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Increasing Samosir Red Onion (Allium ascalonicum L.) Production Through Induction of Ethyl Methane Sulfonate (EMS) Mutation and Administration Interval of Silver Nanoparticles Natural PGR (AGNPS-A)

Marinus Mintodeus Waruwu[1], Wismaroh Sanniwati Saragih[2], Roswita Oesman[3]
[1,2,3]Fakultas Pertanian, Universitas Pembinaan Masyarakat Indonesia, Medan, Indonesia

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ABSTRACT

Samosir Shallots (Allium ascalonicum L.) is one of the vegetable commodities that is widely used by people as a food flavoring ingredient. Apart from being a flavoring, shallots are also widely used as traditional medicine. The importance of applying Ethyl Methane Sulfonate (EMS) mutation technology and providing natural ZPT silver nanoparticles (AGNPS-A) on the growth and productivity of Samosir shallots. This research was carried out from May to August 2023, which took place in the experimental garden of the Faculty of Agriculture, Indonesian Community Development University (UPMI) Jl. Balai Desa Pasar 12 Marindal II Medan Amplas. This research used a Completely Randomized Design (CRD)which consists of 3 factors with levels of 3x3x2. First factor, AGNPS-A administration interval (A), A0 (Control); A1 (3 MST); A2 (5 MST). Second factor, Ethyl Methane Sulfonate (E),E0 (Control); E1 (0.25%); E2 (0.5%); Factor (iii), Soaking time (J), J1 (2 hours); J2 (4 Hours). The results of EMS and AGNPS-A treatment had a very real influence in increasing onion production on the observation parameters of plant height, number of leaves, number of tillers and wet weight. This combination of treatments is able to interact to increase the production of Samosir shallots(Allium ascalonicum L.).

Corresponding Author:

Marinus Mintodeus Waruwu
Fakultas Pertanian, Universitas Pembinaan Masyarakat Indonesia
Jl. Teladan No.15, Teladan Bar., Kec. Medan Kota, Kota Medan, Sumatera Utara 20214
Email: mintodeusw@gmail.com

1. INTRODUCTION

Samosir shallots (Allium ascalonicum L.) is a superior vegetable commodity that has long been intensively cultivated by farmers. Shallots can be used as a cooking spice (flavour), vegetables (pickles and salads), and processed products (fried onions)(Garjito, 2013). Red onion bulb extract is currently being studied as a traditional medicine (antimicrobial, anticancer, and anti-inflammatory)(Sari, 2017). Shallot production in North Sumatra is quite low and unable to meet local needs. The low productivity of shallots in North Sumatra is partly due to the application of inappropriate fertilization technology and the unavailability of location-specific fertilization packages.(Winarni, 2012).

Based on BPS results for 2018-2021, shallot production in North Sumatra, in 2018 shallot production was 16,337 tonnes/year, in 2019 shallot production was 18,072 tonnes/year, in 2020

shallot production reached 29,222 tonnes/year, while in In 2021, shallot production will be 53,962 tons/year (Central Statistics Agency, 2020).

The nutritional content in shallot bulbs can help the body's circulatory system and digestive system(Aryanta, 2019). In this case, an important benefit of shallot bulbs is their role as a natural antioxidant, which is able to suppress the carcinogenic effects of free radical compounds.(Kuswardhani, 2016). Regular consumption can prevent us from lacking vitamins and minerals (Ritbang, 2013).

Mutation induction means improving genetic quality with the aim of obtaining plants based on desired characteristics through changes in the plant's genetic composition(Damayanti, 2021). One of the ingredients for gene mutation is to use Ethyl Methanesulfonate (EMS). Mutations using EMS chemicals have been widely used and produce useful traits in a number of plant species(Espina et al., 2018). Inducing mutations in plants with EMS can cause changes in genetic traits in plants to negative or positive. Mutations in the positive direction are mutations desired by plant breeders while mutations in the negative direction are changes that are not desired by the breeder.(Laksono & Fanata, 2022). These compounds have one or more reactive alkyl groups that can be transferred to other molecules. EMS (Ethyl Methane Sulphonate) is an alkyl compound that converts guanine into 7-ethylguanine which pairs with thymine(Andriyani & Mus seenin, 2017).

To speed up the growth period, growth regulators (ZPT) should be used. Plant growth can be supported by adding appropriate concentrations of growth regulators to influence cell elongation(Rachmawati & Machfudz, 2017). This method of adding growth regulators is expected to produce plant seeds that remain of good quality in large quantities. Providing growth regulators (ZPT) in making plant seed cuttings will improve the quality and number of seeds below normal standards so that it can improve the economic level of the community.(Mansur & Kadarisman, 2019).

Nowadays, nanoparticle technology has been discovered which is known to increase the effectiveness of a substance. Nanoparticle technology or nanotechnology is a material that has a size of 1-100 nm(Maryani et al., 2017). Nanomaterials can provide solutions in the field of technology and environmental problems such as antimicrobials, medicine, biotechnology, optics, microelectronics, catalysis(Princess, 2019). Silver nanoparticles (AgNPs) are one of the most widely produced and used nanomaterials. The benefits of NPP include being an antibacterial that is not resistant to MDR (multi-drug resistant) bacteria, a biological management agent for mosquitoes, and a biopesticide (Qais et al., 2019).

