HORTIN II Co Innovation Programme

Towards cost effective, high quality value chains

Improvement of shallot supply chains; Research 2008

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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 the selected commodities hot pepper, shallot and sweet pepper. Among others this can be achieved when technology development takes place in close collaboration between public institutions, farmers and private companies.

In Indonesia, the programme is carried out by the Indonesian Vegetable Research Institute (IVEGRI) in Lembang. In the Netherlands Applied Plant Research (APR), WUR-Greenhouse Horticulture (GH) and Agricultural Economics Research Institute (AEI), all part of Wageningen University and Researchcentre, are the principal partners.

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Summary

In 2008 in Brebes and in Purwakarta a number of transplanting and direct sowing experiments were done in which TSS crops (Tuktuk and a new Hybrid) were compared with crops grown from seed bulbs. Also an economic evaluation was made of the most important options of growing TSS.

The following conclusions could be drawn from the trials done in 2008:

- A nursery mixture consisting of sandy soil and stable manure or a mixture of paddy field soil, sandy soil and stable manure are giving a higher seed efficiency than mixtures containing burned rice husks. The sandy soil and stable manure are available in Brebes.
- Tuktuk transplanted at 150 plants per m^2 gives a higher yield than transplanted at 100 plants per m^2. It is possible that the optimal plant density of the Hybrid is less than 150 plants per m^2.
- In general the survival of transplanted seedlings is good: 95% or higher.
- The use of clusters on soil modules is not needed for solving a problem in reaching the correct plant density. Producing clusters on soil modules in polybags is giving too much work and the seed efficiency in these polybags is low. Transplanted seedlings on soil modules are giving less wilting after transplanting. When clusters on soil modules are used harvesting could be done earlier and when the crop is not allowed to mature normally the production is higher than with transplanted individual seedlings.
- The production of clusters of seedlings without soil modules is giving extra labour costs at sowing. Pellets which were used had a negative effect on seed efficiency. These disadvantages are more important than the advantage of less labour spend during transplanting.
- There is no clear influence on grading if seedlings are grown in clusters.
- In a good transplanting trial in Brebes it appeared that the yield of TSS Tuktuk grown at 150 plants/m^2 was 61% higher than the yield of the best seed bulb crop (Tanduyung, imported, 23,2 ton/ha); Tuktuk grown at 100 plants/m^2 was 33% higher than Tanduyung. The yield of the new Hybrid was 71% (100 plants/m2) to 83% (150 plants/m^2) higher than the yield of Tanduyung. In Purwakarta on a clay soil the yield of TSS Tuktuk grown at 150 plants/m^2 was 13% higher than the yield of Tanduyung; on a sandy soil the yield was 20% lower. The yield of the Hybrid was on the clay soil 25% (100 plants/m^2) to 75% (150 plants/m^2) higher than the yield of Tanduyung. On the sandy soil the Hybrid was giving 92% (100 plants/m^2) to 106% (150 plants/m^2) more yield than Tanduyung.
- The growing period of TSS is 2,5 till 3,5 weeks longer than the growing period of shallots grown from seed bulbs. Compared to Tuktuk the new developed hybrid is about 1 week earlier.
- The disadvantages of direct sowing are the long growing period (12-13 weeks in stead of 8 weeks with a bulb seed crop), the extra labour spend on weed control and probably the higher risks of damage by rain after sowing. The advantages are: no nursery is needed and no labour is needed for transplanting. In the experiments of 2008 in Brebes the yield of direct seeding TSS Tuktuk was lower than the yield of the seed bulb crops. It is possible that the fertilization level of the direct seeding crop was too low.
- In the direct seeding experiments in Brebes no difference in seed efficiency was found between closing the furrow with paddy field soil, nursery mixture (containing sandy soil and stable manure) and burned rice husks. The seed efficiency was not influenced clearly by covering with rice straw.
- The trials with seed treated with different insecticides were failed.
- Assuming a seed efficiency of 60% in the nursery the total variable costs of TSS are on the same (150 plants/m^2) or on a lower level (100 plants/m^2) than the variable costs of seed bulb crops grown from imported seed bulbs or seed bulbs bought from store. It depends on the assumed cost price of the farmers own seed bulbs if the variable costs of TSS are higher or lower. The much higher yield of TSS combined with comparable or even lower variable costs makes it theoretically profitable for the farmer to grow TSS.

1 Introduction

In 2008 research on production of True Seed Shallots in Brebes is continued. The growing conditions in Brebes were much better than in 2007. The trials were started earlier in the dry season. The attack by Spodoptera was less severe, because of the earlier start of the trials in the dry season and because of the better quality of the insecticides. Also the water supply was better than in 2007. In 2008 East West Seed Indonesia provided seeds of Tuktuk and seeds of a new Hybrid, especially bred for TSS-production.
At the end of 2007 a seed lot of 1 kg Tuktuk was send to SUET in Germany. SUET has made pellets of seeds, containing 6-7 seeds per pellet. The pellets were send to Indonesia in April 2008. In some trials the pellets were used. EWSI has treated some TSS seed with insecticide in order to test if it is possible to give protection against Spodoptera.

The research in 2008 was focused on the following questions:

- What is the most optimal nursery mixture in relation to seed efficiency and local availability in Brebes?
- What is the optimal plant density of Tuktuk and the Hybrid in transplanted production fields?
- What is the percentage of survival of seedlings after transplanting?
- What is the advantage of using clusters of seedlings produced on soil modules with respect to survival of seedlings, labour input and production?
- What is the advantage of using clusters without soil modules with respect to survival of seedlings, labour input and production?
- What is the effect of using clusters of seedlings, with or without soil modules, or planting individual seedlings in clusters on the grading of the bulbs at harvest?
- What is the level of production of TSS grown as a transplanted crop, in relation to seed bulb crops grown from seed bulbs imported, bought from store or produced by the farmers?
- Is it possible to reduce the input of labour at sowing by using pellets of seeds?
- What are the advantages and disadvantages of direct sowing of TSS?
- How can direct sowing be done in such a way that the seed efficiency is as high as possible?
- Is it possible to improve seed efficiency and to protect against Spodoptera by treating the seed with insecticides?
- What is the economic advantage of TSS crops in relation to crops grown from seed bulbs?

In 2008 the following experiments were done in Brebes:

- Experiment with different nursery mixtures
- Transplanting experiment 1; nursery sown on 15 April, transplanting date: 29/30 May
- Direct sowing experiment 1, without rice straw cover, sown on 15 June
- Direct sowing experiment 2, with rice straw cover, sown on 25 June
- Transplanting experiment 2; nursery sown on 29 June, transplanting date: 8 August
- Direct sowing experiment with seeds treated with insecticides

In May a soil sample was taken in Brebes. The results of the soil analysis are given in table 1.

Table 1. Soil analysis of the beds used for the trials in Brebes in 2008; sampling in May.

	pH KCL	N-Kjeldahl (%)	P2O5 (ppm)	K2O (ppm)	Mg (me/100 g)
Sample 1 (Exp. 1-4 and 6)	5.7	0.12	75.3	181.8	8.55
Soil sample 2 (Exp. 5)	5.6	0.13	76.1	190.8	8.96

In 2008 East West Seed Indonesia has done the following experiments in Purwakarta in which the same treatments as in Brebes were included:

- Transplanting experiment on clay soil; nursery sown on 23 April, transplanting on 3 June.
- Transplanting experiment on sandy soil; nursery sown on 23 April, transplanting on 3 June.

On 31 July 2008 a field day was organized in which the different treatments in the trials and the obtained results were presented to the farmers, exporters, local traders and agronomists. About 75-100 persons have visited the field day. On 6-7 August 2008 farmers from different provinces of Indonesia have visited the trials in Brebes. These farmers have been invited by the government.

Picture 1. Visitors of the Field day 31 July 2008.

2 Experiment with different nursery mixtures

Methods and materials

On 15 April different mixtures of paddy field soil, home garden soil, sandy soil (the black one used for building), stable manure and burned rice husks were made (see table 2). The experiment was done in trays in 3 replicates. In each replicate one tray of 28 cm x 36 cm; depth of soil layer 7.5 cm. Per tray (replicate) 355 seed of Tuktuk were sown. The sowing was done in rows (distance between rows 7 cm). Sowing depth was ca. 1 cm. Before sowing 5 grams Carbofuran, 50 grams KCl and 50 grams SP36 (containing P2O5) per m^2 was mixed into the upper layer of the soil in the trays. After sowing the trays were covered with plastic in order to avoid loss of moisture. The plastic was removed when seedlings started to emerge. Watering was done twice a day with a bruse. Fertilizer was given five times by means of 2 grams of NPK (15+15+15) per liter water. It is estimated that ca. 25 kg N/ha is given. A mixture of rice sifting and Dursban is spread 3 times over the nursery to protect against mole cricker (1 kg of rice sifting + 50 ml Dursban (1 time before sowing and 2 times after sowing). Spraying with insecticides was done two times (Tracer and Hostathion). Weed control was done 3 times by hand. Four weeks after sowing the emerged plants were counted.

