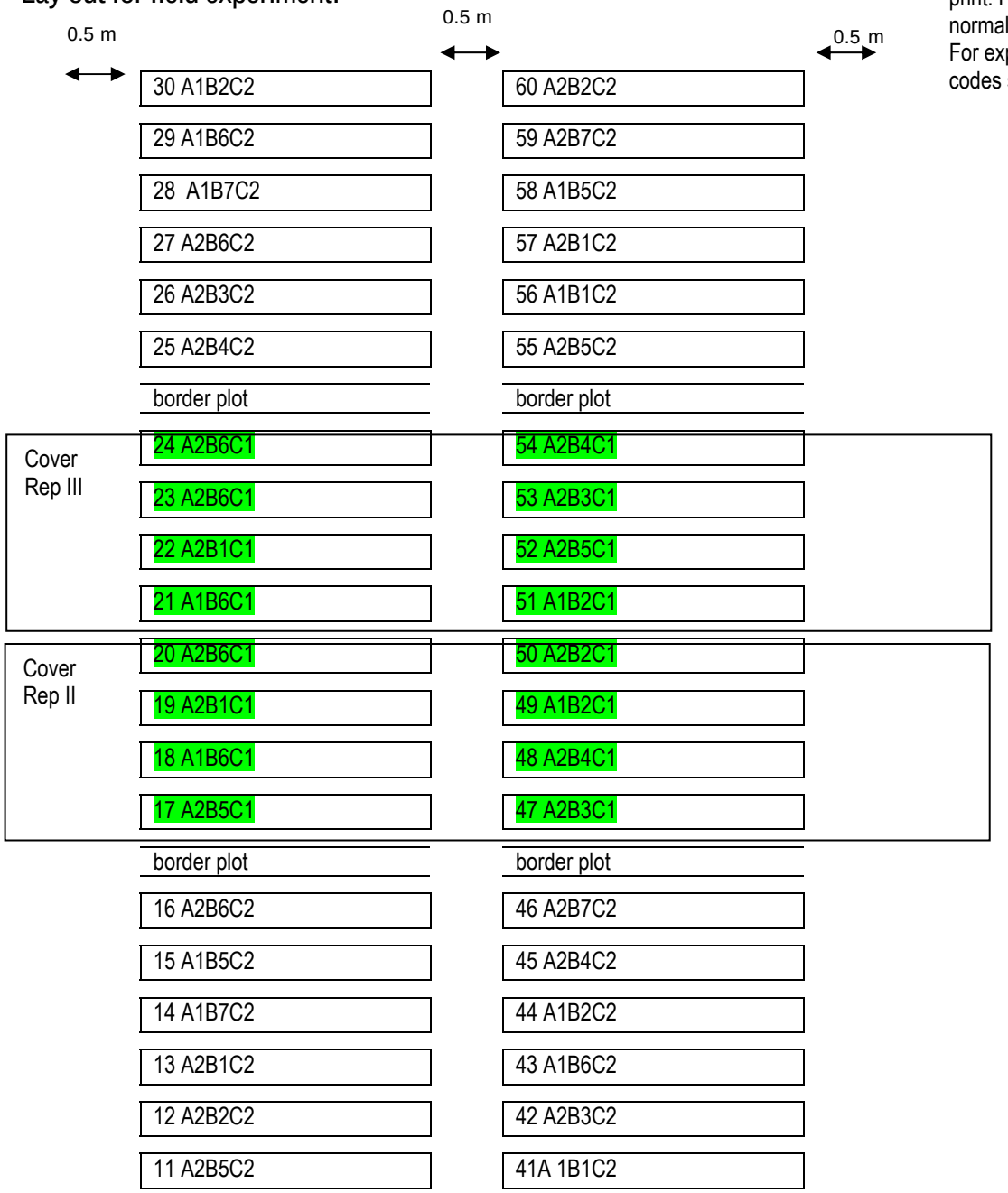
I, II, III = positions for measuring light intensity outside the nursery

Annex III. Layout of treatments in the field.

