The Effect of Number and Age of TSS (True Shallot Seed) Seedling on Shallot Seed Production

Pitri Ratna Asih[1(✉)], Agus Wartapa[1], Mustakim Mustakim[2], and Sukiyanto Sukiyanto[2]

[1] Program Study of Seed Technology, Major of Agriculture, Polytechnic of Agricultural Development Yogyakarta-Magelang, Jl. Kusumanegara No. 2, Yogyakarta, Indonesia
pitriratna@gmail.com

[2] Agricultural Extension Center Subdistrict Girimulyo, District Kulon Progo, Yogyakarta, Indonesia

Abstract. Shallot seed production using true shallot seed (TSS) is more effective and efficient in terms of storage and distribution, but it must be sown first. The purpose of this study was to determine response and obtain the best combination of number and age of TSS seedlings in increasing shallot seeds production. The experiment was arranged in a randomized complete design of number × age of seedling with 3 replications. The number of seedlings consisted of 1, 2, 3, and 4 seedlings for each planting hole, and the age of seedlings consisted of 25, 35, 45, and 55 days after seeding (DAS). The result showed the number and age of TSS seedlings affected vegetative growth parameters (plant height and the number of leaves), yield (yield per m^2, dry yield per m^2, sample yield, sample dry yield), productivity, and characteristics of the seed bulbs produced (number, diameter, and weight). The treatment of 3 seedlings per planting hole and 35 DAS significantly and consistently showed better response than other treatments. That treatment increased vegetative growth parameters (plant height and the number of leaves), yield (yield per m^2, dry yield per m^2, sample yield, sample dry yield), productivity, and the number of bulbs with lighter weight and smaller diameter characteristics of bulbs.

Keywords: Plant density · Nursery · Transplanting · Vegetative growth · Bulb characteristic

1 Introduction

1.1 Background

Shallot is one of the lowland horticultural commodities that have high economic value. This commodity is classified as a spiced vegetable that is always needed as a cooking spice. In addition, shallot is also used as a traditional medicine that has many health benefits.

A. G. Abdullah et al. (Eds.): SEAVEG 2021, ABSR 23, pp. 110–119, 2023.
https://doi.org/10.2991/978-94-6463-028-2_14

Data from the Ministry of Agriculture [1] shows that in the last three years, namely in 2017/2018 there was an increase in productivity and national shallot production by 3.31% and 2.26%. Meanwhile, the national shallot harvest area decreased by 0.88% from 2017, which was 158,172 ha to 156,779 ha in 2018. The main provinces producing shallots (> 1,000 ha) are Central Java, DIY, East Java, West Java, North Sumatra, West Sumatra, South Sulawesi, Bali, and West Nusa Tenggara. The contribution of 9 provinces to total production is 95.8% and Java 75%. The per capita requirement of 4.56 kg/year or 0.38 kg/month and increase to 10–20% toward religious holidays.

To meet the demand for onions, production must be increased. One way to increase production is the availability of quality seeds with sufficient quantities following the needs of farmers.

Shallot seed production is done through bulbs or botanical seeds. Production through TSS has the advantage of being more effective and efficient in terms of storage and distribution. Shelf life is longer than seed bulbs. As well as reducing the 'competition' of the use of bulbs for seeds with for consumption [2].

The production of shallot seeds through botanical seeds can be sown first [2]. The plant moving phase from seedlings to cultivated land is a crucial phase in crop growth because it requires plants to adapt to new ecosystems and this affects the production and quality of shallot seeds produced. Young seedlings are very risky because the plant is still weak and the rooting is not yet strong, while old seedlings will potentially reduce production. The number of seedlings per planting hole also determines production because it is related to the absorption of nutrients, the potential for disease, as well as population and production per unit area of land [3].

Based on the background that has been outlined, research is needed to find out the age of planting move and the right number of seeds per planting hole to obtain plant growth, production, and good quality of onion seeds.

1.2 Purpose

The purpose of this research is 1) to find out the response of quality and production of shallot seeds to the number of seeds per planting hole and the age of TSS seedlings treatment, and 2) to get the best combination between the number of seeds per planting hole and the age of TSS seedlings treatment in improving the growth, yield, and quality of shallot seeds.

