vegIMPACTNL

vegIMPACT NL Report 11

December 2021

vegIMPACTNL

Improving vegetable production and strengthening private sector development in Indonesia

The vegIMPACT NL program contributes to improved vegetable production and private sector development in Indonesia. The program builds on the results of previous joint Indonesian-Dutch horticultural cooperation projects, especially the vegIMPACT program (2012 – 2017). The program activities of vegIMPACT NL (2017-2020) address Knowledge transfer, Seed potato technology and supply system, Shallot production and post-harvest technology and Young farmers, while digital information and social media are cross-cutting and supporting activities. The vegIMPACT NL program is financed by the Government of the Netherlands and coordinated by Wageningen University & Research in The Netherlands.

Wageningen University & Research
Contact person: Huib Hengsdijk, huib.hengsdijk@wur.nl

Effect of planting methods on bulb size of True Shallot Seed

H. de Putter, W. Adiyoga, M. Pratama, Rahma, A. Adrinyata and R. Firdaus

Contents

1 Summary

In 2020 an experiment was carried out with True Shallot Seed (TSS) in Purwakarta, West java, Indonesia. This experiment was jointly implemented by Wageningen University and Research (The Netherlands), The Indonesia Vegetable Research Institute (IVEGRI) (Lembang, Indonesia), Yayasan Bina Tani Sejahtera (YBTS) (Jakarta, Indonesia) and PT East West Seed Indonesia (EWINDO) (Purwakarta, Indonesia).

Effect of different plant densities obtained by different spacings or plant arrangements were observed on yield and bulb size. A higher plant density resulted in higher yields but at the same time also resulted in smaller bulbs.

2 Introduction

True Shallot Seed (TSS) is a technology with high potential to improve the shallot cultivation. The present TSS varieties have potential higher yields when grown professional. Another benefit is the high quality of seeds leading to disease free starting material. Finally, since TSS is a production system with seeds it means start material can be transported much easier and storage is less problematic than the current system with seed bulbs. However, TSS has also some challenges, one of them is the preparation of starting material from seeds, farmers have the option to do direct sowing, raising transplants or using minibulbs raised the season before from seeds. All of these options have benefits and disadvantages. For the time being it seems that raising transplants either by the farmer himself or a professional raiser is the most promising option.

Another issue is the perceived dislike of consumers/traders for large grade shallots. So far experiments and tests have shown that yield of TSS is significant higher than that of the traditional shallot production. However, bulb size of TSS is also significant higher than that of traditional shallots. Different sources (farmers mainly) mention that traders are not easily accept TSS produce and pay lower prices since consumers would prefer smaller bulbs which would be easier to crush to make paste from. In case the consumer study shows a preference for smaller grades it is important to grow TSS in a different way to produce less big bulbs but with the same high yield.

Factors that could have an effect on shallot bulb size are: transplant age, size of plants, planting density, plant arrangement, leaf cutting, density of the seeds in the nursery producing transplants and nutrient applications in the production field.

3 Materials and methods

In 2020 an experiment was carried out together with PT EWINDO at Purwakarta. For the experiment the PT EWINDO TSS variety Lokananta F1 was used and implemented as a complete randomized block design with four blocks (Table 1).

Table 1. General data of experiment.

Location	:	PT Ewindo, Purwakarta, West Java.
GPS coordinates	:	-6.513305, 107.495856
Altitude	:	50 m A.S.L.
Soil type	:	Clay Loam
Variety	:	Lokananta F1 (TKW 3.8)
Design	:	Complete Randomized Block Design
Plot size	:	5 x 1.2 m

Treatments consisted of three different nursery sowing densities, different planting distances and arrangements and leaf cutting (Table 2). For the experiments transplants were raised in three fieldbed nurseries constructed at Purwakarta. Sowing took place on July 15, 2020. Standard sowing density in the nursery for raising transplant was 0.4 g/m sowing line for which a bed with total of 93 x 1 meter sowing lines was prepared. Two other treatments were the use of 0.2 g/m on 6 x 1 meter and 0.6 g/m on 3 x 1 meter. Transplants were ready for transplanting on August 25 and harvested from the nurseries and planted immediately in the production field.