North →

Lay out for field experiment:

Treatment codes are in bold print. Field numbers are in normal print
For explanation of treatment codes see table 2.




10 A1B1C2
40 A2B4C2
9 A1B5C2
39 A2B1C2
8 A1B6C2
38 A2B5C2
7 A1B2C2
37 A2B3C2
6 A2B6C2
36 A2B7C2
5 A1B7C2
35 A2B2C2
border plot
border plot
Cover
Rep I
4 A2B5C1
34A1B2C1
3 A1B6C1
33 A2B6C1
2 A2B4C1
32 A2B3C1
1 A2B2C1
31 A2B1C1
1.5 m
6.5 m

Annex IV. Used pesticides and amounts per hectare

		Open field		Screen net cover	
product	price per ml or g	amount (l or kg)	costs (IDR)	amount (l or kg)	costs (IDR)
Tracer (ml)	875	5.7	5,024,854	1.8	1,576,023
Metindo (g)	120	3.0	355,088	1.5	181,053
Buldok (ml)	150	21.8	3,275,439	5.0	743,860
Marshal (ml)	94	5.7	537,614	1.0	91,251
Prevathon (ml)	650	4.0	2,592,398	0.5	311,696
Confidor (ml)	617	5.1	3,123,171	2.4	1,464,212
Agrimec (ml)	1200	6.0	7,242,105	2.7	3,228,070
Pegasus (ml)	1763	5.5	9,647,368	0.4	721,491
Ampligo (ml)	1500	5.5	8,175,439	1.1	1,649,123
Demolis (ml)	850	1.3	1,083,626	0.6	467,251
Omite (ml)	775	1.3	1,006,140	1.3	1,006,140
insecticide total		64.8	42,063,241	18.1	11,440,171
Antracol (g)	75	28.3	2,123,684	10.0	747,368
Score (ml)	463	6.1	2,812,865	1.0	454,386
Bion M (g)	190	21.4	4,060,000	6.5	1,233,333
fungicide total		55.8	8,996,550	17.4	2,435,088
total		64.8	42,063,241	35.6	13,875,258

Annex V. Chronological overview of used material and activities.

Date	Activity	Material	Quantity
26 - 07 - 2009	Weeding		
27 - 07 - 2009	Flooding of the field		
01 - 08 - 2009	Bed making		
11 - 08 - 2009	Construction of net houses	Bamboo	80 poles
till		Wire	2 kg
19 - 08 - 2009		Nails	4.5 kg
		Rubber bands	
		Insect net	168 m
		Wire	1 roll
		Wire DX	80 m
		Sewing thread	3 rolls
		Sleting	3 pieces
20 - 08 - 2009	Howing and weeding		
	Fertilization	SP - 18	15 kg
	and soil treatment against gryllotalpa	Furadan	2 kg
21 - 08 - 2009	Egalization of soil, fertilization and plastic mulch	Mulch	
	Maintance net hosue		
	Rice straw ammendment underneath plastic mulch		
21 - 08 - 2009	Nursery maintenance	Bamboo	6 poles
till		Wire	0.5 kg
22 - 08 - 2009		Nails	0.5 kg
22 - 08 - 2009	Shallot planting		
23 - 08 - 2009	Watering of shallot		39 times (morning and afternoon)
till			
28 - 09 - 2009			
23 - 08 - 2009	Collection of top soil for media		
25 - 08 - 2009	Preparing (granulation/filtering) of manure for manure		
	Filling of plastic bags and tray with media		
28 - 08 - 2009	Making ridges around the bed with mud to avoid running off of fertilizer		
30 - 08 - 2009	Weeding shallots		
	Shallot fertilization	Urea	8 kg
		ZA	20 kg
		KCL	4 kg
		NPK 15-15-15	5 kg
31 - 08 - 2009	Soaking of seeds	Tit Segetiga seeds	
		Gada seeds	
03 - 09 - 2009	Watering of seedlings (daily)		
till			
28- 09 - 2009			
03 - 09 - 2009	Pesticide application shallot inside net house	Tracer 0.5 ml	
		Metindo 1 g	8.5 ltr water
		Antracol 2 g	
	Pesticide application shallot outside	Tracer 0.5 ml	
		Metindo 1 g	12.75 ltr water
		Antracol 2 g	