Results and discussion

In table 2 the results of the experiments are presented. It appeared that the mixtures containing stable manure were giving a better emergence than the mixtures containing burned rice husks. The mixture "Andisol soil + Stable manure" was giving the best results, but the disadvantage of this mixtures is the poor availability in Brebes. The mixture "Paddy field Soil + sandy Soil + Stable manure" was second best. In 2008 all mixtures were giving a lower emergence than the mixture "Sandy soil + Stable manure" in 2007. It can be concluded that mixtures of sandy soil and Stable manure are the best mixtures. Sandy soil and stable manure are available in Brebes.

Table 2. Experiment on nursery media. Emergence % after 4 weeks

Treatment	% emergence
Paddy Field Soil = PFS	21.8
Home garden soil = HGS	27.0
Sandy soil = SS	12.5
Mixture Paddy Field Soil + Sandy Soil (1:1)	13.0
Mixture Home garden soil + Sandy Soil (1:1)	13.2
Mixture Paddy Field Soil + Sandy Soil + Stable Manure (1:1:1)	46.5
Mixture Home garden soil + Sandy Soil + stable Manure(1:1:1)	31.2
Mixture Paddy Field Soil + Sandy Soil + Burned rice husk (1:1:1)	17.4
Mixture Home garden soil + Sandy Soil + Burned rice husk (1:1:1)	16.0
Andisol soil + Stable manure (1: 1) (media from IVEGRI)	51.6
To compare with 2007:	
Sandy soil + Stable manure (1:2) (2007 data)	64.2

Remark: The mixtures are volume based mixtures

Picture 2. Sowing the nursery in plastic trays; april 2008

3 Transplanting experiment 1 in Brebes

Methods and materials

On 15 April seeds of Tuktuk and seeds of the new Hybrid were sown in trays and polybags. The size of the trays: 28 cm x 36 cm; depth of soil layer: 7.5 cm. Diameter of polybags: 5 cm; depth 10 cm. The nursery mixture was composed as follows: sandy soil mixed with compost coming from Lembang. The compost was not steamed. Before sowing 5 grams Carbofuran, 50 grams KCl and 50 grams SP36 (containing P2O5) per m^2 was mixed into the upper layer of the soil in the trays (not in the polybags, because of the risk to damage the seed).
Per tray 1 gram of seed was sown. This means: Tuktuk 329 seeds and the Hybrid 247 seeds.
The fertilization, control of pest, diseases and weeds is done in the same way as in the experiment on different nursery mixtures (see 2).

On 29/30 May the seedlings were transplanted. The transplanting experiment was done in 3 replicates. The plot-size was bruto 8.25 m2, netto 7.5 m2. Because of the poor emergence the number of planned replicates was reduced from 4 to 3 and also some treatments were skipped. Fertilization of the transplanted experiment was as follows (amounts per ha, area without ditches):

- before transplanting 74 kg P_2O_5 (as SP36) per ha;
- 10 days after transplanting 24 kg N (as Urea), 24 kg N (as Ammonium phosphate) and 33 kg K_2O per ha;
- 25 days after transplanting 24 kg N (as Urea), 24 kg N (as Ammonium phosphate) and 33 kg K_2O per ha;
- 35 days after transplanting 200 kg NPK 15+15+15 was given (30 kg N/ha).

In total 126 kg N, 104 P_2O_5 and 96 kg K_2O per ha is given.
For Bima Curut seed bulb crops Balitsa is giving the following advice: 146 kg N, 111 kg P2O5 and 100 kg K2O per ha.
EWSI is fertilizing transplanted fields as follows:

- two weeks after transplanting 500 kg NPK 16+16+16/ha;
- four weeks after transplanting 500 kg NPK 16+16+16/ha;
- six weeks after transplanting 500 kg NPK 16+16+16/ha;
- 250 kg KCl/ha.

In total EWS is giving 240 kg N/ha.

The control of pest (mainly Spodoptera) was done as follows: the seed bulb crops were sprayed 20 times and the TSS crops 25 time with mixtures of 4 (sometimes 2 or 3) pesticides. In table 3 and table 4 the application of pesticides is given for respectively the seed bulb crops and the TSS crop, including costs per ha (area with 70% beds and 30 % ditches). Next to this eggs of Spodoptera were removed by hand (18 times). Shortly after transplanting water was given with the green can (bruse) and when the seedlings were strong enough the iron basket was used. Weed control was done 8 times by hand.

Table 3. Pesticides used for shallot cultivation from bulb seed in transplanting experiment 1 (20 times application)

Pesticides	Volume applied **per 511.5 m2** **(gr or cc)**	Volume applied **per ha** **(gr or cc)**	Price per package IDR	Volume per package (gr or cc)	Costs per ha (IDR/ha)
Traser	**756.5**	10353	87000	100	9007009
Dursban	**102.0**	1396	30000	500	83754
Hostathion	**306.0**	4188	57000	500	477396
Tumagon	**663.0**	9073	110000	200	4990323
rampage	**518.5**	7096	440000	1000	3122151
antracol	**1326.0**	18147	57000	1000	1034358
score	**110.5**	1512	350000	1000	529277
daconil	**416.5**	5700	120000	1000	683988
dithane	**357.0**	4886	50000	1000	244282
Total					20172536

Table 4. Pesticides used for shallot cultivation from TSS in transplanting experiment 1 (25 times application)

Pesticides	Volume applied per 511.5 m2 (gr or cc)	Volume applied per ha (gr or cc)	Price per package IDR	Volume per package (gr or cc)	Costs per ha (IDR/ha)
Traser	1020.0	13959	87000	100	12144282
Dursban	102.0	1396	30000	500	83754
Hostathion	306.0	4188	57000	500	477396
Tumagon	663.0	9073	110000	200	4990323
rampage	782.0	10702	440000	1000	4708817
antracol	1326.0	18147	57000	1000	1034358
score	110.5	1512	350000	1000	529277
daconil	680.0	9306	120000	1000	1116716
dithane	884.0	12098	50000	1000	604888
Total					25689808

Picture 3. Transplanting experiment 1; 17 June 2008

Results and discussion

In table 5 the emergence and some characteristics of the seedlings are given. The emergence was rather poor, especially on the polybags. It appeared that the nursery mixture was very stiff. Especially in the polybags this was giving a poor emergence. The transplanted seedlings were much smaller than the seedlings transplanted in 2007.

Table 5. Emergence in nursery april 2008; nursery for transplanting trial 1

	% emergence	Characteristics seedlings at transplanting		
		length of seedling	Number of leafs	length of roots
Tuk tuk in trays, first sowing	51.4	16.7	2.8	5.1
Tuk tuk in trays, second sowing (5 weeks)	59.8	16.2	3.1	5.3
Hybrid in trays, first sowing	55.3	18.0	3.0	5.7
Tuk tuk on polybags (10 seeds per polybag)	11.0	7.7	2.3	7.8
Tuk tuk on polybags (5 seeds per polybag)	23.0	7.3	2.3	9.6
Hybrid on polybag (8 seeds per polybag)	17.4	9.3	2.1	11.5
Hybrid on polybag (5 seeds per polybag)	6.4	9.5	2.3	10.7
Tuk tuk sown in clusters in trays	45.4	15.6	2.6	4.9

In table 6 percentage of survival of seedlings after transplanting is given. Also the actual plant density reached 18 days after transplanting is shown. Harvest of the treatments was done at the moment of 75% fall over of leafs. The number of bulbs per hole is counted.

Table 6. Transplanting experiment 1 in 2008. Survival of seedlings, Spodoptera incidence, earliness and number of bulbs per hole

		% plant survival 18 days after trans-planting	Actual plant density after 18 days	Spodoptera incidence 32 days after planting	Earliness days until harvest	Number of bulbs per hole at harvest
T1	Tuk tuk Single seedlings 100pl/m2	93.7	94	9	82	1.47
T2	Tuk tuk Single seedlings Tuk tuk 150pl/m2	97.9	147	12	81	1.56
T3	Tuk tuk Clusters of 2.6 seedlings plastic bags; 150 pl/m2	_	139	4	81	3.25
T4	Tuk tuk 2 individual seedlings per hole; 200 pl/m2	92.2	184	7	81	1.92
T5	Tuk tuk Clusters of 4.5 seedlings plastic bags; 150 pl/m2	_	187	5	75	5.66
T6	Tuk tuk Single seedlings 150pl/m2*	96.5	145	11	82	1.42
T7	Hybrid Single seedlings 100pl/m2	98.3	98	6	75	2.81
T8	Hybrid Single seedlings 150pl/m2	96.3	144	4	75	2.14
T11	Bima curut-store 33,3 bulbs/m2	98.9	33	2	57	7.26
T12	Tanduyung-imported 33,3 bulbs/m2	98	33	3	56	15.05
T13	Bima curut-farmer 33,3 bulbs/m2	98.3	33	2	57	6.83
T14	Tuk tuk 2 individual seelings per hole; 150 pl/m2	94.2	141	5	81	2.18
T15	Tuk tuk 3 individual seelings per hole; 225 pl/m2	91.6	206	3	81	2.93
F probability (Anova)						
LSD 5%						
Observation on 1 or 2 plots (to compare)*						
T10A	Tuk tuk Clusters of 2.4 seedlings plastic bags; 100 pl/m2			4	75	6.62
T10B	Tuk tuk Single seedlings planted 3/hole; 408 pl/m2				75	1.82

*: 5 weeks old seedling; the other treatments 6 weeks old seedling at transplanting time
**: ha with 70% beds and 30% ditches
_: not exactly measured;estimated 98-100%

Picture 4. Transplanting experiment 1; 17 June 2008. T4 = Tuktuk 200 plants per m2 (2 seedlings in 1 hole), T2 = Tuktuk 150 plants per m2 (1 seedling per hole), T12= Tanduyung seed bulb crop.