Table 2. Description of treatments in production field.

CODE	Plants per plant hole	Number of lines per plant row	Plant hole distance (in row x between (sub)rows (cm)	Leaf cutting at planting	Plant number/m^2	Nursery sowing density of transplants	
						In g/m	In seeds/meter
Al	1	1	10 X 10	No	100	0.2	57
Ah	1	1	10 X 10	No	100	0.6	171
A	1	1	10 X 10	No	100	0.4	114
B	1	1	5 X 5	No	400	0.4	114
C	1	1	5 x 10	No	200	0.4	114
D	1	2	10 X 10 (2 cm)	No	177	0.4	114
E	2	1	10 X 10	No	200	0.4	114
F	2	1	5 X 10	No	400	0.4	114
G	1	1	10 X 10	Yes	100	0.4	114
H	1	1	5 X 5	Yes	400	0.4	114

Plants were manually planted on the beforehand prepared beds at the planting distances mentioned in table 2. The plant arrangement for treatment D is visualized in figure 1. Shallots were grown according to good agricultural practices. Chemical fertilizers were used and pesticides were sprayed when deemed necessary to control pests and diseases.

Harvest took place 70 days after planting on November 3, 2020. Shallots were pulled out manually and bundled and air dried for 2 weeks.

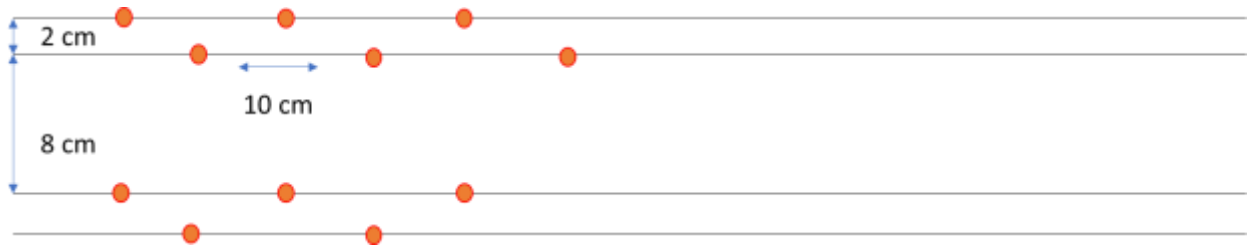

Figure 1. Planting arrangement for Treatment D.

3.1 Observations

At the nursery emergence and final plant density of transplant in the nursery bed was determined by counting number of emerged seeds of 15 random selected sowing lines of 1 meter length. Percentage was calculated based on the number of sowed seeds per meter line. These observations were done at 10, 21 and 33 days after sowing. At 33 days after sowing also from 3 random chosen spots in the nursery a total plant count of seedling in 1 m2 was done.

After transplanting observations were done on plant establishment by counting number of plants per bed of 5m2 on August 25, immediately after transplanting, on September 17, and at harvest on November 3. On the September 2 (8 DAT) and October 22 (50 DAT) plant height as it was in the natural field situation of 10 random selected plants was measured.

At harvest the fresh weight on November 3 and weight after air drying on November 17 was observed for marketable and non-marketable bulbs. The number of marketable bulbs was observed at both dates. From 10 clusters per bed the number of splits (or number of individual bulbs) per plant was observed. The marketable bulbs were graded in four categories, A: > 3.5 cm, B: 2.5 – 3.5 cm, C: 1.5 – 2.5 cm and D: < 1.5 cm (Fig. 2).

Figure 2. Baskets used to grade the bulbs.