2 Materials and Methods

The research was conducted in March to October 2020, in the BP3K Girimulyo area, Girimulyo subdistrict, Kulon Progo regency, Yogyakarta. Altitude the area is ± 700 m above sea level with vertisol soil. The materials used in this study are TSS, Urea fertilizer, organic fertilizer, KCl Fertilizer, SP-36 fertilizer.

This study used a randomized complete design with a combination of the number of seedlings per planting hole and age of planting seedlings, repeated 3 times. The treatment is as follows:

J1U1: One seedling per planting hole, 25 DAS
J1U2: One seedling per planting hole, 35 DAS
J1U3: One seedling per planting hole, 45 DAS
J1U4: One seedling per planting hole, 55 DAS
J2U1: Two seedlings per planting hole, 25 DAS
J2U2: Two seedlings per planting hole, 35 DAS
J2U3: Two seedlings per planting hole, 45 DAS
J2U4: Two seedlings per planting hole, 55 DAS
J3U1: Three seedlings per planting hole, 25 DAS
J3U2: Three seedlings per planting hole, 35 DAS
J3U3: Three seedlings per planting hole, 45 DAS
J3U4: Three seedlings per planting hole, 55 DAS

Seedbed made with width 100–120 cm, chaff is given with 15–20 cm of thickness then burned at a distance of fire points per 1 m. The chaff was left perfectly burned for 1 night. After leaving for a night, the bed is doused with enough water then mixed evenly.

True shallot seeds begin to grow at 5–7 days after seedling. Seedlings are watered once every 1–3 days depending on soil moisture. NPK fertilizer 16: 16: 16 is given at a dose of 0.5 g/lt after the age of 21 HSS. Age of plant moving according to the treatment. Seedlings were transplanted with age according to the treatment, planting distance 10 cm $\times$ 10 cm, and the number of seeds per hole adjusted to the treatment.

The parameters of growth and productivity observed were: (1) plant height, (2) number of leaves, (3) number of flowering plants per plot, (4) number of bulbs per clump, (5) number of bulbs per plot, (6) bulb diameter, (7) Weight of wet bulbs per plot, (8) Weight of wet bulbs per clump, (9) Weight of dry bulbs. Data were analyzed by analysis of variance and if there was a significant difference continued with DMRT (Duncan Multiple Range Test) levels of 5%.

3 Results and Discussion

3.1 Effect of Number and Age of TSS Seeds on Shallot Growth

Treatment of the number and age of TSS seedlings showed a significant effect on plant height at 2 weeks after planting (WAP), had no significant effect at 3 WAP, and was very significant at 4 WAP and 5 WAP (Table 1). At 2 WAP, the J2U4 treatment showed the highest plant height value compared to all treatments, which was 31.00 cm.

The age of old seedlings, in this study 55 DAS, in the early stages of transplanting physically has a larger size, so that in the early stages of growth it will look superior to the age of young seedlings [3–5]. At 4 WAP, treatments J3U1 and J3U2 showed the highest plant height values compared to all treatments with values of 34,667 cm and 33,447 cm, respectively. And at 5 WAP, treatments J2U1, J2U2, J3U1, and J3U2 showed the highest plant height values compared to all treatments with values of 59.22 cm, 58.45 cm, 61.44 cm, and 60.22 cm. The use of three seeds per planting hole showed higher vegetative growth from the aspect of plant height compared to the treatment with fewer seeds. This is because the population density in one planting hole will cause competition for growth-supporting elements, in this case, especially sunlight. As a result,