Picture 4. Transplanting experiment 1; 2 July 2008: T4 = Tuktuk 200 plants per m2 (2 seedlings in 1 hole), T2 = Tuktuk 150 plants per m2 (1 seedling per hole). Same plots as in picture 4.

Picture 6. Transplanting experiment 1; 2 July 2008: T2 = Tuktuk 150 plants per m2 (1 seedling per hole), T12= Tanduyung seed bulb crop. Same plots as in picture 4.

Picture 7. T2= Tuktuk 150 plants per m2 (1 Seedling per hole); 30 July 2008

Picture 8. T12= Tanduyung seed bulb crop; 30 July 2008

At the end of July the treatments with shallots grown from bulb seeds were harvested (T11, T12, T13). The treatments with TSS Hybrid were harvested ca. 12 August (ca. 2,5 weeks later). The treatments with TSS Tuk tuk were harvested ca. 19 August. The results of earliness, yield, number of shallots and the grading are presented in table 7.

It is concluded that the Hybrid is an improvement in earliness, but the growing period is still ca. 2,5 weeks longer than the growing period of shallots grown from seed bulbs. Tuktuk grown from clusters on soil modules was not always giving an earlier ripening crop: only treatment T5 and T10A were earlier than the other Tuktuk treatments. In 2007 the improvement in earliness caused by clusters on soil modules was clear. This was ascribed to the fact that the seedlings on soil modules were not wilting after transplanting.

Table 7. Transplanting experiment 1 in 2008. Earliness, yield, number of harvested shallots and grading.

		Earliness days until harvest	Shallots with leaves 3 days after harvest Yield ton/ha**	Shallots with leaves 10-14 days after harvest Yield ton/ha**	Shallots (without leafs) Yield ton/ha**	Number of shallots harvested per m2	Grading (weight%) (5-15) mm	(15-25) mm	(25-35) mm	(35-45) mm	>45 mm
T1	Tuk tuk Single seedlings 100pl/m2	82	30.9	23.9	21.9	146	0.0	1.1	16.7	82.0	0.2
T2	Tuk tuk Single seedlings Tuk tuk 150pl/m2	81	36.2	28.7	23.8	162	0.0	1.0	16.3	82.7	0.0
T3	Tuk tuk Clusters of 2.6 seedlings plastic bags; 150 pl/m2	81	35.0	27.1	21.4	148	0.0	1.8	14.0	82.8	1.4
T4	Tuk tuk 2 individual seedlings per hole; 200 pl/m2	81	35.0	27.2	22.4	156	0.0	1.7	15.4	82.2	0.7
T5	Tuk tuk Clusters of 4.5 seedlings plastic bags; 150 pl/m2	75	38.0	21.8	19.3	144	0.0	3.3	25.2	71.1	0.3
T6	Tuk tuk Single seedlings 150pl/m2*	82	37.5	27.8	24.7	143	0.0	1.0	20.1	77.9	1.0
T7	Hybrid Single seedlings 100pl/m2	75	39.7	27.2	23.1	264	0.0	10.5	66.5	23.0	0.0
T8	Hybrid Single seedlings 150pl/m2	75	42.5	27.7	24.3	297	0.0	17.1	69.7	13.2	0.0
T11	Bima curut-store 33,3 bulbs/m2	57	14.3	12.1	11.4	206	3.3	32.5	56.1	8.0	0.0
T12	Tanduyung-imported 33,3 bulbs/m2	56	23.2	19.3	17.6	545	8.1	71.6	20.3	0.0	0.0
T13	Bima curut-farmer 33,3 bulbs/m2	57	17.1	14.4	14.6	222	0.7	24.0	58.0	17.3	0.0
T14	Tuk tuk 2 individual seelings per hole; 150 pl/m2	81	34.6	27.1	23.7	155	0.0	1.5	10.7	86.3	1.5
T15	Tuk tuk 3 individual seelings per hole; 225 pl/m2	81	36.5	28.9	23.4	157	0.0	2.2	17.9	79.6	0.3
F probability (Anova)			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
LSD 5%			4.60	2.60	3.02	53.0	1.15	7.35	12.02	14.25	1.28
Observation on 1 or 2 plots (to compare)*											
T10A	Tuk tuk Clusters of 2.4 seedlings plastic bags; 100 pl/m2	75	30.4	19.8	19.8	235.0	4.2	14.0	51.9	30.2	0.0
T10B	Tuk tuk Single seedlings planted 3/hole; 408 pl/m2	75	44.9	26.8	24.1	211.0	0.0	3.8	32.3	63.8	0.0

*: 5 weeks old seedling; the other treatments 6 weeks old seedling at transplanting time
**: ha with 70% beds and 30% ditches

The yield of the TSS-treatments was ca. 2 times or more higher than the yield of Bima grown from seed bulbs. The yield of Bima grown from seed bulbs from farmers was higher than the yield of Bima grown from seed bulbs from store. The yield of Tanduyung was higher than the yield of Bima.
The yield of the Hybrid is significantly higher than the yield of Tuktuk (3 days after harvest T7-T1:18% and T8-T2: 17%)
Within the Tuktuk treatments T6 was giving a high yield. This means that transplanting of young seedlings (5 weeks instead of 6 weeks old seedlings) is also possible and this can give a higher yield.
Tuktuk was giving a significantly higher yield (17%) when grown at 150 plants per m^2 instead of 100 plants per m^2. T4 was not different from T2. This means 200 plants is not better than 150 plants. Treatment T10B was only present in 2 replicates, but the yield of this treatment with 408 plants per m^2, planted in separate holes was giving the highest yield. However the very high plant density of this treatment is not realistic because of the high costs of the nursery. The yield of T15 (225 plants per m^2, planted in clusters of 3 per hole) was not giving a higher yield than 150 plants per m^2.
The Hybrid was giving the highest yield when grown at 150 plants per m^2, but the difference with 100 plants per m^2 was not significant. This indicates that the optimal plant density for the Hybrid can be lower than for Tuk tuk. A lower optimal plant density means also a smaller area which is needed for the nursery. This is reducing the costs of the nursery.
Tuktuk is giving a high percentage of big bulbs (35 – 45 mm). The hybrid is giving less big bulbs and is probably more acceptable for the Indonesian market. So in size of the bulbs the Hybrid is an improvement. The bulbs of the Hybrid are still bigger than the bulbs grown from seed bulbs, especially seed bulbs from the variety Tanduyung.

Picture 9. Samples of Tuktuk, the new Hybrid, Bima curut and Tanduyung after harvest.

4 Direct sowing experiment 1, without rice straw cover

Methods and materials

On 15 June the trial was sown on the beds. The experiment was done in 3 replicates. The plot-size was bruto 8.25 m2, netto 7.5 m2. The sowing was done in rows. Distance between the rows 25 cm. Single seeds of Tuktuk and the Hybrid were sown with 120 seeds per rowlength of 1.5 m. This means the sowing density was 320 seeds per m2. Pellets of Tuktuk, containing 6-7 seeds per pellet were sown in a density of 21 pellets per row length of 1.5 m (364 seeds per m2). The seed bed was good. The furrows in the sowing was done were made with a stick and closed with different material (see table 5).

Picture 10. Sowing the direct sowing experiment.

Weed control was done 14 times. Weeding was done by 5 women each time for one day work (day of 5 hours) (70 women days for 264 m2 means 1856 women days for 1 ha (70% beds).

Control of pests and diseases was done in the same way as was done in transplanting experiment 1. The amounts of pesticides used on the bulb seed crops is comparable with the amounts mentioned in table 3. The direct seeding TSS crops was sprayed ca. 30 times. It is estimated that the amount of pesticides is ca. 20% higher as mentioned in table 4.

Eggs of Spodoptera were removed by hand.

Fertilization of the experiment was as follows (amounts per ha, without ditches):

- before sowing 74 kg P2O5 (as SP36) per ha
- 14 days after sowing 24 kg N (as Urea), 24 kg N (as Ammonium phosphate) and 33 kg K2O per ha
- 25 days after transplanting 24 kg N (as Urea), 24 kg N (as Ammonium phosphate) and 33 kg K2Oper ha

In total 96 kg N/ha was given.