4 Results

4.1 Emergence of seeds

Sowing density had no significant effect on emergence of seeds (Table 3). The emergence of seeds sown at 0.2 gram per meter line seems to be slightly higher still than the emergence at the other two sowing densities. Although not significant competition between seedlings might cause higher losses at higher sowing densities. The final number of seedlings per square meter is 652 plants at 0.4 g/m while at 0.2 gram this is 519 plant. With three times more seeds compared to 0.2 g/m the plant density is only about two times higher at 0.6 g/m.

Table 3. Emergence of seeds at 10, 21 and 33 DAS.

Sowing density	Emergence (%) at:			Plant density in the nursery at transplanting (pl/m2)
	10 DAS	21 DAS	33 DAS	
0.2 g/m	77.2	80.1	68.2	519
0.4 g/m	75.8	72.5	58.8	652
0.6 g/m	69.5	67.1	59.8	1047
Mean	74.2	73.3	62.2	740
Fprob	0.1	0.1	0.2	< 0.001
LSD 0.05	7.7	12.5	10.4	64

4.2 Plant height and plant establishment

Eight days after planting the plant length of treatment B (5 x 5 cm spacing) and F (two plants per hole at 5 x 10 cm spacing) was the highest (Fig. 3).

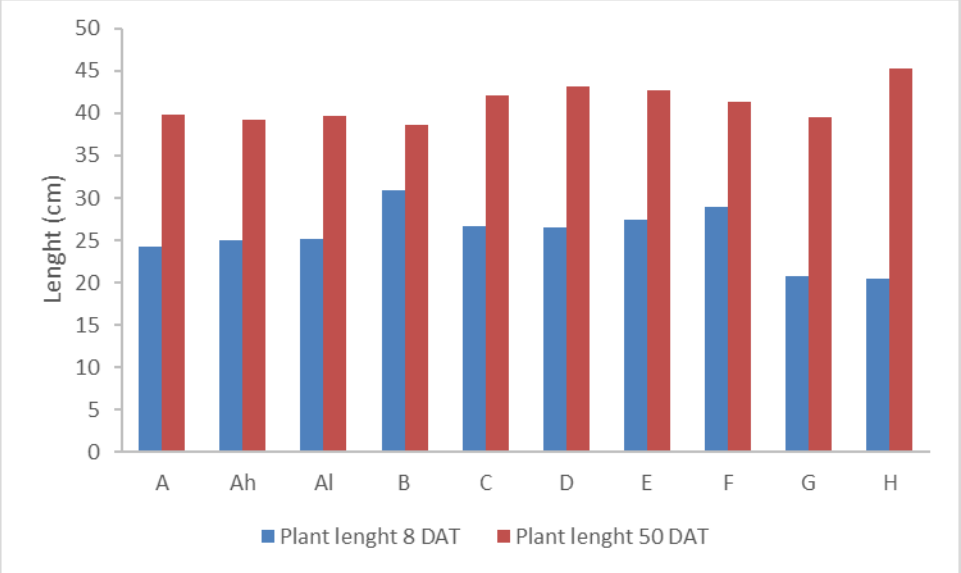

Figure 3. Plant length of shallots observed at 8 (LSD 3.0; Fprob < 0.001) and 50 days (LSD 3.7; Fprob 0.02) after planting.

Since these two treatments had the highest density this might be caused by some elongation.

Treatment H was also planted at 5 x 5 cm but seedlings were clipped before planting as where the seedlings for treatment G thus these treatments showed the shortest plant length.

At 50 days after planting no significant differences in plant length were present.

No differences in healthy clusters were present at 23 days after planting (Fig. 4). At 70 days after planting at harvest the lowest percentage of healthy clusters was present at treatment H with 86%. This was lower than treatment G where also leaves were cut off before planting. Also at other high density treatments, B and F, the percentage healthy clusters was relatively low. At treatment Ah (0.6 g/m seeds in nursery) percentage healthy clusters was lower compared to A (0.4 g/m) and Al (0.2 g/m2). A higher density in the nursery might have cause the infection of the plants with diseases that later on lead to more infected clusters in the field. A similar patterns is still present after field air drying of the separate clusters.