Table 1. Effect of treatment number and age of TSS seeds on shallot plant height

Treatment	Week						
	2		3	4		5	
J1U1	25.22	cd	32.333	41.56	cd	51.33	b
J1U2	28.22	abcd	32.557	37.11	e	43.78	e
J1U3	27.33	abcd	31	38.89	cde	48.67	bcd
J1U4	29.67	abcd	34.667	42.00	c	49.33	bc
J2U1	24.78	d	33.333	52.33	ab	59.22	a
J2U2	26.66	bcd	33.11	50.45	b	58.45	a
J2U3	29.11	abc	33.11	40.44	cde	50.89	b
J2U4	31.00	a	34	38.22	de	45.78	cde
J3U1	25.67	cd	34.667	55.22	a	61.44	a
J3U2	28.11	abcd	33.447	54.78	a	60.22	a
J3U3	29.78	ab	34.11	41.45	cd	51.78	b
J3U4	30.22	ab	32.997	37.89	e	44.89	ed
ANOVA	*		Not significant	**		**	

Description: The numbers in the same column followed by the same letter show results that are not significantly different in Duncan's test at the 5% level

the plant will grow lengthwise because it tries to get enough sunlight to support its growth. Lack of sunlight physiologically causes plants to grow taller or the effect of etiolation [6–9].

Leaves are important organs for plants because they are the place where photosynthesis takes place. Therefore, in addition to plant height, the optimum number of leaves also supports the optimal growth of shallot plants [10]. Treatment of the number and age of TSS seedlings showed a very significant effect on the number of leaves observed at 2 WAP, 3 WAP, 4 WAP, and 5 WAP (Table 2). At 2 and 3 WAP, treatments J3U1, J3U2, J3U3, and J3U4 produced the highest number of leaves and were better than other treatments. A large number of leaves in the treatment of planting three seedlings is easy to understand considering that many seeds cause the plant population per planting hole to increase, thus the number of leaves produced is also increasing [11]. At 4 WAP and 5 WAP, treatment J3U1 showed the highest number of leaves compared to all treatments with values of 46.00 and 64.44, respectively. Young seedlings have better adaptability to new environments than old seedlings so that vegetative growth is not hampered [12]. Older seedlings age faster and enter the generative phase.

3.2 Effect of Number and Age of TSS Seeds on Shallot Yield

The treatment of the number and age of TSS seedlings showed a very significant effect on the observed yield per m^2 and the yield of the sample plants, both under conditions of dry harvest and drying (Table 3). The treatment that showed the highest number in

Table 2. Effect of treatment number and age of TSS seedlings on number of leaves of shallots

Treatments	Week							
	2		3		4		5	
J1U1	6.56	c	9.22	c	17.11	f	23.11	e
J1U2	6.89	c	8.11	c	15.78	fg	19.55	e
J1U3	5.67	c	7.56	c	14.00	gh	19.33	e
J1U4	6.22	c	7.67	c	12.89	h	18.45	e
J2U1	11.78	b	15.56	b	27.45	d	37.11	d
J2U2	12.78	b	16.11	b	25.11	e	37.00	d
J2U3	12.67	b	17.22	b	28.11	d	38.67	d
J2U4	13.67	b	15.00	b	26.78	e	34.22	d
J3U1	23.22	a	30.67	a	46.00	a	64.44	a
J3U2	21.45	a	29.11	a	43.00	b	56.89	b
J3U3	22.33	a	29.44	a	40.33	c	52.89	b
J3U4	21.22	a	28.78	a	38.78	c	46.78	c
ANOVA	**		**		**		**	

Description: The numbers in the same column followed by the same letter show results that are not significantly different in Duncan's test at the 5% level

the observation of dry yield per m^2 and dry yield per m^2 was the J3U2 treatment with a weight of 4.78 kg and 3.83 kg, respectively. The treatment that showed the highest number in the observation of the dry yield of the sample was the J3U2 treatment with a weight of 66.43 g. While the treatment that showed the highest number in the observation of the drying results of the samples was treatment J3U1 with a weight of 52.13 g and J3U2 with a weight of 52.52 g.

The density of the number of seeds of 3 plants per planting hole with young seedlings was still able to produce vegetative growth and significantly better yield performance than the treatment with fewer seeds and old planting age. When planting shallots using TSS, 2–3 seeds were planted in each hole with a spacing of 10 cm × 10 cm according to the method of carrying out this research [13]. A high population can increase the yield per unit area [6]. Young seedlings have sufficient time to optimize vegetative growth which will affect the generative growth and yield of shallots [12].