The level of fertilization was based on the advice for a Bima Curut seed bulb crop. However the area of a bed was calculated as 11 m2. In fact the area of a bed was 16.5 m2. Because of this the fertilization level was 33% lower than the advice.

Results and discussion

Five weeks after sowing the plant density was observed. The results are shown in table 8. In each plot the plants in 8 rows were counted. The seed efficiency is rather high in this trial: ca. 50% in D3. This is higher than found in the nurseries on a seedbed in the field. Probably this is because of the relatively late sowing. The soil was good prepared before sowing. The treatment in which the plots were covered with plastic after sowing until emergence (D7) was giving a relative low number of plants. This means that is possible that the plastic was too long covering the plots. Seedlings could be killed by too high temperatures under the cover.

Picture 11. Direct sowing experiment 1. Development on 2 July 2008.

There were hardly no differences plant density between the different ways of closing the furrow after sowing. Closing the furrow with soil was not giving a lower plant density than closing the furrow with organic material.

Table 8. Direct sowing trial 1 in 2008, without rice straw cover. % emergence, plant density, Spodoptera incidence and bulbs per m2.

		Emergence 5 weeks after sowing	Plants per m2 5 weeks after sowing	Spodoptera incidence (% attacked leafs) 18-aug	Harvested bulbs/ m2
D1	Tuk tuk 1 cm deep furrow, closed with burned rice husks	42.3	135	9	141
D2	Tuk tuk 1 cm deep furrow, closed with nursery mixture	46.8	150	7	155
D3	Tuk tuk 1 cm deep furrow, closed with soil	49.7	159	13	169
D4	Tuk tuk pellets 1cm deep furrow, closed with burned rice husks	25.3	81	14	109
D5	Tuk tuk pellets 1 cm deep furrow, closed with nursery mixture	25.0	80	15	104
D6	Tuk tuk pellets 1 cm deep furrow, closed with soil	24.4	78	14	105
D7	Tuk tuk pellets 1 cm deep furrow, closed with soil, covered with plastic before emergence	16.6	53	16	70
D8	Hybrid 1 cm deep furrow, closed with burned rice husks	33.2	106	10	258
D9	Ilokos (imported) 33,3 bulbs/m2	92.1	28	1	470
D10	Bima curut (farmers seed bulbs) 33,3 bulbs/m2	95.4	29	3	360
D11	Tuk tuk 1 cm deep furrow, closed with ashes	41.6	133	9	139
F probability (Anova)		<0.001	<0.001	0.03	<0.001
LSD 5%		7.90	17.6	9.3	57.7

The seed bulb treatments (D9 and D10) were harvested on 19 August (65 days after planting). The TSS treatments were harvested on 17 September (94 days after sowing). The treatments ware harvested when 75% of the leafs had fallen over. The growing period is ca. 2 weeks longer than the growing period of the transplanted TSS-crops of transplanting experiment 1. The yield data and the grading data are presented in table 9.

Table 9. Direct sowing trial 1 in 2008, without rice straw cover. Yield and grading.

		Yield with leaves		Yield	Grading (weight%)				
		3 days after harvest ton/ha*	13 days after harvest ton/ha*	without leaves	(5-15) mm	(15-25) mm	(25-35) mm	(35-45) mm	>45 mm
D1	Tuk tuk 1 cm deep furrow, closed with burned rice husks	19.8	15.7	14.1	0.0	4.7	33.0	62.3	0.0
D2	Tuk tuk 1 cm deep furrow, closed with nursery mixture	21.9	17.2	15.2	0.0	3.4	33.8	62.8	0.0
D3	Tuk tuk 1 cm deep furrow, closed with soil	21.0	16.2	14.2	0.0	5.4	32.3	61.4	1.0
D4	Tuk tuk pellets 1cm deep furrow, closed with burned rice husks	12.3	9.6	8.5	0.0	4.8	23.2	71.1	1.0
D5	Tuk tuk pellets 1 cm deep furrow, closed with nursery mixture	15.2	11.8	10.5	0.0	4.2	31.1	62.3	2.4
D6	Tuk tuk pellets 1 cm deep furrow, closed with soil	14.6	11.3	10.1	0.0	3.8	27.4	66.4	2.4
D7	Tuk tuk pellets 1 cm deep furrow, closed with soil**	10.5	8.1	7.2	0.0	4.0	25.3	68.8	1.9
D8	Hybrid 1 cm deep furrow, closed with burned rice husks	21.8	16.6	14.6	0.0	5.5	62.4	32.1	0.0
D9	Ilokos (imported) 33,3 bulbs/m2	34.2	27.3	25.6	2.0	39.7	58.3	0.0	0.0
D10	Bima curut (from farmer) 33,3 bulbs/m2	23.5	18.3	17.0	2.3	37.0	59.0	1.7	0.0
D11	Tuk tuk 1 cm deep furrow, closed with ashes	20.6	16.1	14.1	0.0	8.9	25.9	64.3	1.0
F probability (Anova)		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.44
LSD 5%		4.11	3.56	2.30	0.78	10.08	14.14	9.50	2.82

*: ha with 70% beds and 30% ditches
**: covered with plastic during emergence

Compared to transplanting trial 1 the yield of the seed bulb crops was higher. Especially Ilokos was giving a good yield.
The yield of TSS was low in comparison with the yield in Transplanting trial 1. The treatments sown with pellets (D4 – D7) had low plant densities (lower than 100 plants per m2). This explains the low yield.
The treatments sown with normal seed however had plant densities comparable with the plant densities in transplanting experiment 1. It is not exactly known why the yield of these treatments is low. Spodoptera incidence was not higher (table 8) than in transplanting experiment 1. The number of bulbs per plant is much lower than in Transplanting experiment 1. Assuming no plants were dying after 5 weeks it can be seen in table 8 that no splitting was occurring in the seedlings obtained from seed (D1, D2 and D3). In Transplanting experiment 1 about 1.5 bulbs were produced per plant with Tuktuk (table 5). This could be part of the explanation for the low yield in the direct seeding experiment. The difference in splitting however is much smaller with the Hybrid (2.4 bulbs per plant in the direct seeding experiment and 2.1 – 2.8 in Transplanting experiment 1). So a lower splitting rate can not explain the lower yield in the direct sowing with the Hybrid. It is possible that the fertilization, especially with nitrogen, has been too low. In total 96 kg N is given. May be there has been shortage of nitrogen. The grading data are showing that the bulbs of Tuktuk and the Hybrid were smaller than in Transplanting experiment 1.

Picture 12 . Direct sowing experiment 1 (without rice straw cover); 23 August 2008

5 Direct sowing experiment 2, with rice straw cover

Methods and materials

On 25 June the trial was sown on the beds. The experiment was done in 3 replicates. The plot-size was bruto 8.25 m^2, netto 7.5 m^2. The sowing was done in rows. Distance between the rows 25 cm. Single seeds of Tuktuk and the Hybrid were sown with 120 seeds per rowlength of 1.5 m. This means the sowing density was 320 seeds per m^2. Pellets of Tuktuk, containing 6-7 seeds per pellet were sown in a density of 21 pellets per rowlength of 1.5 m (364 seeds per m^2). The seed bed was good. After sowing the soil was covered with rice straw until seedlings have emerged. The furrows were made with a stick and closed with different material (see table 10). Weed control was done 12 times. Weeding was done by 4 women each time for one day work (day of 5 hours) (48 women days for 264 m2 means 1273 women days for 1 ha (70% beds).

Picture 13. Direct sowing experiment 2, with rice straw cover

Control of pests and diseases was done in the same way as was done in transplanting experiment 1. The amounts of pesticides used on the bulb seed crops is comparable with the amounts mentioned in table 3. The direct seeding TSS crops was sprayed ca. 30 times. It is estimated that the amount of pesticides is ca. 20% higher as mentioned in table 4.

Eggs of Spodoptera were removed by hand.

Fertilization of the experiment was as follows (amounts per ha, without ditches):

- before sowing 74 kg P2O5 (as SP36) per ha
- 14 days after sowing 24 kg N (as Urea), 24 kg N (as Ammonium phosphate) and 33 kg K2O per ha
- 25 days after transplanting 24 kg N (as Urea), 24 kg N (as Ammonium phosphate) and 33 kg K2Oper ha

The level of fertilization was based on the advice for a Bima Curut seed bulb crop. However the area of a bed was calculated as 11 m^2. In fact the area of a bed was 16.5 m^2. Because of this the fertilization level was 33% lower than the advice.

Results and discussion

Five weeks after sowing the plant density was observed. The results are shown in table 10. In each plot the plants in 8 rows were counted. In this trial the seed efficiency is also rather high (up to 44% in D13, but lower than in the experiment without rice straw covering.