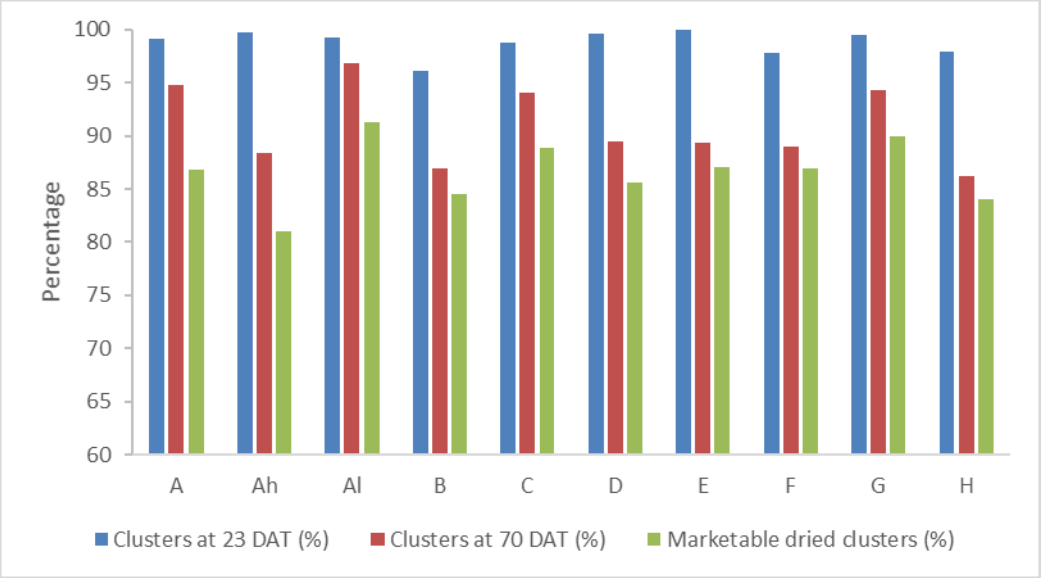

Figure 4. Percentage healthy clusters observed at 23 (LSD 2.5; Fprob 0.08) and 70 days (LSD 6.0; Fprob 0.008) after planting and after field drying (LSD 6.0; Fprob 0.06).

Figure 5. Plot of shallot planted at 10 x 10 cm (100 pl/m2) on September 11, 2021.

Figure 6. Plot of shallot planted at 5 x 10 cm (200 pl/m2) on September 11, 2021.

Figure 7. Plot of shallot planted at 5 x 5 cm (400 pl/m2) on September 11, 2021.

4.3 Yield

At harvest the marketable yield of treatment H followed by treatment B were the highest (Table 4).

Table 4. Yield of TSS grown at different plant distances.

Treatment	Plant loss at 70 DAT (%)	Marketable weight at harvest (t/ha)	Total weight at harvest (t/ha)	Marketable weight after 2 weeks drying (t/ha)	Total weight after 2 weeks air drying (t/ha)	drying losses of marketable weight (%)
Ah	11.6	38.7	40.5	27.0	28.2	30.1
Al	3.2	41.2	41.8	29.8	31.4	27.5
A	5.3	41.2	41.6	28.9	30.8	29.2
B	13.1	59.5	60.4	45.5	46.4	23.5
C	5.9	52.6	53.1	37.9	39.1	28.0
D	10.6	47.9	48.5	34.1	35.3	28.5
E	10.6	53.6	54.5	39.7	40.4	25.8
F	11.1	55.6	56.3	42.9	43.7	22.9
G	5.7	39.6	40.1	28.0	28.9	29.3
H	13.8	61.0	61.4	43.5	44.4	28.6
Mean	9.1	49.1	49.8	35.7	36.8	27.3
Fprob	0.008	<0.001	<0.001	< 0.001	< 0.001	0.07
LSD 0.05	6.0	6.1	6.4	3.5	3.6	5.0

These treatments both had a plant density of 400 plants per m2 with a planting arrangement of 5 x 5 cm. Treatment F also had 400 plants/m2 but with 5 x 10 cm and two plants per planthole. No difference between leaf cutting or no leaf cutting seemed to be present. Treatment B differed not from treatment F and treatment A not from treatment G.