Yield productivity has a very significant effect due to the treatment of the number and age of TSS seedlings. The treatment that produced the highest productivity was J3U2, which was 30.6 quintals per ha (Table 4). The plant population can affect the level of plant production [14]. The increase in plant population will be followed by an increase in plant production per unit area. The treatment of the number of seeds per planting hole can affect plant productivity because it will determine the number of plants that grow in one clump [9]. The results of Irfan's research [15] showed that increasing the plant density per unit area to a certain extent was able to increase yields. However, plants

Table 3. Effect of treatment number and age of TSS seeds on yield per m^2 and yield of shallot samples

Treatments	Yield per m^2				Yield of Shallot Sample			
	Wet weight (Kg)		Dry weight (Kg)		Wet weight (g)		Dry weight (g)	
J1U1	4.15	def	3.32	def	57.59	def	45.78	cd
J1U2	4.21	cde	3.36	de	58.43	de	47.27	c
J1U3	3.9	f	3.12	f	54.12	f	43.74	d
J1U4	3.61	g	2.89	g	50.09	g	40.41	e
J2U1	4.48	bc	3.58	bc	62.25	bc	49.88	b
J2U2	4.35	cd	3.48	cd	60.37	cd	47.67	c
J2U3	4.3	cd	3.44	cd	59.64	cd	47.58	c
J2U4	4	ef	3.2	ef	55.56	ef	41.48	e
J3U1	4.7	ab	3.76	ab	65.26	ab	52.13	a
J3U2	4.78	a	3.83	a	66.43	a	52.52	a
J3U3	4.69	ab	3.75	ab	65.09	ab	51.19	ab
J3U4	3.96	ef	3.16	ef	54.93	ef	43.95	d
ANOVA	**		**		**		**	

Description: The numbers in the same column followed by the same letter show results that are not significantly different in Duncan's test at the 5% level

grown at a density exceeding the limit can reduce yields due to competition for nutrients, water, solar radiation, and space to grow [15]. In this study, the treatment of three seeds per planting hole was still able to produce higher productivity than other treatments. In general, high production per unit area is achieved with a high population because the maximum use of light is achieved at the beginning of growth [6]. A younger seed age will accelerate plant adaptation to the environment so that plant growth and development are not hampered. If the age of the seed is too old, the plant does not have enough time to complete its vegetative growth, the plant ages faster, enters the generative phase faster, and the results are not optimal [12]. So that the use of young transplanting seedlings affects productivity.

3.3 Effect of Number and Age of TSS Seeds on Characteristics of Shallot Seed Bulbs

In observing the characteristics of seed bulbs, the treatment of the number and age of TSS seedlings showed a significant effect on the parameters of bulb diameter and very significant on the parameters of the number of bulbs and bulb weight (Table 5). The J3U2 treatment showed the highest number of bulbs with an average number of 8.11 bulbs per plant and was significantly better than all treatments. The number of bulbs is influenced by the population. The denser the population, the greater the number of bulbs produced because at a denser plant density, the number of bulbs produced in one clump is more

Table 4. Effect of treatment number and age of TSS seeds on productivity per Ha of shallots

Treatments	Productivity	
J1U1	26.5	def
J1U2	26.9	de
J1U3	24.9	f
J1U4	23.1	g
J2U1	28.7	bc
J2U2	27.8	cd
J2U3	27.5	cd
J2U4	27.1	ef
J3U1	30.1	ab
J3U2	30.6	a
J3U3	30.0	ab
J3U4	25.3	ef
ANOVA	**	

Description: The numbers in the same column followed by the same letter show results that are not significantly different in Duncan's test at the 5% level

[16]. Increasing plant density being able to increase the number of bulbs per plot [17]. The highest number of bulbs was obtained from planting shallot bulbs with a density of 100 plants/m^2 compared to a density of 30 plants/m^2 or 60 plants/m^2. Younger seed ages have better adaptability when transplanting and can affect growth and production processes including the number of bulbs per plant [12].