2. METHOD

This research was carried out in May - August 2023, carried out in the experimental garden of the Faculty of Agriculture, Indonesian Community Development University (UPMI) Jl. Balai Desa Pasar 12 Marindal II Medan Amplas. The tools used in this research were polybags, filter paper, tissue, measuring tape, hoe, gloves, stationery and camera. The materials used in this research were Samosir shallot bulbs, EMS dissolved in phosphate buffer, soil, manure, ZPT silver nanoparticles and other materials needed.

This research uses the RAL method which consists of 3 factors with levels of 3x3x2. Factor (i), AGNPS-A administration interval, A0 = Control; A1 = 3 WAP; and A2 = 5 WAP. Factor (ii), EMS; E0 = Control ; E1 = 0.25%; and E2 = 0.5%; Factor (iii), Soaking time J1 = 2 hours; J2 =4 Hours. The parameters observed in this research were plant height, number of leaves, number of tillers and wet weight of tubers.

3. RESULTS AND DISCUSSION

3.1 Research results

In this research, an analysis was carried out on the use of Ethyl Methane Sulfonate (EMS) Mutation Induction, natural ZPT Silver Nanoparticles (AGNPS-A) and also the soaking period (J) on the growth and production of samosir shallots (Allium ascalonicum L.). This research was also carried out 18 treatments and 3 repetitions. Several indicators observed regarding the growth and production of shallots were plant height (cm), number of leaves (strands), number of tillers. The results of the analysis are described as follows.

3.1.1 Plant Height (cm)

The following are the results of the analysis of plant height according to the AGNPS-A treatment which had a very significant effect on observations 2, 3 and 4 WAP. It can be seen in the following table.

Table 1. Average height of plants aged 2, 3, and 4 WAP with AGNPS-A treatment

AGNPS-A (A)	Plant Height (cm)		
	2 WAP	3 WAP	4 WAP
A0 = Control	11.6 a	17.33 a	24.40 a
A1 = 3 WAP	48.95 BC	60.40 bc	71.65 bc
A2 = 4 MST	58.85 d	67.00 d	76.65 d

Note: Numbers followed by different lowercase letters in columns indicate very significant differences at the 5% test level (DMRT)

Table 1 above can be seen that there was an increase each time the AGNPS-A treatment was given to the height of the plants at the ages of 2, 3 and 4 WAP. It can be said that giving AGNPS-A treatment at level A2 = 4 WAP gives the highest average results compared to level A0 = Control. Meanwhile, the results of Ethyl Methane Sulfonate (EMS) treatment had a very significant effect on observations 2, 3 and 4 WAP. It can be seen in the following table.

Table 2. Average height of plants aged 2, 3, and 4 WAP with Ethyl Methane Sulfonate (E) treatment

Ethyl Methane Sulfonate (E)	Plant Height (cm)		
	2 WAP	3 WAP	4 WAP
E0 = Control	13.93 a	18.43 a	25.40 a
E1 = 0.25%	49.00 BC	61.50 BC	72.70 bc
E2 = 0.5%	58.80 d	65.90 d	75.60 d

Note: Numbers followed by different lowercase letters in columns indicate very significant differences at the 5% test level (DMRT)

Table 2 above shows an increase in each Ethyl Methane Sulfonate (EMS) treatment at the ages of 2, 3 and 4 WAP. It can be said that giving Ethyl Methane Sulfonate (EMS) treatment to plant height at the E2 = 0.5% level gives the highest average yield compared to the E0 = Control level.

3.1.2 Number of Leaves (pieces)

The following are the results of the analysis of the number of leaves according to the AGNPS-A treatment which had a very significant effect on observations 2, 3 and 4 WAP. It can be seen in the following table.

Table 3. Average number of leaves aged 2, 3, and 4 WAP with AGNPS-A treatment

AGNPS-A (A)	Number of Leaves (pieces)		
	2 WAP	3 WAP	4 WAP
A0 = Control	4.00 a	11.00 a	15.00 a
A1 = 3 WAP	22.50 BC	38.00 BC	41.00 BC
A2 = 5 MST	23.50 d	40.00 d	48.00 d

Note: Numbers followed by different lowercase letters in columns indicate very significant differences at the 5% test level (DMRT)

Table 3 above can be seen that there was an increase each time the AGNPS-A treatment was given at the ages of 2, 3 and 4 WAP. It can be said that giving AGNPS-A treatment to the number of leaves at level A2 = 5 WAP gave the highest average results compared to level A0 = Control. Meanwhile, the results of Ethyl Methane Sulfonate (EMS) treatment had a very significant effect on observations 2, 3 and 4 WAP. It can be seen in the following table.