Sowing density in the nursery seemed not to have an effect on marketable yield since no significant differences between treatment A, Al and Ah were present. A higher yield of marketable weight at both harvest and 2 weeks drying was higher with increasing plant density as can be seen at treatment A (100 pl/2), C (200 pl/m2) and B (400 pl/m2). Also when leaves were cut off at planting the yield at treatment H (400 pl/m2) was significant higher than the yield at treatment G (100 pl/m2) At treatment E (200 pl/m2) and F (400 pl/m2) where two plants per plant hole were planted no increase in yield was observed.

The different planting arrangements had no significant effect on drying losses.

Figure 8. Plot of shallot planted at 5 x5 cm (400 pl/m2) one day before harvest on November 2, 2021.

Figure 9. Plot of shallot planted at 5 x 10 cm (200 pl/m2) one day before harvest on November 2, 2021.

Figure 10. Plot of shallot planted at 10 x 10 cm (100 pl/m2) one day before harvest on November 2, 2021.

4.4 Grading

Bulb weight of shallots grown at treatment B, H and F, plant density of 400 pl/m2, was the lowest (Table 5). Comparing two plants per plant hole (E and F) with one plant per hole at a same plant density (A and C) showed lower bulb weight at the two plants per hole treatment. With 100 pl/m2 at treatment A the bulb weight is higher but not significant different from treatment C (200 pl/m2). Weight at treatment C is higher than at treatment B 9400 pl/m2). At other treatments with a same plant arrangement but different density (e.g. treatment G vs. treatment H or treatment E vs. F) bulbs were lighter at higher densities.

When looking at the yield per grade more Grade A was present at treatments with a lower plant density.

Table 5. Mean bulb weight at harvest and after drying and diameter based grading of TSS.

Treatment	Bulb weight at harvest (g/bulb)	Bulb weight after 2 weeks drying (g/bulb)	Yield of dried Grade A (t/ha)	Yield of dried Grade B (t/ha)	Yield of dried Grade C (t/ha)	Share of grade A weight in total dried yield (%)
Ah	30.4	23.6	16.2	9.1	1.7	59.5
Al	22.8	18.7	14.6	12.1	3.1	48.3
A	27.0	21.7	14.2	11.8	3.0	48.9
B	11.8	10.4	8.6	22.5	14.4	19.0
C	23.6	18.6	13.8	16.9	7.2	36.6
D	25.5	20.5	10.6	14.7	8.8	30.7
E	18.0	14.6	10.1	16.4	13.2	25.5
F	13.5	11.7	5.4	17.2	20.2	12.5
G	25.9	20.0	11.1	10.3	6.6	39.7
H	14.7	11.5	8.2	17.7	17.5	19.3
Mean	21.3	17.1	11.3	14.9	9.6	34.0
Fprob	< 0.001	< 0.001	0.004	< 0.001	< 0.001	< 0.001
LSD 0.05	6.5	5.0	5.1	5.0	6.9	13.7

A correlation is present between final plant density at harvest and yield where yield increases with increasing plant density. At the same time bulb weight is less with increase plant density.