The results of statistical analysis on bulb diameter parameters showed that the J1U2 and J2U2 treatments produced the largest seed bulb diameter with values 23.0 mm and 23.03 mm significantly different, significantly better than all treatments. While the smallest bulb diameter produced by the J3U4 treatment was 20.85 mm. Plant density affects the appearance and production of plants, mainly because of the efficient use of light. In general, high production per unit area is achieved with a high population because the maximum use of light is achieved at the beginning of growth. However, in the end, the appearance of each plant decreases due to competition for light and other growth factors [6]. Dense plant densities gave higher total bulb yields per unit area but most of the bulbs produced were small. On the other hand, the rare plant density produces a higher percentage of large bulbs but lower total bulb yield per unit area [4, 18].

The treatment of the number and age of TSS seedlings on the heaviest bulb weight parameter, namely J1U1 of 11.22 g was not significantly different from the treatment of J1U2 with a weight of 10.55 g. While the treatment with the lowest weight was J3U3 and J3U4 with a value of 6.55 g and 6.28 g, respectively. Setting the spacing or plant population is closely related to the level of competition between plants for growth factors. Close spacing results in a higher level of competition so that there will be plants whose growth is stunted, either because they are shaded by the surrounding plants or

Table 5. Effect of treatment number and age of TSS seeds on number, diameter, and weight of shallot seed bulbs

Treatments	Characteristic of shallot seed bulb					
	Amount		Diameter (mm)		Weight (g)	
J1U1	4.11	g	22.44	ab	11.22	a
J1U2	4.45	g	23.00	a	10.55	ab
J1U3	4.22	g	22.00	abc	10.28	b
J1U4	4.67	g	22.22	abc	8.61	c
J2U1	6.44	de	21.61	bc	8.30	c
J2U2	5.89	ef	23.03	a	8.22	c
J2U3	5.78	f	22.48	ab	7.73	cd
J2U4	6.45	de	21.59	bc	7.00	de
J3U1	7.67	ab	21.19	bc	6.89	de
J3U2	8.11	a	21.44	bc	6.83	de
J3U3	7.44	bc	21.84	abc	6.55	e
J3U4	7.00	cd	20.85	c	6.28	e
ANOVA	**		*		**	

because of plant competition in getting water, nutrients, and oxygen [19]. Less spacing allows plants to absorb more water to increase the wet weight both per bulb and per plant [20]. The lower bulb weight per clump due to population growth was caused by competition for nutrients between plants which caused the size and number of bulbs to become smaller. However, in total, although the weight of bulbs in production per clump is low because the number of clumps is large due to population growth, the weight of bulbs per plot becomes more [16].

4 Conclusion

The treatment of the number and age of TSS seedlings affected vegetative growth parameters (plant height and the number of leaves), yield (yield per m^2, dry yield per m^2, sample yield, sample dry yield), productivity, and characteristics of the seed bulbs produced (number, diameter, and bulb weight). Treatment of plant density with the number of 3 seedlings per planting hole and transplanting age of 35 DAP (J3U2) significantly and consistently showed a significantly different effect better than other treatments on the observation of vegetative growth parameters (plant height and the number of leaves), yield (yield per m^2, dry yield per m^2, sample yield, sample dry yield), productivity and number of the bulb with smaller diameter and bulb weight characteristics.