06 - 09 - 2009	Pesticide application shallot inside net house	Tracer 0.5 ml	
		Metindo 1 g	8.5 ltr water
		Antracol 2 g	
		Apsa 0.5 ml	
	Pesticide application shallot outside	Tracer 0.5 ml	
		Metindo 1 g	12.75 ltr water
		Antracol 2 g	
		Apsa 0.5 ml	
09 - 09 - 2009	Pesticide application shallot outside	Tracer 1 ml	
		Metindo 1 g	19.1 ltr water
		Antracol 2 g	
10 - 09 - 2009	Hand picking of pests in shallot		
11 - 09 - 2009	Weeding shallots		
12 - 09 - 2009	Pesticide application shallot inside net house	Tracer 1 ml	
		Metindo 1 g	14.2 ltr water
		Antracol 2 g	
		Apsa 0.5 ml	
	Pesticide application shallot outside	Tracer 1 ml	
		Metindo 1 g	21.25 ltr water
		Antracol 2 g	
		Apsa 0.5 ml	
13 - 09 - 2009	Hand picking of pest in shallot		
14 - 09 - 2009	Watering and fungicide treatment of seedlings	Score	
15 - 09 - 2009	Pesticide application shallot outside	Tracer 1 ml	
		Metindo 1 g	25.25 ltr water
		Antracol 2 g	
	Making ridges around the bed with mud		
17 - 09 - 2009	Shallot fertilization	Urea	8 kg
		AS	12 kg
		KCL	6 kg
		NPK 16-16-16	5 kg
18 - 09 - 2009	Watering and fertigation of seedlings	NPK 16-16-16	2 g/l water
	Pesticide application shallot outside	Buldok 1 ml	
		Tracer 1 ml	25.25 ltr water
		Antracol 2 g	
18 - 09 - 2009	Hand picking of pests in shallot		
21 - 09 - 2009	Watering and fertigation of seedlings	NPK 16-16-16	2 g/l water
	Pesticide application shallot outside	Buldok 1 ml	
		Tracer 1 ml	25.25 ltr water
		Antracol 2 g	
24 - 09 - 2009	Watering and fertigation of seedlings	NPK 16-16-16	2 g/l water
	Pesticide application shallot inside net house	Buldok 1 ml	
		Tracer 1 ml	14.2 ltr water
		Antracol 2 g	
		Apsa 0.5 ml	
	Pesticide application shallot outside	Buldok 1 ml	
		Tracer 1 ml	21.25 tr water
		Antracol 2 g	
		Apsa 0.5 ml	
24 - 09 - 2009	Weeding shallots		
27 - 09 - 2009	Watering and fertigation of seedlings	NPK 16-16-16	2 g/l water
	Pesticide application shallot outside	Buldok 1 ml	
		Tracer 1 ml	25.5 ltr water
		Antracol 2 g	

