vegIMPACTNL

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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

Performance of True Shallot Seed in lowland area of Java, Indonesia

H. de Putter and W. Adiyoga

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1. Summary

A participatory trial of TSS cultivation was set up involving 8 farmers in Cirebon and Brebes. The expected output of this activity was to get farmers becoming more familiar with TSS and be able to provide first-hand opinions about TSS based on their field practice experience. Those farmers were asked to set aside part of their traditional shallot (bulb-seed) cultivated farm for planting TSS under the assumption that they purchased the seedlings from seedling grower. However, observations were not only carried out during transplanting stage, but also in the stage of seedling raising (nursery). As compared to Trisula and Maserati, the performance of Sanren was the best in both nursery and transplanting stage. However, in terms of some quality attributes (colour and pungency), this variety was rated quiet low by farmers. Maserati has the second best performance in terms of seed emergence in the nursery and crop yield after transplanted. Farmers highly appreciated Maserati's quality attributes, especially colour and bulb size. In this case study, however, Trisula showed somewhat disappointing results in terms of both seedling production and crop yield. Even though, farmers had rated high scores for this variety's colour, pungency and bulb-shape, a poorer yield of Trisula had especially made it less financially viable as compared to the other two varieties. Since, this was a case and a cross-section study, all findings of this study cannot be generalized to shallot farmers' population (statistical generalization). Therefore, it is recommended to demonstrate the cultivation of TSS varieties to higher number of participants/farmers, so that the output of such dissemination activity may not only be generalizable, but also speed up the rate of TSS adoption at the farmers' level.

2. Introduction

One of the efforts to increase the yield of shallots is the use of True Shallot Seed (TSS) which has high potential as an alternative to tuber seeds. Some of the advantages offered by TSS include: (a) not bulky, (2) relatively cheap planting material, (3) easy in terms of transportation, (4) long-term shelf life, (5) produce healthy tubers that are relatively pathogen free and large in size, (6) higher yield.

TSS research was initiated in the 1990s during the Indonesian-Netherlands research collaboration (Hortin I) and it has been more intensively and extensively studied since the Ministry of Agriculture began to revitalize the TSS development program in 2015/2016. Various research activities ranging from improving seedling production techniques, improving the performance of seedlings after transplanting and improving mini tuber production techniques generally provides an overview that the use of TSS is technically feasible. The use of TSS as an alternative to tuber seeds has also received quite a positive response from farmers, although the preliminary study conducted by Balitsa shows that its adoption is still not as fast as expected.

In order to obtain more information about farmers' responses to TSS, a participatory trial of TSS cultivation was set up involving 8 farmers in Cirebon and Brebes. By cultivating TSS in their own field, it was expected that farmers will become more familiar with TSS and be able to provide first-hand opinions about TSS based on their field practice experience.

3. Materials and methods

Five farmers in Brebes and three farmers in Cirebon were selected based on their willingness to participate in this action research activity. Those farmers were asked to set aside part of their traditional shallot (bulb-seed) cultivated farm for planting TSS. Farmers cultivated TSS under the assumption that they purchased the seedlings from seedling grower. In this case, Balitsa was acted as seedling supplier. During the seedling production, farmers were invited to the nursery three times (sowing, growing and harvesting stage) to observe and learn. Meanwhile, from transplanting to harvesting, even though cultivation technology was handed over to farmers (since it was quite similar to shallot bulb-seed cultivation techniques), Balitsa still provided technical assistance and guidance when necessary.

3.1 Seedling raising and field production of TSS

Two nurseries were constructed, one each per location at one of the participating farmer's fields. In both nurseries seedlings were raised from the varieties of Trisula, Sanren and Maserati. In Cirebon a nursery of 45 m2 with 15 m2 per variety was established. In Brebes the total surface of the nursery was 54 m2. The nurseries were prepared on beds that were protected by bamboo-plastic roof construction. Fertilizers were added and the top soil was well prepared by manual hoeing and overall the soil was refined to have an optimal seedbed. The beds were approximately 1 meter wide and perpendicular on the beds shallow grooves were drawn. Between those sowing lines a distance of 10 cm was maintained to have 10 lines for each meter of bed. Per line 0.4 g/line or 4 g g/m2 was sown. This resulted in different densities per variety related to the TKW (Table 1).