Table 4. Average number of leaves aged 2, 3 and 4 WAP with Ethyl Methane Sulfonate (E) treatment

Ethyl Methane Sulfonate (E)	Number of Leaves (pieces)		
	2 WAP	3 WAP	4 WAP
E0 = Control	6.33 a	12.00 a	14.33 a
E1 = 0.25%	20.00 BC	36.50 BC	43.00 BC
E2 = 0.5%	26.00 d	41.50 d	46.00 d

Note: Numbers followed by different lowercase letters in columns indicate very significant differences at the 5% test level (DMRT)

Table 4 above shows an increase in each Ethyl Methane Sulfonate (EMS) treatment at the ages of 2, 3 and 4 WAP. It can be said that giving Ethyl Methane Sulfonate (EMS) treatment to the

number of leaves at the E2 = 0.5% level gave the highest average yield compared to the E0 = Control level.

3.1.3 Number of Cubs

The following are the results of the analysis of the number of tillers according to the AGNPS-A treatment which has a very significant effect on harvesting samosir onions at the ages of 3 and 6 WAP. It can be seen in the following table.

Table 5. Average number of tillers aged 2, 3, and 4 WAP with AGNPS-A treatment

AGNPS-A (A)	Number of Cubs	
	3 WAP	6 WAP
A0 = Control	4.00 a	7.30 a
A1 = 3 WAP	15.50 d	26.50 d
A2 = 5 MST	13.30 BC	14.00 BC

Note: Numbers followed by different lowercase letters in columns indicate very significant differences at the 5% test level (DMRT).

Table 5 above can be seen that there was an increase each time the AGNPS-A treatment was given at the ages of 3 and 6 WAP. It can be said that giving AGNPS-A treatment to the number of tillers at the A1 = 3 MST level gave the highest average results compared to the A0 = Control and A2 = .5 WAP levels. Meanwhile, the results of Ethyl Methane Sulfonate (EMS) treatment had a very significant effect on observations 3 and 6 WAP. It can be seen in the following table.

Table 6. Average number of tillers aged 2, 3, and 4 WAP treated with Ethyl Methane Sulfonate (EMS)

Ethyl Methane Sulfonate (E)	Number of Cubs	
	3 WAP	6 WAP
E0 = Control	3.67 a	5.70 a
E1 = 0.25%	14.00 BC	15.50 BC
E2 = 0.5%	15.00 d	25.00 d

Note: Numbers followed by different lowercase letters in columns indicate very significant differences at the 5% test level (DMRT).

Table 6 above shows an increase in each Ethyl Methane Sulfonate (EMS) treatment at the ages of 2, 3 and 4 WAP. It can be said that giving Ethyl Methane Sulfonate (EMS) treatment to the number of tillers at the E2 = 0.5% level gave the highest average results compared to the E0 = Control level.

3.1.4 Gross weight

The following are the results of the wet weight analysis according to the AGNPS-A treatment which has a very significant effect on the harvesting of Samosir onions. It can be seen in the following table.

Table 7. Average wet weight aged 2, 3, and 4 WAP with AGNPS-A treatment

AGNPS-A (A)	Wet Weight (gr)
	Harvest
A0 = Control	33.30 c
A1 = 3 WAP	33.00 BC
A2 = 5 MST	22.50 a

Note: Numbers followed by different lowercase letters in columns indicate very significant differences at the 5% test level (DMRT)

Table 7 above can be seen that there is an increase each time the AGNPS-A treatment is given. It can be said that giving AGNPS-A treatment to wet weight at level A0 = 3 WAP gave the highest average results compared to levels A1 = Control and A2 = .5 WAP. Meanwhile, the results of Ethyl Methane Sulfonate (EMS) treatment had a very real effect. It can be seen in the following table.

Table 8. Average wet weight aged 2, 3, and 4 WAP with Ethyl Methane Sulfonate (EMS) treatment

Ethyl Methane Sulfonate (E)	Wet Weight (gr)
	Harvest
E0 = Control	33.30 d
E1 = 0.25%	25.00 BC
E2 = 0.5%	15.50 a

Note: Numbers followed by different lowercase letters in columns indicate very significant differences at the 5% test level (DMRT)

Table 8 above shows an increase in each Ethyl Methane Sulfonate (EMS) treatment at the ages of 2, 3 and 4 WAP. It can be said that giving Ethyl Methane Sulfonate (EMS) treatment to the number of tillers at the E0 = Control level gave the highest average results compared to the E1 = 0.25% and E2 = 0.5% levels.

4. CONCLUSION

Providing Ethyl Methane Sulfonate (EMS) mutation induction on the growth and production of Samosir shallots had a very significant effect on observations of plant height, number of leaves, number of tillers and wet weight. Induction of mutations turns out to be able to improve genetic quality in the vegetative phase, resulting in morphological changes in plants for the better. This is because the concentration of EMS is used to increase plant genetic variation. The effect of the interval of giving natural PGR silver nanoparticles (AGNPS-A) on the growth and production of Samosir shallots also greatly influences the production of shallot plants. This is due to the antimicrobial and antifungal properties of the planting media as implemented in this research. In this research, the effect of treatment with the combination of Ethyl Methane Sulfonate (EMS) and natural ZPT silver nanoparticles (AGNPS-A) is very good. This is because the function of each treatment is very complete with the soaking time being long enough so that shallot production can be maximized.

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