		Apsa 0.5 ml	
29 - 09 - 2009	Planting of hot pepper seedlings		
30 - 09 - 2009 till 15 - 10 - 2009	Watering of shallot and hot pepper		18 times
30 - 09 - 2009	Pesticide application shallot outside	Buldok 1 ml Marshal 1 ml Antracol 2 g Apsa 0.5 ml	25.25 ltr water
30 - 09 - 2009	Hand picking of pests in shallot		
01 - 10 - 2009	Making ridges around the bed with mud		
03 - 10 - 2009	Pesticide application shallot outside	Buldok 1 ml Marshal 1 ml Antracol 2 g	25.25 ltr water
05 - 10 - 2009	Hand picking of pests in shallot		
06 - 10 - 2009	Weeding shallots		
	Pesticide application shallot outside	Buldok 1 ml Marshal 1 ml Antracol 2 g	31.9 ltr water
07 - 10 - 2009	Hand picking of pests in shallot		
09 - 10 - 2009	Pesticide application shallot inside net house	Buldok 1 ml Prevathon 0.5 ml Marshal 1 ml	19.8 ltr water
	Pesticide application shallot outside	Buldok 1 ml Prevathon 0.5 ml Marshal 1 ml	29.75 ltr water
	Hand picking of pests in shallot		
12 - 10 - 2009	Pesticide application shallot outside	Buldok 1 ml Prevathon 0.5 ml Marshal 1 ml	31.9 ltr water
15 - 10 - 2009	Pesticide application shallot outside	Buldok 1 ml Prevathon 0.5 ml Marshal 1 ml	31.9 ltr water
17 - 10 - 2009	Harvest of shallot		
18 - 10 - 2009	Weeding hot pepper		
19 - 10 - 2009 till 12 - 01 - 2010	Watering of hot pepper		18 times
19 - 10 - 2009	Pesticide application hot pepper inside net house	Confidor 0.6 ml Agrimec 0.3 ml	11.3 ltr water
	Pesticide application hot pepper outside	Confidor 0.6 ml Agrimec 0.3 ml	17 ltr water
20 - 10 - 2009	Hot pepper fertilization	NPK 15-15-15 Furadan DAP	10 kg 2 kg 15 kg
20 - 10 - 2009	Applying mud on the bed around the plants		
22 - 10 - 2009	Pesticide application hot pepper outside	Confidor 0.6 ml Agrimec 0.3 ml	25.5 ltr water
25 - 10 - 2009	Pesticide application hot pepper inside net house	Confidor 0.6 ml Agrimec 0.3 ml	14.2 ltr water
	Pesticide application hot pepper outside	Confidor 0.6 ml Agrimec 0.3 ml	21.25 ltr water
28 - 10 - 2009	Pesticide application hot pepper inside net house	Confidor 0.6 ml Agrimec 0.3 ml	17 ltr water

		Antracol 2 g	
	Pesticide application hot pepper outside	Confidor 0.6 ml	
		Agrimec 0.3 ml	25.5 ltr water
		Antracol 2 g	
30 - 10 - 2009	Weeding hot pepper		
31 - 10 - 2009	Pesticide application hot pepper inside net house	Confidor 0.6 ml	
		Agrimec 0.3 ml	17 ltr water
		Antracol 2 g	
	Pesticide application hot pepper outside	Confidor 0.6 ml	
		Agrimec 0.3 ml	25.5 ltr water
		Antracol 2 g	
03 - 11 - 2009	Pesticide application hot pepper inside net house	Confidor 0.6 ml	
		Agrimec 0.3 ml	17 ltr water
		Antracol 2 g	
	Pesticide application hot pepper outside	Confidor 0.6 ml	
		Agrimec 0.3 ml	25.5 ltr water
		Antracol 2 g	
05 - 11 - 2009	Hand picking of pests		
06 - 11 - 2009	Pesticide application hot pepper outside	Confidor 0.6 ml	
		Agrimec 0.3 ml	25.5 ltr water
		Antracol 2 g	
09 - 11 - 2009	Pesticide application hot pepper inside net house	Confidor 0.6 ml	
		Agrimec 0.3 ml	17 ltr water
		Antracol 2 g	
	Pesticide application hot pepper outside	Confidor 0.6 ml	
		Agrimec 0.3 ml	25.5 ltr water
		Antracol 2 g	
10 - 11 - 2009	Hot pepper fertilization	Urea	10 kg
		DAP	5 kg
		NPK 15-15-15	8 kg
	Applying mud on the bed around the plants		
	Hand picking of pests		
12 - 11 - 2009	Pesticide application hot pepper outside	Confidor 0.6 ml	
		Agrimec 0.3 ml	25.5 ltr water
		Antracol 2 g	
	Hand picking of pests		
14 - 11 - 2009	Weeding hot pepper		
	Pesticide application hot pepper inside net house	Confidor 0.6 ml	
		Agrimec 0.3 ml	17 ltr water
		Score 0.6 ml	
	Pesticide application hot pepper outside	Confidor 0.6 ml	
		Agrimec 0.3 ml	25.5 ltr water
		Score 0.6 ml	
17 - 11 - 2009	Pesticide application hot pepper inside net house	Agrimec 0.5 ml	
		Pegasus 0.5 ml	17 ltr water
		Score 0.6 ml	
	Pesticide application hot pepper outside	Agrimec 0.5 ml	
		Pegasus 0.5 ml	25.5 ltr water
		Score 0.6 ml	
18 - 11 - 2009	Hand picking of pests		
20 - 11 - 2009	Pesticide application hot pepper outside	Agrimec 0.5 ml	
		Pegasus 0.5 ml	25.5 ltr water
		Score 0.6 ml	
23 - 11 - 2009	Pesticide application hot pepper outside	Pegasus 0.5 ml	