Closing the furrow with manure was giving the best emergence with normal seed. With pellets there was no difference. Also in this trial the emergence of the seed in pellets was lower than the emergence of normal seed.

Table 10. Direct sowing trial 2 in 208, with rice straw cover. % emergence, plant density, Spodoptera incidence and bulbs per m2.

	Emergence 5 weeks after sowing	Plants per m2 5 weeks after sowing	Spodoptera incidence (% attacked leafs)	Har-vested bulbs/ m2
D12 Tuk tuk 1 cm deep furrow, closed with burned rice husks	37.6	120	2.7	111
D13 Tuk tuk 1 cm deep furrow, closed with manure	44.0	141	5.0	140
D14 Tuk tuk 1 cm deep furrow, closed with soil	40.8	130	3.2	141
D15 Tuk tuk pellets 1cm deep furrow, closed with burned rice husks	20.4	65	5.1	71
D16 Tuk tuk pellets 1 cm deep furrow, closed with manure	20.8	67	0.7	88
D17 Tuk tuk pellets 1 cm deep furrow, closed with soil	21.9	70	2.7	81
D18 Hybrid 1 cm deep furrow, closed with burned rice husks	20.4	65	7.3	131
D19 Bulb seed Ilokos (imported), 33,3/m2	94.4	28	0.1	367
D20 Tuk tuk 1 cm deep furrow, closed with ashes	35.3	113	1.1	103
D21 Tuk tuk 1 cm deep furrow, closed with ashes 333 seeds per row	34.9	310	2.2	305
D22 Bulb seed Bima curut (from farmer) 33,3/m2	95.8	29	0.4	634
F probability (Anova)	<0.001	<0.001	0.413	<0.001
LSD 5%	8.65	35.4	6.39	31.9

The seed bulb treatments (D19 and D22) were harvested on 28 August (64 days after planting). The TSS treatments were harvested on 28 September (95 days after sowing). The treatments ware harvested when 75% of the leafs had fallen over. The yield data and the grading data are presented in table 11.

Table 11. Direct sowing trial 2 in 2008, with rice straw cover.Yield and grading.

	Yield with leaves		Yield	Grading (weight%)				
	6 days after harvest ton/ha*	13 days after harvest ton/ha*	without leaves 13 days	(5-15) mm	(15-25) mm	(25-35) mm	(35-45) mm	>45 mm
D12 Tuk tuk 1 cm deep furrow, closed with burned rice husks	16.8	13.4	12.0	0.0	4.6	54.9	40.4	0.0
D13 Tuk tuk 1 cm deep furrow, closed with manure	17.9	14.5	12.8	0.0	9.7	49.5	40.1	0.7
D14 Tuk tuk 1 cm deep furrow, closed with soil	15.4	12.1	10.6	0.0	9.4	63.9	26.0	0.7
D15 Tuk tuk pellets 1cm deep furrow, closed with burned rice husks	14.5	11.3	10.0	0.0	5.4	41.6	50.2	2.8
D16 Tuk tuk pellets 1 cm deep furrow, closed with manure	13.6	10.8	9.7	0.0	4.6	35.1	57.7	2.6
D17 Tuk tuk pellets 1 cm deep furrow, closed with soil	14.3	11.1	10.0	0.0	5.4	38.4	51.6	4.7
D18 Hybrid 1 cm deep furrow, closed with burned rice husks	12.8	10.0	8.7	0.0	9.5	81.1	9.4	0.0
D19 Bulb seed Ilokos (imported), 33,3/m2	27.2	21.5	19.4	1.0	53.4	45.6	0.0	0.0
D20 Tuk tuk 1 cm deep furrow, closed with ashes	17.9	13.8	12.6	0.0	5.1	50.1	44.8	0.0
D21 Tuk tuk 1 cm deep furrow, closed with ashes 333 seeds per row	27.8	22.2	19.4	0.0	5.3	33.4	61.3	0.0
D22 Bulb seed Bima curut (from farmer) 33,3/m2	26.5	21.0	18.8	1.2	50.0	48.7	0.0	0.0
F probability (Anova)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.135
LSD 5%	3.95	3.05	2.60	0.55	6.07	16.08	17.28	3.55

*: ha with 70% beds and 30% ditches

The yield of TSS were low in comparison with the yield in Transplanting experiment 1. The treatments sown with pellets (D15 – D17) had low plant densities (lower than 100 plants per m2). This explains the low yield. The treatments sown with normal seed however had plant densities comparable with the plant densities in transplanting experiment 1. It is not exactly known why the yield of these treatments is low. Also in this trial Tuktuk has a lower splitting rate than in Transplanting experiment 1, but also here the Hybrid does not show a splitting which is much lower than in Transplanting experiment 1. This means that also in this trial the lower splitting rate can not explain the low yield. Spodoptera incidence was not higher than in transplanting experiment 1. It is possible that the fertilization, especially with nitrogen, has been too low. In total 96 kg N is given. May be there has been shortage of nitrogen. The grading data are showing that the bulbs of Tuktuk and the Hybrid were smaller than in Transplanting experiment 1.

6 Transplanting experiment 2 in Brebes

Methods and materials

On 29 June seeds of Tuktuk and seeds of the new Hybrid were sown in trays and polybags. The size of the trays: 28 cm x 36 cm; depth of soil layer 7.5 cm. Diameter of polybags: 5 cm; depth 10 cm. The nursery mixture was composed as follows: sandy soil mixed with compost coming from Lembang. The compost was not steamed. Before sowing 5 grams Carbofuran, 50 grams KCl and 50 grams SP36 (containing P2O5) per m^2 was mixed into the upper layer of the soil in the trays (not in the polybags, because of the risk to damage the seed).
Per tray 1 gram of seed was sown. This means: Tuktuk 329 seeds and the Hybrid 247 seeds.
The fertilization, control of pest, diseases and weeds is done in the same way as in the experiment on different nursery mixtures (see 2).

Picture 14. Nursery sown for transplanting experiment 2. The trays and polybags are covered with plastic during the period before emergence.

On 8 August the seedlings were transplanted. The transplanting experiment was done in 3 replicates. The plot-size was bruto 8.25 m2, netto 7.5 m2. Fertilization of the transplanted experiment was as follows (amounts per ha, without ditches):

- before transplanting 74 kg P2O5 (as SP36) per ha
- 10 days after transplanting 24 kg N (as Urea), 24 kg N (as Ammonium phosphate) and 33 kg K2O per ha
- 25 days after transplanting 24 kg N (as Urea), 24 kg N (as Ammonium phosphate) and 33 kg K2O per ha

The level of fertilization was based on the advice for a Bima Curut seed bulb crop. However the area of a bed was calculated as 11 m2. In fact the area of a bed was 16.5 m2. Because of this the fertilization level was 33% lower than the advice.

The control of pest (mainly Spodoptera) was done in the same way as in transplanting trial 1. The same is true for the pest control by hand and the watering,

The trial was more or less destroyed by heavy rain fall in October. The damage, especially in the TSS crops, was large and it was decided to harvest the trial.

Results and discussion

In table 12 the emergence and some characteristics of the seedlings are given. The emergence was rather poor, especially on the polybags. It appeared that the nursery mixture was very stiff. Especially in the polybags this was giving a poor emergence.

Table 12. Emergence in nursery june 2008; sown 29 June

	% emergence
Tuk tuk in trays	50.1
Hybrid in trays, first sowing	13.6
Tuk tuk on polybags (6 seeds per polybag)	11.7
Tuk tuk pellets in trays	27.6
Tuk tuk pellets in polybag (1 pellet per bag)	16.0
Tuk tuk pellets in polybag (2 pellets per bag)	25.4
Hybrid on polybag (10 seeds per polybag)	7.0

Three weeks after transplanting the survival of seedlings was determined. The results are given in table 13.

Table 13.Transplanting experiment 2 in 2008. % survival after transplanting, plantdensity, earliness and number of bulbs per hole

		% plant survival 21 days after trans-planting	Actual plant density after 21 days
B1	Tuk tuk Single seedlings Tuk tuk 150pl/m2	94.9	142
B2	Tuk tuk Clusters of 6.1 seedlings plastic bags; 150 pl/m2	_	148
B3	Tuk tuk Single seedlings 100pl/m2	95.6	96
B4	Tuk tuk Clusters of 3.0 seedlings plastic bags; 150 pl/m2	_	147
B5	Tuk tuk Clusters of 2.9 seedlings without soil 150 pl/m2	_	153
B6	Tuk tuk 2 individual seelings per hole; 150 pl/m2	91.0	137
B7	Tuk tuk 3 individual seelings per hole; 225 pl/m2	89.7	202
B8	Tuk tuk 4 individual seelings per hole; 300 pl/m2	94.0	282
B9	Bima curut-farmer 33,3 bulbs/m2	97.4	32
B10	Hybrid Single seedlings 100pl/m2	96.7	97
B13	Tuk tuk Clusters of 2.2 seedlings plastic bags; 100 pl/m2	_	

_: not exactly measured;estimated 98-100%

On 11 October the bulb seed crop (B9) was harvested (64 days after planting). The TSS crops were harvested on 19 October (72 days after transplanting). The yield data and the grading data are presented in table 14.