References

1. Ministry of Agriculture, Outlook Komoditas Pertanian Tanaman Pangan: Kacang Tanah. Jakarta: Kementerian Pertanian, 2018.
2. N. Sumarni, R. Rosliani, Suwandi, "Optimasi jarak tanam dan dosis pupuk NPK untuk produksi bawang merah dari benih umbi mini dai dataran tinggi," J. Hort., vol. 22, no. 2, pp. 148–155, 2012.
3. W.A. Darma, A.D. Susila and D. Dinarti, "Pertumbuhan dan Hasil Bawang Merah Asal Umbi TSS Varietas Tuk pada Ukuran dan Jarak Tanam yang Berbeda," AGROVIGOR, vol. 8, no. 2, pp. 1–7, 2015.
4. J.L. Brewster and P.J. Salter, "A Comparison of the effect of regular versus random within row spacing on the yield and uniformity of size of spring-sown bulb onion," J. Hort. Sci., vol. 55, no. 3, pp. 235–238, 1980.
5. E. Lubis, Pengaruh Sistem Tanam dan Umur Bibit terhadap Pertumbuhan dan Produksi Beberapa Varietas Padi Sawah (Oryza sativa L.). Tesis. Universitas Sumatera Utara. Medan, 2004.
6. S.S. Harjadi, Pengantar Agronomi. Jakarta: Gramedia Pustaka Utama, 2002.
7. Y. Sufyati, "Pengaruh Ukuran Fisik dan Jumlah Umbi Per Lubang terhadap Pertumbuhan dan Hasil Bawang Merah (Allium ascalonicum L.)," Jurnal Floratek, vol. 2, no. 1, 2006.
8. 9. U. Made, "Respons berbagai populasi tanaman jagung manis (Zea mays saccharata Sturt.) terhadap pemberian pupuk area," J. Agroland., vol. 17, no. 2, pp. 138–143, 2010.
9. 10. T. Nugrahini, "Respon Tanaman Bawang Merah (Allium ascolonicum L.) Varietas Tuk terhadap Pengaturan Jarak Tanam dan Konsentrasi Pupuk Organik Cair Nasa," Ziraa'ah, vol. 36, no. 1, pp. 60–65, 2013.
10. 11. L. Nazirah and D.I. Libra, "Respon Bawang Merah (Allium ascalonicum L) Terhadap Pemotongan Umbi dan Aplikasi Pupuk Organik," Jurnal Agrium, vol. 16, no. 2, pp. 118–125, 2019.
11. 12. M. Saidah and P.R. Syafruddin, "Pengaruh jarak tanam terhadap pertumbuhan dan hasil bawang merah asal biji di Kabupaten Sigi, Sulawesi Tengah," Pros Sem Nas Masy Biodiv Indon., vol. 5, no. 2, pp. 209–212, 2019.
12. G.A. Sopha, M. Syakir, W. Setiawati, Suwandi and N. Sumarni, "Teknik Penanaman Benih Bawang Merah Asal True Shallot Seed di Lahan Suboptimal," J. Hort., vol. 27, no. 1, pp. 35–44, 2017.
13. S.M.D. Soedirdjoatmodjo, Bertanam Bawang. Jakarta: Badan Penerbit Karya Tani, 1987.
14. S. Heddy, W. H. Susanto and M. Kurniati, Pengantar Produksi Tanaman dan Penanganan Pasca Panen. Jakarta: Raja Grafindo Persada, 1994.
15. M. Irfan, Respon Tanaman Jagung (Zea mays L.) Terhadap Pengolahan Tanah dan Kerapan Tanam Pada Tanah Andisol dan Ultisol. Disertasi. Fakultas Pertanian Universitas Sumatera Utara, Medan, 1999.
16. 17. S. Simatupang, "Kajian Jumlah Populasi dan Varietas Terhadap Produksi dan Keuntungan Usaha Tani Bawang Merah di Sumatra Utara," Jurnal Hortikultura, vol. 29, no. 2, pp. 219, 2019.
17. 18. G. Wiguna, I. Hidayat and C. Azmi, "Perbaikan Teknologi Produksi Benih Bawang Merah Melalui Pengaturan Pemupukan, Densitas, dan Varietas," Jurnal Hortikultura, vol. 23, no. 2, pp. 137, 2016.
18. M.P.K. Stallen and Y. Hilman, Effect of plant density and bulb size on yield and quality of shallot. Edisi Khusus, 1991.

19. F. Firmansyah, T.M. Onngo and A.M. Akyas, “Pengaruh Umur Pindah Tanam Bibit dan Populasi Tanaman terhadap Hasil dan Kualitas Sayuran Pakcoy (Brassica campestris L., Chinensis group) yang Ditanam dalam Naungan Kasa di Dataran Medium,” Agrikultura, vol. 20, no. 3, 2009.
20. 21. S. Sumarni and R. Rosliani, Pengararuh Takaran Pupuk Kalium dan Pupuk Kandang Sapi terhadap Pertumbuhan dan Hasil Bawang Merah. Universitas Wangsa Manggala. Yogyakarta, 2003.