		Prevathon 0.5 ml	38.25 ltr water
		Agrimec 0.5 ml	
		Score 0.6 ml	
25 - 11 - 2009	Hot pepper harvest 1		
26 - 11 - 2009	Pesticide application hot pepper outside	Pegasus 0.5 ml	
		Prevathon 0.5 ml	38.25 ltr water
		Agrimec 0.5 ml	
		Score 0.6 ml	
28 - 11 - 2009	Pesticide application hot pepper outside	Prevathon 0.5 ml	
		Pegasus 0.5 ml	38.25 ltr water
		Score 0.6 ml	
29 - 11 - 2009	Hot pepper fertilization	Urea	10 kg
		AS	5 kg
		KCL	5 kg
		NPK 16-16-16	5 kg
29 - 11 - 2009	Applying mud on the bed		
30 - 11 - 2009	Weeding hot pepper		
	Hot pepper harvest 2		
01 - 12 - 2009	Pesticide application hot pepper outside	Prevathon 0.5 ml	
		Pegasus 0.5 ml	38.25 ltr water
		Score 0.6 ml	
04 - 12 - 2009	Hot pepper harvest 3		
	Pesticide application hot pepper outside	Buldok 0.6 ml	
		Pegasus 0.5 ml	44.6 ltr water
		Score 0.6 ml	
06 - 12 - 2009	Hot pepper harvest 4		
07 - 12 - 2009	Pesticide application hot pepper outside	Buldok 0.6 ml	
		Pegasus 0.5 ml	44.6 ltr water
		Score 0.6 ml	
10 - 12 - 2009	Pesticide application hot pepper outside	Buldok 1 ml	
		Ampligo 0.5 ml	44.6 ltr water
		Bion 2 g	
11 - 12 - 2009	Hot pepper harvest 5		
12 - 12 - 2009	Weeding hot pepper		
13 - 12 - 2009	Hot pepper harvest 6		
14 - 12 - 2009	Pesticide application hot pepper inside net house	Agrimec 0.5 ml	
		Buldok 1 ml	22.7 ltr water
		Antracol 2 g	
	Pesticide application hot pepper outside	Agrimec 0.5 ml	
		Buldok 1 ml	34 ltr water
		Antracol 2 g	
15 - 12 - 2009	Hot pepper fertilization	AS	8 kg
		KCL	4 kg
		NPK 16-16-16	5 kg
	Melepa Tanaman Cabai		
17 - 12 - 2009	Pesticide application hot pepper outside	Ampligo 0.5 ml	
		Buldok 1 ml	44.6 ltr water
		Bion 2 g	
20 - 12 - 2009	Hot pepper harvest 7		
	Weeding hot pepper		
	Pesticide application hot pepper outside	Buldok 1 ml	
		Pegasus 0.5 ml	44.6 ltr water
		Antracol 2 g	
24 - 12 - 2009	Pesticide application hot pepper inside net house	Ampligo 1 ml	