Table 14. Transplanting trial 2 in 2008. Yield and grading

		Yield with leaves		Yield	Grading (weight%)				
		4 days after harvest ton/ha*	13 days after harvest ton/ha*	without leaves 13 days	(5-15) mm	(15-25) mm	(25-35) mm	(35-45) mm	>45 mm
B1	Tuk tuk Single seedlings Tuk tuk 150pl/m2	14.2	11.2	10.1	0.0	4.4	37.5	58.2	0.0
B2	Tuk tuk Clusters of 6.1 seedlings plastic bags; 150 pl/m2	21.0	16.5	14.6	0.0	5.1	37.6	57.4	0.0
B3	Tuk tuk Single seedlings 100pl/m2	7.5	5.8	5.1	0.0	2.4	32.2	65.4	0.0
B4	Tuk tuk Clusters of 3.0 seedlings plastic bags; 150 pl/m2	19.0	14.9	13.1	0.0	1.6	33.6	64.9	0.0
B5	Tuk tuk Clusters of 2.9 seedlings without soil 150 pl/m2	15.4	11.9	10.7	0.0	1.6	40.9	57.5	0.0
B6	Tuk tuk 2 individual seelings per hole; 150 pl/m2	13.4	10.4	9.4	0.0	3.1	43.9	53.1	0.0
B7	Tuk tuk 3 individual seelings per hole; 225 pl/m2	15.8	12.2	10.7	0.0	2.4	48.5	49.1	0.0
B8	Tuk tuk 4 individual seelings per hole; 300 pl/m2	18.0	13.7	12.5	0.0	8.5	60.7	30.8	0.0
B9	Bima curut-farmer 33,3 bulbs/m2	9.8	7.8	7.2	1.6	50.2	48.2	0.0	0.0
B10	Hybrid Single seedlings 100pl/m2	13.8	10.8	9.5	0.0	17.7	68.7	13.6	0.0
B13	Tuk tuk Clusters of 2.2 seedlings plastic bags; 100 pl/m2	21.5	17.1	15.0	0.0	8.5	59.7	31.8	0.0
F probability (Anova)		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
LSD 5%		2.58	1.92	1.68	0.27	6.41	13.16	14.46	

*: ha with 70% beds and 30% ditches

Compared to transplanting experiment 1 the yield of transplanting experiment 2 is very low. This is also true for Bima Curut, although the length of the growing was more or less the same. It is possible that Spodoptora has caused a lot of damage. It is also possible that the nitrogen gift was too low. The yield of the TSS crop is also low. Partly this can be explained by the damage caused by heavy rains. The growing period was ca. 10 days shorter than in transplanting experiment 1. The yields of the treatments obtained by planting clusters on soil modules (B2, B13 and B4) were higher than the yields of the treatments obtained by transplanting individual seedlings. Probably there was an advantage of less wilting after transplanting. The production of the clusters on soil module was started earlier. The difference between B4 and B5 gives also rise to this conclusion.
With transplanting individual seedlings a higher plant density was giving a higher yield.
The yield of the Hybrid was not high, but it was higher than with Tuktuk grown at the same plant density.
The differences in grading were the same as in transplanting experiment 1: Tuktuk is producing the biggest bulbs, followed by the Hybrid and Bima had the smallest bulbs. The grading was not clearly influenced by growing in clusters.

7 Direct seeding experiment with treated seed

Methods and materials

East West Seeds has treated seeds of Tuktuk with the following insecticides:

- 0.16 mg Cyromazine/1000 seeds
- 0.08 mg Cyromazine/1000 seeds
- 1.36 mg Spinosad/ 1000 seeds

The seeds were dressed and not pelleted with these insecticides (50 gram each).

After sowing the trial was too much damaged by heavy rainfall. Counting the emerged plants had no sense.

8 Transplanting experiments done by East West Seed Indonesia

Methods and materials

On 23 April the seeds of Tuktuk and seeds of the new Hybrid were sown in trays and polybags. On 30 April a second sowing was done to obtain 5-weeks-old seedlings at transplanting time. The nursery mixture was composed as follows: sown in beds: bed soil mixed with burn rice hustle; polybags: fine soil: burn rice hustle: fine compost (2:1:1). On 3 June the seedlings were transplanted. Two experiments were done: one on a clay soil and one on a sandy soil. Both experiments had two replicates. The plot-size was 1 m^2.

Picture 15. Seedlings produced by EWSI in Purwakarta. Box on the left: Tuktuk, box on the right: New hybrid

Results and discussion

In the fourth week after sowing of the nursery the number of seedlings was counted. In table 15 the percentages of emergence are given. The emergence on trays was much better than on a seedbed in the field. The emergence of the seeds in the SUET-pellets was much lower than the emergence of the unpelleted seeds. The emergence of the Hybrid was higher than the emergence of Tuktuk. At transplanting time the seedlings in Purwakarta were more developed than in Brebes: more leafs and greater plant length. In the seedlings sown on 23 April more Antracnose was present than in the seedlings sown on 30 April.

Table 15. Emergence in EWS-nursery sown in Purwakarta on 23 April

	% emergence after 4 weeks	Characteristics seedlings at transplanting	
		Number of leafs	Plant length (cm)
Tuk tuk sown on seedbed in the field	20.6	4 à 5	30 à 40
Tuk tuk sown on seedbed in the field on 30 April	32.8	3 à 4	20 à 27
Tuk tuk sown in trays	81.7	4 à 5	25 à 35
Tuk tuk sown 10 seeds per hole in trays	70.3	4 à 5	25 à 35
Tuk tuk SUET-pellets with 7 seeds sown in trays	34.4	4 à 5	25 à 35
Tuk tuk sown in polybags (10 seeds)	52.7	3 à 4	22 à 30
Tuk tuk sown in polybags (6 seeds)	65.0	3 à 4	22 à 30
Tuk tuk SUET-pellets with 7 seeds sown in polybags	37.7	3 à 4	22 à 30
Hybrid sown on seedbed in the field	36.4	4 à 5	30 à 40
Hybrid sown on seedbed in the field on 30 April	29.8	3 à 4	20 à 27
Hybrid sown in trays	91.6	4 à 5	25 à 35
Hybrid sown in polybags (8 seeds)	74.3	4 à 5	25 à 35
Hybrid sown in polybags (5 seeds)	82.4	4 à 5	25 à 35

Three weeks after transplanting the survival of seedlings was observed. In the tables 16 and 17 the percentage of survived seedlings is given. It appeared that the variation between replicates was rather big: for example survival of plants of treatment 1 on clay soil 4% and 52 %. Especially the survival after transplanting of the single seedlings of Tuktuk was rather poor. The survival of the Hybrid was much better. The most important reason for the poor survival of Tuktuk seedlings was the attack by antracnose.
The survival of Tuktuk individual seedlings was the best if 5-weeks old seedlings were transplanted. May be the 6-weeks old seedling were too well developed for successfully transplantation. And because of the attack of Anthracnose had already started in the seedling/nursery time.

Table 16. Transplanting experiment on clay soil done by EWS in 2008. Survival of plants, yield, number of harvested shallots.

		% of seed-lings survived after 21 days	Earliness days until harvest	Number of harvested bulbs per m2	Shallots with leaves		
					At harvest Yield ton/ha**	3 days after harvest Yield ton/ha**	10 days after harvest Yield ton/ha**
T1	Tuk tuk Single seedlings 100pl/m2	28	79	25	8.8	8.1	6.7
T2	Tuk tuk Single seedlings Tuk tuk 150pl/m2	27	77	10	3.2	2.5	2.1
T3	Tuk tuk 30 clusters with 5-6 seedlings/m2 (polybag); 150 pl/m2	73	72	18	4.6	3.2	2.5
T4	Tuk tuk 80 clusters with 2-3 seedlings/m2 (polybag); 160 pl/m2	58	79	12	4.9	4.2	3.7
T5	Tuk tuk 35 clusters with 5-6 seedlings (from trays); 175 pl/m2	51	72	20	3.2	2.9	2.6
T6	Tuk tuk Single seedlings (5 weeks old)* 100pl/m2	98	80	95	19.1	17.9	15.4
T7	Hybrid Single seedlings 100pl/m2	82	68	66	21.9	19.7	14.7
T8	Hybrid Single seedlings 150pl/m2	75	69	106	30.5	27.7	21.4
T9	Tuk tuk 25 clusters with 4-5 seedlings (polybags); 100 pl/m2	84	66	21	6.5	5.0	2.8
T10	Tuk tuk 50 clusters with 2-3 seedlings (polybags); 100 pl/m2	89	66	81	22.3	20.4	12.8
T11	Bima curut-store 33,3 bulbs/m2	81	56	32	13.0	10.3	8.6
T12	Tanduyung-imported 33,3 bulbs/m2	88	58	42	20.7	15.9	13.1
T13	Bima curut-farmer 33,3 bulbs/m2	96	62	26	17.4	13.8	11.6
T14	Tuk tuk 2 individual seelings per hole; 150 pl/m2	39	79	46	13.3	11.9	10.0
T15	Tuk tuk 3 individual seelings per hole; 225 pl/m2	29	80	36	9.3	8.2	6.8
T16	Tuk tuk 4 individual seelings per hole; 300 pl/m2	60	79	60	8.1	6.8	5.8
T17	Tuk tuk 80 clusters with 2-3 seedlings/m2 (polybag; SUET); 160 pl/m2	89	72	38	11.6	7.4	6.1
T18	Hybrid Single seedlings (5 weeks old)* 150pl/m2	99	68	69	21.2	19.6	14.5
						0.0	0
F probability (Anova)		<0.001		<0.001	<0.001	<0.001	<0.001
LSD 5%		32.1		37.47	9.534	9.7	7.82229

*: 5 weeks old seedling; the other treatments 6 weeks old seedling at transplanting time
**: ha with 70% beds and 30% ditches

Table 17. Transplanting experiment on sandy soil done by EWS in 2008. Survival of plants, earliness, yield, number of harvested shallots.