Table 1 Varieties used in the experiment.

Variety	TKW (g)	No of seeds per 4 g (seed number per m2)	Estimated # of seeds/line
Trisula	2.5	1600	160
Maserati	3.2	1250	125
Sanren	3.6	1111	111

Once seedlings were ready for transplanting, they were divided and distributed to the participating farmers. Each farmer then grew the shallots on their field. The plot size per variety at farmers' field ranged between 2 to 12 m2 (Table 2). The farmer did all the crop management but received guidance on how to grow the TSS varieties.

Table 2 Plot size per variety per farmer (m^2).

Region	Farmer	Trisula	Maserati	Sanren
Brebes	1	6	9	6
	2	2	9	5
	3	4	7	4
	4	3	3	2
	5	3	2	2
Cirebon	1	7.5	7.5	7.5
	2	7.5	7.5	7.5
	3	12	12	12

3.2 Observations

Material costs and labour needed to construct the nurseries and to raise the seedlings were recorded. Performance of seedlings was evaluated by observing the emergence of 7, 14 and 21 days after sowing. Per nursery bed 2 lines per meter bed, were randomly selected for observing the number of plants. Emergence percentage was calculated as present number of plants per line related to the estimated number of seeds sowed per line. Just before transplanting, number of usable seedlings per square meter was observed on July 26. Based on the estimated number of seeds sown, the percentage of usable seedlings was calculated.

At harvest the fresh yield was observed and dried after which the dried yield was also weighted. During production all inputs used and costs spent on the cultivation of the TSS were recorded. After drying farmers were invited to evaluate the produce in terms of appearance and productivity by using a short questionnaire in which they could rate several factors on a scale from 1 (lowest mark) to 5 (best mark).

4. Results

4.1 Raising seedlings and costs of raising

Table 3 showed that Sanren had the best germination in Brebes. At both locations, at 21 days after sowing, Trisula showed the lowest germination with 24% (Brebes) and 47% (Cirebon). At transplanting stage, Sanren was averaging the highest percentage of useable transplants with 65%, while Trisula showed the lowest percentage with 30%.

Table 3 Percentage of emerged seedlings counted at 7, 14, and 21 days after sowing and percentage of usable transplants at transplant stage of 57 days after sowing

	n=	7 days (%)	14 days (%)	21 days (%)	Usable at 57 days (%)
Brebes	108	10	45	55	50
Maserati	36	12	54 c	65 c	56
Sanren	36	14	68 e	77 e	64
Trisula	36	5	12 a	24 a	29
Cirebon	90	13	49	62	51
Maserati	30	14	55 c d	64 c	56
Sanren	30	19	57 d	74 d	65
Trisula	30	7	35 b	47 b	31
mean		12	47	58	50
Maserati	66	13 b	54	64	56 b
Sanren	66	16 c	63	76	65 c
Trisula	66	6 a	23	34	30 a
Fprob					
variety		<0.001	<0.001	<0.001	<0.001
nursery		<0.001	<0.001	<0.001	0.6
var*nur		0.106	<0.001	<0.001	0.8
LSD 0.05					
variety		1.1	1.6	1.7	4.4
nursery		0.9	1.3	1.4	3.6
var*nur	minimum	1.5	2.1	2.3	6.0
	average	1.6	2.2	2.4	6.3
	maximum	1.7	2.3	2.5	6.5

The germination and final useable number of transplants have a big impact on the costs per seedling. For professional seedling raisers it is important to determine the costs in order to establish a selling price. Hence, the cost per seedling is affected by the seed costs, number of seedlings and the total costs of production. Cost of production are divided over fixed costs (money spent on durable goods for a

certain period of time e.g. nursery structure costs) and variable costs (money spent on expendable materials during the raising phase e.g. pesticides). For this test a simple field bed nursery with a cover was used to protect seedlings from harsh weather conditions, direct sunlight and heavy rain. When opting for a nursery with a table construction and plastic trays, investment costs are much higher. Total costs on the nursery including seed costs of a variety with a given seed price of 2,500 IDR/gram is close to 7 million rupiah (440 euros). The seed costs take up about 43% and the nursery itself only 5% when considering a depreciation period of 12 months.