		Buldok 1 ml	22.7 ltr water
		Antracol 2 g	
		Demolis 0.5 ml	
	Pesticide application hot pepper outside	Ampligo 1 ml	
		Buldok 1 ml	34 ltr water
		Antracol 2 g	
		Demolis 0.5 ml	
28 - 12 - 2009	Hot pepper harvest 8		
	Pesticide application hot pepper outside	Buldok 1 ml	
		Agrimec 0.5 ml	31.9 ltr water
		Bion 2 g	
31 - 12 - 2009	Pesticide application hot pepper outside	Ampligo 1 ml	
		Demolis 0.5 ml	31.9 ltr water
		Bion 2 g	
01 - 01 - 2010	Hot pepper harvest 9		
04 - 01 - 2010	Pesticide application hot pepper inside net house	Buldok 1 ml	
		Agrimec 0.5 ml	22.7 ltr water
		Bion 2 g	
	Pesticide application hot pepper outside	Buldok 1 ml	
		Agrimec 0.5 ml	34 ltr water
		Bion 2 g	
07 - 01 - 2010	Hot pepper harvest 10		
	Pesticide application hot pepper inside net house	Omite 1.2 ml	22.7 ltr water
	Pesticide application hot pepper outside	Omite 1.2 ml	34 ltr water
10 - 01 - 2010	Hot pepper harvest 11		
11 - 01 - 2010	Pesticide application hot pepper outside	Ampligo 0.5 ml	
		Buldok 1 ml	44.6 ltr water
		Bion 2 g	
14 - 01 - 2010	Hot pepper harvest 12		
	Pesticide application hot pepper outside	Ampligo 0.5 ml	
		Buldok 1 ml	44.6 ltr water
		Bion 2 g	
18 - 01 - 2010	Hot pepper harvest 13		
21 - 01 - 2010	Hot pepper harvest 14		
	Pesticide application hot pepper inside net house	Bion 2 g	22.7 ltr water
	Pesticide application hot pepper outside	Bion 2 g	34 ltr water
26 - 01 - 2010	Hot pepper harvest 15		
28 - 01 - 2010	Pesticide application hot pepper inside net house	Bion 2 g	22.7 ltr water
	Pesticide application hot pepper outside	Bion 2 g	34 ltr water
02 - 02 - 2010	Hot pepper harvest 16		
08 - 02 - 2010	Hot pepper harvest 17		
14 - 02 - 2010	Hot pepper harvest 18		

Annex VI. Temperature recording

date	day	Tegal min T	Tegal max T	Open field min T	Open field max T	Net house min T	Net house max T
1-9-2009	1	25	33	22	30	20	41
2-9-2009	2	24	33	22	31	20	42
3-9-2009	3	24	34	21	30	20	41
4-9-2009	4	25	33	21	31	20	42
5-9-2009	5	24	33	22	31	20	42
6-9-2009	6	24	33	21	31	20	41
7-9-2009	7	24	32	21	30	20	42
8-9-2009	8	24	34	20	31	20	42
9-9-2009	9	24	34	20	30	20	42
10-9-2009	10	25	33	20	30	20	43
11-9-2009	11	25	32	20	31	20	43
12-9-2009	12	25	33	20	30	20	43
13-9-2009	13	25	33	20	30	20	43
14-9-2009	14	25	33	20	30	20	44
15-9-2009	15	25	35	20	30	21	43
16-9-2009	16	25	32	20	30	20	42
17-9-2009	17	25	33	20	30	20	44
18-9-2009	18	25	33	20	30	20	43
19-9-2009	19	24	35	20	30	19	43
20-9-2009	20	24	34	20	30	20	43
21-9-2009	21	24	34	20	30	20	44
22-9-2009	22	24	34	20	30	20	44
23-9-2009	23	24	33	20	31	21	44
24-9-2009	24	24	34	21	31	21	44
25-9-2009	25	25	36	21	31	20	44
26-9-2009	26	24	35	21	31	19	44
27-9-2009	27	24	35	21	31	21	43
28-9-2009	28	23	36	21	30	19	43
29-9-2009	29	25	34	21	31	19	42
30-9-2009	30	25	34	21	30	19	42
1-10-2009	1	24	34	19	29	19	42
2-10-2009	2	25	32	19	30	19	42
3-10-2009	3	25	33	19	30	19	41
4-10-2009	4	25	32	20	30	20	43
5-10-2009	5	25	32	19	29	19	42
6-10-2009	6	25	34	19	29	19	43
7-10-2009	7	25	33	19	30	19	43
8-10-2009	8	25	32	20	30	20	43
9-10-2009	9	25	32	20	31	20	44
10-10-2009	10	26	33	20	30	20	42
11-10-2009	11	26	33	20	30	20	42
12-10-2009	12	26	33	19	30	19	43
13-10-2009	13	25	32	19	30	19	44
14-10-2009	14	25	32	19	30	19	43
15-10-2009	15	26	32	19	31	19	44
16-10-2009	16	25	35	19	30	20	42
17-10-2009	17	24	35	19	30	20	42