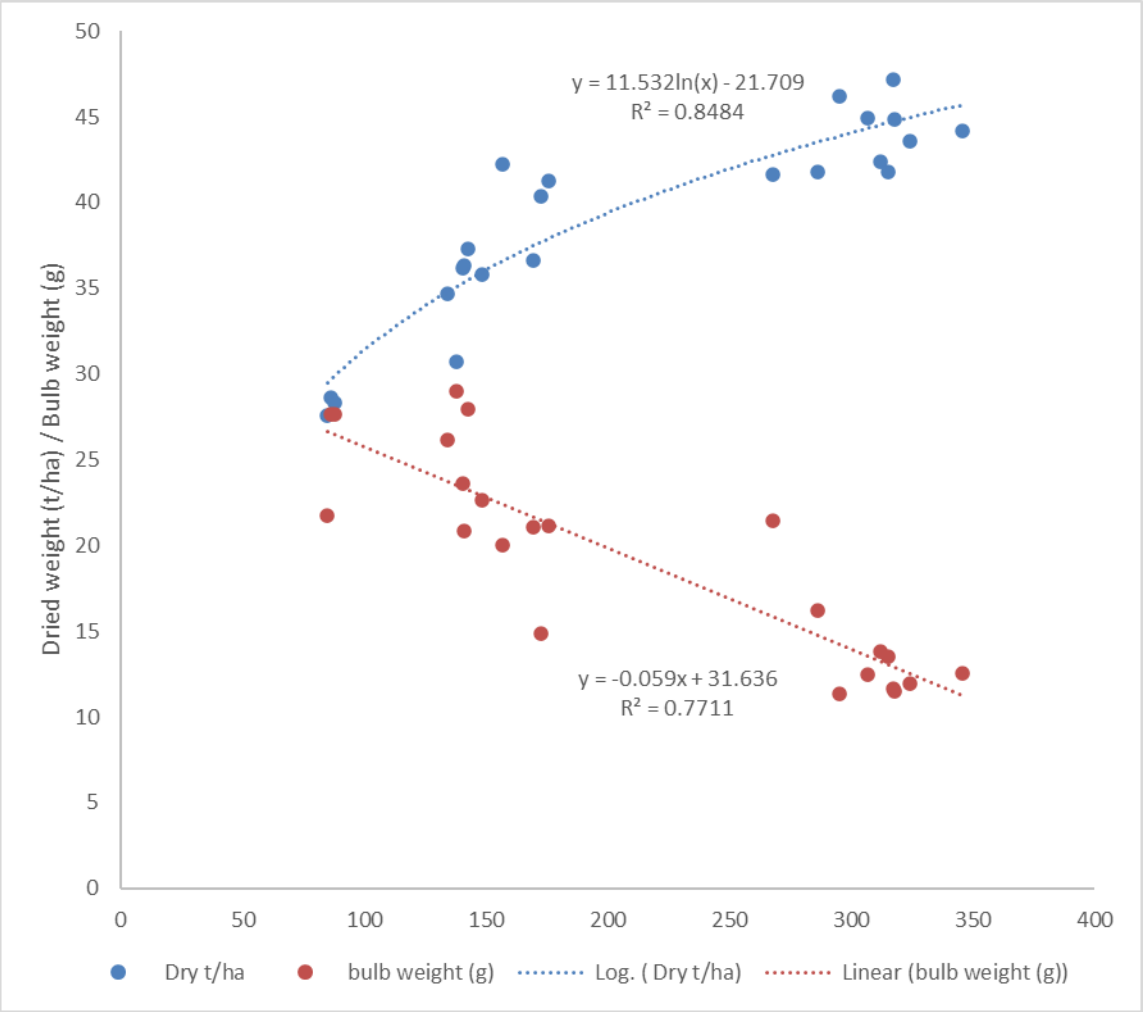

Figure. Effect of planting density at harvest on yield and bulb weight.

5 Conclusions

From the results of this experiment concluded can be that plant density regardless the arrangement has an effect on yield and bulb size. With increased plant density a higher yield and smaller bulbs were present.

Leaf cutting did not result in different results than no cutting of leaves at planting.

Nursery sowing density has an effect on emergence where at higher density more plants were lost. Also it seems that with high sowing densities plants are more susceptible to diseases resulting in more losses later in the production field.

Drying of shallots resulted in same drying losses for all densities and arrangements of on average 30%.