Table 4 *Transplant raising costs for a 30 m^2 field bed nursery surface for a period of 60 days (IDR x 1,000) and a depreciation period of 12 months for re-usable nursery materials and considering a 2 month raising period.*

Part	Item	Quantity	Unit	Unit price (IDR)	Sub total before depreciation (IDR x 1,000)	Costs after deducting depreciation (IDR x 1,000)	Totals (IDR x 1,000)
Seeds	Seeds	120	g	2,500	300.0		300.0
Nursery	Bamboo	4	pc	15,000	60.0	10.0	
	Plastic for shading	3	kg	3,500	10.5	1.7	
	Raffia string	2	roll	1,000	2.0	2.0	
	Wire rope	0.2	kg	20,000	4.0	0.7	
	Flush scoop	2	piece	5,000	10.0	1.7	
	Nail	0.2	kg	15,000	3.0	0.5	
	Cutter	2	piece	12,000	24.0	4.0	
	Dolomite	6	kg	500	3.0	0.5	
	"Subur Ijo" organic planting material	30	kg	2,400	72.0	12.0	33.1
Inputs for raising	SP-36	600	g	3	1.8	1.8	
	NPK Mutiara 16:16:16	1200	g	10	12.0	12.0	
	KNO3 red (15-14-0)	3600	g	25	90.0	90.0	
	Previcur N 100ml	30	ml	340	10.2	10.2	
	Daconil 500 gr	60	g	170	10.2	10.2	
	Arjuna 250 ml	100	ml	520	52.0	52.0	
	Besmore 100ml	90	ml	180	16.2	16.2	192.4
Labour costs	Land preparation				20.0	20.0	
	Watering, fertilizing, pesticide spraying			lumpsum	60.0	60.0	
	Planting, weeding			lumpsum	45.0	45.0	
	Bed maintenance			lumpsum	20.0	20.0	
	Seedling harvesting			lumpsum	23.0	23.0	168.0
Raising costs excl. seed costs							393.5
Total costs	Incl. seed costs						693.5

When taking into account the raising costs excluding seed costs, depending on the seed price and seedling raising success rate, a seedling cost price can be calculated (Table 5). With the used nursery cost price ranged between 54 IDR/seedling (at 40% success rate and a seed price of 9.5 IDR per 1,000 seeds) to 25 IDR/seedling (at a success rate of 65% and a seed price of 4 IDR/1,000 seeds). Loss of seeds during the raising phase (nursery) has a big impact on the final cost price. A loss of 25% makes the final seedling almost two times more expensive.

Table 5 *Seedling raising costs (IDR per seedling) with different seed prices, and raising success (% usable raised transplants) at a sowing rate of 1000 sds/m^2.*

	raising success (% usable transplants)					
Seed price (IDR per 1,000 sds)	40	45	50	55	60	65
4	40	36	32	29	27	25
4.5	42	37	33	30	28	26
5	43	38	34	31	29	26
5.5	44	39	35	32	29	27
6	45	40	36	33	30	28
6.5	47	42	37	34	31	29
7	48	43	38	35	32	30
7.5	49	44	39	36	33	30
8	50	45	40	37	34	31
8.5	52	46	41	38	34	32
9	53	47	42	39	35	33
9.5	54	48	43	39	36	33

4.2 Yield and performance TSS

Yield observed immediately after uprooting the shallots from the field was the highest for Sanren with 38 t/ha followed by Maserati (Table 6). Trisula showed the lowest yield although the plant density in the field was exactly the same as the other two varieties. Dried weight of shallots is roughly 50% less than the fresh weight.