		% of seed-lings survived after 21 days	Earliness days until harvest	Number of harvested bulbs per m2	Shallots with leaves		
					At harvest Yield ton/ha**	3 days after harvest Yield ton/ha**	10 days after harvest Yield ton/ha**
T1	Tuk tuk Single seedlings 100pl/m2	54	75	28	10.4	8.6	7.0
T2	Tuk tuk Single seedlings Tuk tuk 150pl/m2	31	75	25	9.0	7.4	6.3
T3	Tuk tuk 30 clusters with 5-6 seedlings/m2 (polybag); 150 pl/m2	56	66	10	3.5	2.8	1.8
T4	Tuk tuk 80 clusters with 2-3 seedlings/m2 (polybag); 160 pl/m2	49	66	8	4.6	3.9	2.8
T5	Tuk tuk 35 clusters with 5-6 seedlings (from trays); 175 pl/m2	80	72	25	6.7	5.8	4.2
T6	Tuk tuk Single seedlings (5 weeks old)* 100pl/m2	80	77	49	12.8	11.7	10.3
T7	Hybrid Single seedlings 100pl/m2	81	62	69	31.2	27.8	22.9
T8	Hybrid Single seedlings 150pl/m2	65	64	88	38.7	29.9	24.2
T9	Tuk tuk 25 clusters with 4-5 seedlings (polybags); 100 pl/m2	76	62	29	11.9	10.0	7.7
T10	Tuk tuk 50 clusters with 2-3 seedlings (polybags); 100 pl/m2	79	64	23	9.0	7.5	5.1
T11	Bima curut-store 33,3 bulbs/m2	78	56	29	13.2	10.0	8.6
T12	Tanduyung-imported 33,3 bulbs/m2	92	58	45	18.8	14.5	12.3
T13	Bima curut-farmer 33,3 bulbs/m2	87	62	24	19.8	15.9	13.3
T14	Tuk tuk 2 individual seelings per hole; 150 pl/m2	35	77	15	5.3	4.4	4.0
T15	Tuk tuk 3 individual seelings per hole; 225 pl/m2	35	75	11	3.5	2.8	2.5
T16	Tuk tuk 4 individual seelings per hole; 300 pl/m2	24	69	3	1.3	0.9	0.5
T17	Tuk tuk 80 clusters with 2-3 seedlings/m2 (polybag; SUET); 160 pl/m2	73	72	48	13.0	10.3	9.5
T18	Hybrid Single seedlings (5 weeks old)* 150pl/m2	92	66	59	20.2	17.9	13.3
F probability (Anova)		0.002		0.003	<0.001	<0.001	<0.001
LSD 5%		31.1		33.3	12.726	8.53	7.45

*: 5 weeks old seedling; the other treatments 6 weeks old seedling at transplanting time
**: ha with 70% beds and 30% ditches

The variation between replicates in both trials is rather high. The results are comparable with the results of transplanting experiment 1 in Brebes. In both trials the shallots grown from bulbs had the shortest growing period: about 60 days. The growing period of Tuktuk TSS was about 2,5 weeks longer. The Hybrid TSS is earlier than Tuktuk TSS: ca. 1,5 weeks. Tuktuk TSS grown on soil modules (polybags) is ca. 1,5 weeks earlier than Tuktuk

grown from single seedlings. Also in these trials it appears that the yield of the Hybrid TSS is higher than the yield of Tuktuk TSS.
The survival of 5-weeks old Tuktuk single seedlings was much better than the survival of 6-weeks old Tuktuk single seedlings. This indicates that transplanting seedlings in a younger stage has advantages

Picture 16. Transplanting experiment in Purwakarta. 3 July 2008.

9 Economic evaluation of TSS

In the trials it was recorded how much labour was spend on the different treatments. Also the costs of used materials, pesticides and so on was registered. Based on this information the variable costs of a nursery and of some TSS crops were calculated. Also a comparison was made with crops grown from seed bulbs.

In table 18 the costs are shown from a nursery in which the sowing is done in plastic trays as used in the project. In the nursery a shelter of plastic net is used. The costs are based on the registration in the project. The costs are expressed in costs made for a nursery giving seedlings for 1 ha production field (70 % beds and 30% ditches). The costs are presented for two situations:

- Transplanting 1 ha at a density of 100 plants per m^2
- Transplanting 1 ha at a density of 150 plants per m^2

Sowing density in the nursery is 329 (1 gram Tuk tuk seed) per tray. This means 3290 seeds per m^2. A seed efficiency is used of 60%. This means 1974 seedlings per m^2. For transplanting 1 ha (7000 m^2 nett) a nursery of 355 m^2 is needed if 100 plants are needed per m^2; if 150 plants are needed per m^2 an area of 532 m^2.

Tabel 18. Biaya berubah di persemaian (variable cost in the nursery) IDR*10000/ha*

Biaya berubah di persemaian (Variable costs in nursery)			Perlakuan (Treatments) (transplanting density)	
	% total	% subtotal	T1: 100 tnm/m2 (100 plants/m2)	T6: 150 tnm/m2 (150 plants/m2)
Kebutuhan benih (seed rate) (kg/ha)			3.8	5.7
Harga benih (seed price) (IDR/kg)			100.0	100.0
a. Sub-total Nilai benih (seed value) (IDR/kg)	22		380.0	570.0
Kegiatan tenaga kerja (Labor operation):				
Mengisi media (filling media) (300 trays per day) @20000 IDR/day		13	25.6	38.2
Semai (Sowing) (130 trays per HOK) @ 10000 IDR/day		15	29.4	44.2
Penyiraman (watering) = 30 minutes per 528 m2 (days) (34 x)		5	8.8	13.2
Penyemprotan (spraying) = 12 minutes per 132 m2 (days) (4 x)		1	1.6	2.4
Penyiangan (weeding) = 2 hours per 99 m2 (days) one time (3 x)		4	8.2	12.3
Pemasangan rangka naungan (installing shading frame) 8 MD/6 beds @ 20000 IDR/MD		57	110.0	166.0
Penutupan persemaian (covering nursery) (2 hours/6 beds)		3	5.4	8.2
Pemupukan (fertilizing) @ 0.2 days/6 beds (5 times)		1	2.8	4.2
Pasang umpan (controlling with bait pesticides) @0.2 days/6 beds (2 x)		1	2.8	4.2
b. Sub-total biaya berubah tenaga kerja (VC of labor)	11	100	194.6	292.9
Materials:				
Pupuk kandang (Manure): 1.8 kg /tray (kg) @ 250 IDR/kg		50	172.2	258.3
Bambu untuk naungan (Bamboo for shading) (10 stems/6 beds) @15000/stem (stems)		30	102.5	155.0
Kawat untuk naungan (wire for shading) (1 kg/6 beds) @ 15000 IDR/kg (kg)		3	10.3	15.5
Dursban (2 btl @ 7000 IDR/6beds) (btl)		3	9.6	14.5
Traser (50 cc/6 beds)@ 50000 (btl)		10	34.0	51.5
Rice sifting 1 pack/6 beds @ 5000 IDR (packs)		1	3.4	5.2
NPK (2kg/6 beds) @ 9500 IDR/kg		4	13.0	19.7
c. Sub-total biaya berubah bahan (VC of materials)	20	100	345.0	519.6
Other costs:				
Nilai penyusutan (depreciation of):				
- Baki plastik (plastic tray) (to be used for 10 x)		52	401.8	602.7
- Tutup plastik persemaian (plastic for nursery cover) (to be used for 20 x)		1	11.3	17.1
- Plastik kasa untuk naungan (plastic net for shading+sewing) (to be used for 10 x)		45	346.5	523.9
Sewa lahan (land rent) (2 months) @1500000 per ha annualy		0	1.7	2.5
Bunga modal (capital interest) (2 months) @ 1.1% a+b+c		2	20.2	30.4
d. Sub-total biaya berubah lain-lain (VC of other costs)	46	100	781.5	1176.6
Total biaya berubah di persemaian (VC of in the nursery) a+b+c+d	100		1701.1	2559.1

*: ha with 70% beds and 30% ditches

In order to estimate how the costs of the nursery are reduced by sowing on a seedbed in the field with a shelter against heavy rain the total costs mentioned in table 18 are reduced with the material costs of the trays. It is estimated that labour costs of prepairing the seedbed, included application of manure/compost, is the same as the labour costs for filling the trays. To grow a nursery without a shelter the material costs and the labour of making the shelter are left out of the calculation. In table 19 it can be seen how the costs are reduced. For the calculations in table 19 it is assumed that seed efficiency is 60% on the seedbed in the field.