18-10-2009	18	25	32	20	30	20	43
19-10-2009	19	26	34	20	30	20	42
20-10-2009	20	26	32	20	30	20	42
21-10-2009	21	26	32	19	30	19	43
22-10-2009	22	26	33	19	19	20	43
23-10-2009	23	25	32	19	30	20	43
24-10-2009	24	25	32	20	30	19	42
25-10-2009	25	25	32	20	30	19	41
26-10-2009	26	25	32	21	30	20	41
27-10-2009	27	25	33	19	29	20	41
28-10-2009	28	25	32	20	29	20	41
29-10-2009	29	26	32	20	30	20	41
30-10-2009	30	26	33	20	30	20	41
31-10-2009	31	26	34	19	30	19	40
1-11-2009	1	26	33	19	29	19	39
2-11-2009	2	26	33	20	30	20	41
3-11-2009	3	26	33	19	29	19	40
4-11-2009	4	26	33	19	29	19	40
5-11-2009	5	27	33	19	30	20	41
6-11-2009	6	26	33	20	30	20	42
7-11-2009	7	26	33	20	30	20	41
8-11-2009	8	26	33	20	30	20	40
9-11-2009	9	26	33	19	29	19	39
10-11-2009	10	26	31	20	30	20	41
11-11-2009	11	26	33	20	29	20	45
12-11-2009	12	25	32	21	30	21	42
13-11-2009	13	24	33	21	30	20	41
14-11-2009	14	24	32	19	29	19	40
15-11-2009	15	26	33	20	30	20	42
16-11-2009	16	25	31	20	30	19	42
17-11-2009	17	25	32	21	31	20	43
18-11-2009	18	24	30	20	29	20	41
19-11-2009	19	24	32	20	30	19	41
20-11-2009	20	25	32	19	30	19	39
21-11-2009	21	24	33	20	31	20	40
22-11-2009	22	25	30	20	30	20	41
23-11-2009	23	25	33	21	30	20	43
24-11-2009	24	25	34	20	30	20	43
25-11-2009	25	25	33	20	31	20	44
26-11-2009	26	25	31	21	30	21	42
27-11-2009	27	25	29	20	29	19	41
28-11-2009	28	25	31	19	29	19	41
29-11-2009	29	25	31	19	30	19	41
30-11-2009	30	25	32	20	30	20	42
1-12-2009	1	25	34	20	30	20	43
2-12-2009	2	26	33	19	30	20	44
3-12-2009	3	25	33	19	29	19	39
4-12-2009	4	26	32	20	30	20	42
5-12-2009	5	25	31	20	20	20	40
6-12-2009	6	25	31	20	30	20	40
7-12-2009	7	25	31	21	30	21	41

8-12-2009	8	26	33	20	31	21	43
9-12-2009	9	25	33	19	29	19	40
10-12-2009	10	25	32	19	29	19	41
11-12-2009	11	25	33	19	29	19	41
12-12-2009	12	25	32	20	30	20	44
13-12-2009	13	26	33	19	30	19	39
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