Table 6 *Yield of shallots, immediately at harvest (fresh weight) and after drying (dried weight)(t/ha) and drying losses (%).*

	Maserati	Sanren	Trisula	mean	fprob	LSD 0.05
Fresh weight (t/ha)	21	38	13	24	0.001	12
Dried weight (t/ha)	12	19	7	13	0.004	7
Drying losses (%)	42	50	45	46	0.1	7

Farmers evaluated the harvest produce of the three varieties (Table 7). Yield and number of bulbs per plant was perceived the highest for Sanren, followed by Maserati and Trisula (rated as the lowest

producing variety). In terms of shape and size no significant differences in farmers' perceptions were present. Although it looks like Sanren was evaluated the least performing variety in terms of shape, it was still rated as reasonably good with a score of 3.3. In terms of colour and pungency Sanren was not rated positive with only 1.1 and 1.6 respectively. The two other varieties scored almost the maximum score for colour and also had a good rating for aroma.

Table 7 Product evaluation by farmers.

variety	Shape	Size	Number of bulbs per plant	Colour	Aroma / Pungency	Yield
Maserati	4.3	4.0	3.6	4.8	3.1	3.9
Sanren	3.3	3.3	4.4	1.1	1.6	4.6
Trisula	4.3	3.5	2.4	4.8	3.6	2.5
mean	3.9	3.6	3.5	3.5	2.8	3.7
Fprob	0.07	0.3	< 0.001	<0.001	<0.001	<0.001
LSD 0.05	0.98	1.0	0.54	0.45	0.58	0.59

Scale: 1= lowest/ negative rating; = highest/positive rating.

4.3 Production costs and cost price of TSS

TSS costs of production was approximately 140 million IDR per hectare in Brebes and 130 million IDR in Cirebon.

Table 8 Cost of production and profit of TSS variaties grown in Brebes and Cirebon at a market price of 15,000 IDR/kg (IDR x 1,000,000 / ha).

	Brebes			Cirebon		
	Maserati	Sanren	Trisula	Maserati	Sanren	Trisula
Revenue	171.4	310.7	95.7	207.6	247.8	123.0
Transplant	42.8	36.2	50.8	42.8	36.2	50.8
Fertilizer	1.8	1.8	1.8	12.0	12.0	12.0
Pesticide	7.7	10.8	7.4	10.8	10.8	10.8
Labour	90.7	87.1	80.9	61.6	61.6	61.6
Production costs	143.0	135.9	140.9	127.2	120.6	135.2
Profit/loss	28.5	174.8	-45.2	80.4	127.2	-12.2

Seedling costs were calculated based on a plant density of 100 plants per square meter plus extra seedlings (0.5%) to provide easiness of selecting the best seedlings for planting or enable of replacing the missing/lost plants in the field. Based on per variety nursery results, a different seedling price was used. For Trisula, Maserati, and Sanren, a price of 50.6, 42.6 and 36.1 IDR/seedling was used respectively. Other costs were obtained from farmers' farm-records. The difference in costs was mainly due to higher labour costs spent in Brebes (Table 8). Of the total production costs, labour and planting material costs are the two-most important components. Labour costs are about 65% of the total costs and transplant costs are about 30% of the total costs. In the previous project vegIMPACT the planting costs for traditional bulbs ranged between 22 and 166 million IDR/ha with an average of 62 million IDR. Compared to that the costs for TSS are not that much different. Besides the traditional bulb price

fluctuates a lot and also quality is not constant. The price greatly depends on the success of a previous crop. If consumer prices are high automatically the prices for planting material will increase since both products are coming from a same source. With TSS, prices will be less prone to price fluctuations. Also the quality of the seeds is always high and guaranteed which is not the case with planting material from traditional shallot systems.

Table 9 *Profit of three TSS varieties grown at two locations (IDR x 1,000,000 / ha).*

	Maserati	Sanren	Trisula	Mean
Brebes	28.5	174.8	-45.2	52.7
Cirebon	80.4	127.2	-12.2	65.1
Mean	47.9 b	156.9 c	-32.8 a	57.4
Fprob	(variety) 0.005			0.8
LSD 0.05	10.4			

When looking at costs of production and yield the cost price of Sanren was the lowest with 8,637 IDR/kg while cost price for Trisula was the highest with 24,664 IDR/kg (Table 10).