Table 19. Costs of different nurseries

	Transplanting 100 plants/m2	Transplanting 150 plants/m2
Nursery with plastic trays and a plastic net for protection	1701.1	2559.1
Nursery on seedbed in the field without trays and with a plastic net for protection*	1299.2	1956.4
Nursery on seedbed in the field without trays and without plastic net for protection*	730.0	1096.0

*: assuming that the same amount of manure is used as in trays and that the preparation of the seed bed is costing the same as filling the trays

For the most important treatments in transplanting trial 1 in Brebes the variable costs are calculated. The result is shown in table 20. The stable costs (costs not depending on the use of TSS or seedbulbs) are not shown. These stable costs are: costs of fertilization, land preparation, weed control.

Tabel 20. Biaya berubah di lapangan (Variable costs in field production); IDR*10000/ha*

Biaya berubah (variable cost)	% Total	% sub-total	T1: Tuk Tuk, 100tnm/m2 (Tuk Tuk, 100 plt/m2)	T6: Tuk Tuk, 150tnm/m2 (Tuk Tuk, 150 plt/m2)	T11 (Bima) BC dari Toko (from store)	T12 Tanduyung dari toko (from store)	T13 (Bima) BC dari petani (from farmer)
Kegiatan tenaga kerja (labor operation)							
Rogol bibit (Cutting bulb leaves for seed) (200 IDR/kg)					41	53	38
Tanam (planting) (days) @ 10000 IDR/day		17	**290**	**315**	**47**	**47**	**47**
Penyiraman (watering) (56 - 81 times) x 1.3 days @20000 IDR/day		12	**211**	**211**	**146**	**146**	**146**
Penyemprotan (spraying) (20 -25 times) x 2.3 days @ 20000 IDR/day		7	**115**	**115**	**92**	**92**	**92**
Ngama (manual pest control) (15 -18 times) @ 10000 IDR/day		23	**406**	**406**	**313**	**313**	**313**
Panen (harvesting) days @ 10000 IDR/day		10	**170**	**188**	**101**	**143**	**125**
Rogol hasil panen (cutting harvested bulb) (200 IDR/kg)		31	**544**	**659**	**257**	**414**	**307**
a. Subtotal Biaya Tenaga Kerja (Cost of labor)	28	100	**1735**	**1894**	**996**	**1207**	**1068**
Bahan (Materials)							
Umbi bibit (Bulb seed) (kg)					2036	2630	1923
Harga bibit (Seed price) IDR/kg					20000	20000	5900
Nilai bahan tanam (Value of planting material) IDR/ha		40	**1701**	**2559**	**4072**	**5260**	**1135**
Pestisida (pesticides) (IDR/ha)		60	**2569**	**2569**	**2017**	**2017**	**2017**
b. Sub-total biaya bahan (cost of materials)	68	100	**4270**	**5128**	**6089**	**7277**	**3152**
Biaya lain-lain (Other costs)							
Sewa lahan (land rent) (1.5 million IDR annually) (2- 3 months)		16	**38**	**38**	**25**	**25**	**25**
Bunga modal (capital interest) (1.1%/month) a+b		84	**198**	**232**	**156**	**187**	**93**
c. Sub-total biaya lain-lain (other costs)	4	100	**236**	**269**	**181**	**212**	**118**
Total biaya berubah di lapangan (Total VC in field production) a + b + c	100		**6241**	**7291**	**7266**	**8696**	**4338**
For comparison:							
Yield in ton per ha			30.9	37.5	14.3	23.2	17.1
Financial yield (3000 IDR/kg harvested bulbs)			**9270**	**11250**	**4290**	**6960**	**5130**

*: 1 ha with 70% beds and 30% ditches

From table 20 it can be concluded that the variable costs of TSS (including costs of nursery) are lower or on the same level if compared with shallots grown from imported seed bulbs or seed bulbs from store. The variable costs of shallots grown from seed bulbs owned by the farmers are much lower. However it can be discussed if the calculated price of these seed bulbs is correct. The price of 5900 IDR is based on the selling price at harvest (3000 IDR) plus storage costs. It is a discussion point if the price of shallots on the market at the end of the wet season should be used: 14.000 IDR per kg. The farmers can sell the stored bulbs for this price. If the price of 14.000 IDR is used than the variable costs of T13 will go up to 5896 (*10000) IDR.
Not only the financial comparison of costs and yields are important. Other factors are: the length of the growing period and the risks. The growing period of TSS Tuktuk is 3.5 weeks longer than the growing period of a crop grown from seed bulbs. The risks of growing TSS can be higher: a lower seed efficiency in the nursery than in the above mentioned calculations is possible.

10 Conclusions Research 2008

The following conclusions could be drawn from the trials done in 2008:

- A nursery mixture consisting of sandy soil and stable manure or a mixture of paddy field soil, sandy soil and stable manure are giving a higher seed efficiency than mixtures containing burned rice husks. The sandy soil and stable manure are available in Brebes.
- Tuktuk transplanted at 150 plants per m^2 gives a higher yield than transplanted at 100 plants per m^2. It is possible that the optimal plant density of the Hybrid is less than 150 plants per m^2.
- In general the survival of transplanted seedlings is good: 95% or higher.
- The use of clusters on soil modules is not needed for solving a problem in reaching the correct plant density. Producing clusters on soil modules in polybags is giving too much work and the seed efficiency in these polybags is low. Transplanted seedlings on soil modules are giving less wilting after transplanting. When clusters on soil modules are used harvesting could be done earlier and when the crop is not allowed to mature normally the production is higher than with transplanted individual seedlings.
- The production of clusters of seedlings without soil modules is giving extra labour costs at sowing. Pellets which were used had a negative effect on seed efficiency. These disadvantages are more important than the advantage of less labour spend during transplanting.
- There is no clear influence on grading if seedlings are grown in clusters.
- In a good transplanting trial in Brebes it appeared that the yield of TSS Tuktuk grown at 150 plants/m^2 was 61% higher than the yield of the best seed bulb crop (Tanduyung, imported, 23,2 ton/ha); Tuktuk grown at 100 plants/m^2 was 33% higher than Tanduyung. The yield of the new Hybrid was 71% (100 plants/m2) to 83% (150 plants/m^2) higher than the yield of Tanduyung. In Purwakarta on a clay soil the yield of TSS Tuktuk grown at 150 plants/m^2 was 13% higher than the yield of Tanduyung; on a sandy soil the yield was 20% lower. The yield of the Hybrid was on the clay soil 25% (100 plants/m^2) to 75% (150 plants/m^2) higher than the yield of Tanduyung. On the sandy soil the Hybrid was giving 92% (100 plants/m^2) to 106% (150 plants/m^2) more yield than Tanduyung.
- The growing period of TSS is 2,5 till 3,5 weeks longer than the growing period of shallots grown from seed bulbs. Compared to Tuktuk the new developed hybrid is about 1 week earlier.
- The disadvantages of direct sowing are the long growing period (12-13 weeks in stead of 8 weeks with a bulb seed crop), the extra labour spend on weed control and probably the higher risks of damage by rain after sowing. The advantages are: no nursery is needed and no labour is needed for transplanting. In the experiments of 2008 in Brebes the yield of direct seeding TSS Tuktuk was lower than the yield of the seed bulb crops. It is possible that the fertilization level of the direct seeding crop was too low.
- In the direct seeding experiments in Brebes no difference in seed efficiency was found between closing the furrow with paddy field soil, nursery mixture (containing sandy soil and stable manure) and burned rice husks. The seed efficiency was not influenced clearly by covering with rice straw.
- The trials with seed treated with different insecticides were failed.
- Assuming a seed efficiency of 60% in the nursery the total variable costs of TSS are on the same (150 plants/m^2) or on a lower level (100 plants/m^2) than the variable costs of seed bulb crops grown from imported seed bulbs or seed bulbs bought from store. It depends on the assumed cost price of the farmers own seed bulbs if the variable costs of TSS are higher or lower. The much higher yield of TSS combined with comparable or even lower variable costs makes it theoretically profitable for the farmer to grow TSS.