Table 10 *Cost price (IDR/ kg) of dried shallot produce for the three tested varieties grown at two locations (excl. land rent).*

	Maserati	Sanren	Trisula	Mean
Brebes	16,023	7,735	26,314	16,691
Cirebon	12,378	10,140	21,914	14,811
Mean	14,656	a b 8,637	a 24,664	b 15,986
Fprob		(variety) 0.021		
LSD 0.05		10,947		

5. Discussion and conclusions

Profitability of TSS is directly related to the cost price of a seedling and to the performance in the field. Another factor is the different appearance of TSS compared to the current shallot available at markets. Both colour and size are significant different from the traditional varieties and can have an effect on market price which in this test is not considered in the calculations.

Costs of seedling are taking 25 up to 40% of the total production costs. With seeds that are expensive, a high germination and final produced number of seedlings is required. In the field bed nurseries the final production show still a loss of 35 to 45 % of the seeds. With the use of a more professional nursery with better soil conditions and more protection to weather uncertainty, this percentage may be decreased. However, whether this improvements will reduce the cost price or not is quite uncertain. Seed losses are less, but then the costs of construction are higher. Meanwhile, based on the calculations, the most detrimental factor that affects shallot farm financial performance is the yield. The total cost of Trisula was slightly higher than that of the other two varieties. Lower revenue and lower (even negative) profit of Trisula was mainly caused by a significant lower yield as compared to Maserati and Sanren. This calculation has not yet included the land rent. In Brebes the land rent per season is about 15,000,000 IDR/ha, while in Cirebon is about 3,500,000 IDR/ha.

In the nursery, Sanren showed the highest emergence and highest number of seedlings produced. Hence, the cost price per seedling was the lowest. Its performance in the field was also good with a yield of 38 t/ha (fresh). However, in terms of some quality attributes (colour and pungency), this variety was rated quiet low by farmers. Cost price of Sanren in this experiment was 10,140 IDR per kg in Cirebon and 7,735 IDR in Brebes. When including the land rent, the cost price is respectively 10,421 IDR and 8,547 IDR per kg.

Maserati also showed a good performance in the nursery with high number of seedlings at the time of transplanting. Yield in this experiment was quite acceptable with 12 t/ha. At other locations e.g. Sumbawa, higher yield levels have been observed which are essential for a successful introduction. However, even with the observed yield in this test the profit of Maserati was positive. Cost price of Maserati was about 12,000 IDR/kg in Cirebon and 16,000 IDR/kg in Brebes. When land rent is included the cost price is respectively 12,700 and 17,800 IDR/kg. Maserati's quality attributes, especially colour and size were rated and appreciated highly by farmers.

In this case study, Trisula showed somewhat disappointing results in terms of seedling production and yield. Final seedling percentage with on average 30% was too low. Yield of Trisula was also the lowest with 7 t/ha. This resulted in high cost price of 22,000 to 26,000 IDR/kg. When land rent is included in the calculations, the cost price for Trisula produced at Brebes is 29,100 IDR/kg and 22,500 IDR/kg at Cirebon.

In the nursery the poorer performance of Trisula could be caused by several factors. Poor seed quality, or less suitability of Trisula to be raised in bed nursery. Probably Trisula is more sensitive to the climatic and soil conditions at the test location. In addition, the seeds and seedlings of Trisula might be more susceptible to possible soil borne pests and diseases. All these factors, however, were not observed or evaluated in this case study and therefore a clear conclusion cannot be drawn.

Field production performance of Trisula was lower than that of the other two varieties even though using the same planting density. This might be caused by lower potential yield of Trisula as compared to the other two varieties. Another factor that may affect the yield of Trisula is that it may be more susceptible to the field conditions of the test locations causing high plant losses and reduced growth. Although, plant losses (46%) as a percentage of initial population was not significantly different to the other two varieties. Finally, there is also a possibility that seedling quality at planting might had an impact on the performance. Unfortunately, no detailed observations were carried out on seedling quality, such as length, diameter etc., so that the findings of this case study could not be firmly (statistically) concluded yet. In terms of product attributes, farmers have rated high scores for Trisula's

colour, pungency and shape.

True Shallot Seed varieties showed good results in the traditional shallot production centre. Farmers also appreciated the quality of the varieties although some attributes were evaluated low. It is recommended to demonstrate the cultivation of TSS varieties to higher number of farmers, so that such dissemination activity may speed up the rate of TSS adoption at the farmers' level.