LETTER OF ACCEPTANCE

The 9th International Conference on Sustainable Agriculture and Environment

Dear Zulfahmi, Dedi Affandi, Mahmuzar, Rosmaina and Gusrinaldi

We are glad to inform you that your abstract with the following identification:

Paper ID: 72
Title: Phenotype Performance of M1 Generation of Bima Shallot (Allium cepa L. var. Ascalonicum) result of Ethyl Methane Sulfonate induced
Author(s): Zulfahmi, Dedi Affandi, Mahmuzar, Rosmaina and Gusrinaldi

is **ACCEPTED** to be presented in ICSAE-9.

The author should prepare the necessary documents for the conference and submitted to EasyChair https://s.id/icsae-easychair.

Regarding the full paper, authors are requested to submit the manuscript to Morressier site on the following link https://s.id/icsae-morressier.

For guides and detail please visit our conference website. Any missing steps during the conference would impact the further decision of manuscript processing in an online proceeding.

All the papers will go through the review process, and the acceptance of publication in the online conference proceeding is solely the decision of IOP Publisher. The committee would try our best to help the author prepare the manuscript to be met with the guide.

Should you have any questions, please send us a message. We are looking forward to welcoming you to the conference venue.

Regards,

Dr. Sigit Prastowo

Chair

ICSAE-IX

9th International Conference on Sustainable Agriculture and Environment

Programme and Abstracts Book

Online conference | 24-25 August 2022
Surakarta, Indonesia

This conference held by
Research and Development Center for Biotechnology and Biodiversity, Universitas Sebelas Maret, Indonesia

in collaboration with:
Faculty of Agriculture, UNS, Indonesia
Faculty of Art and Design, UNS, Indonesia
Faculty of Economic and Business, UNS, Indonesia

Table of Contents

Conference Guide

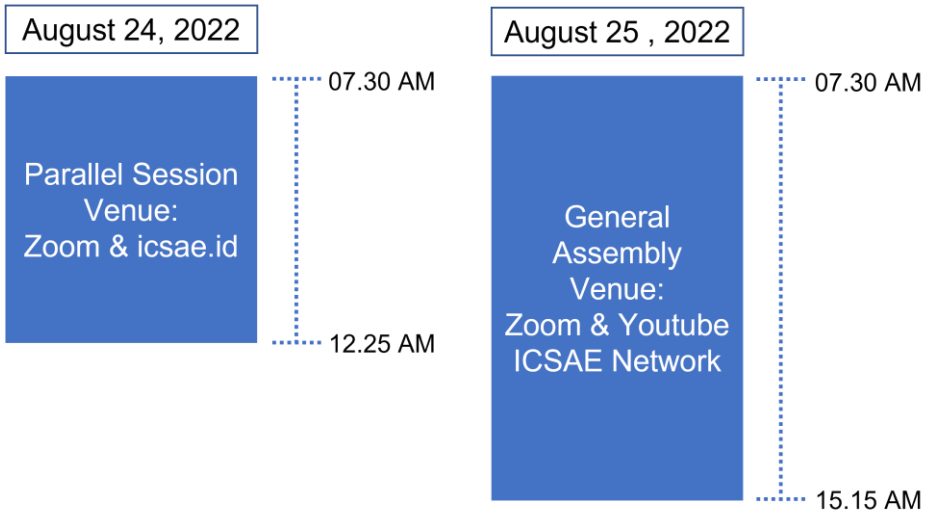
As informed, ICSAE-IX will be held online. There are two different sessions in this conference, namely parallel session and general assembly.

There are two different sessions in this conference, namely parallel session and general assembly. The parallel session can be accessed through Zoom for oral presentations and Website https://icsae.id for poster presentation.

The generall assembly, invited speakers talk, will be performed through Zoom meeting and streamed via Youtube ICSAE Network. Both stages can be enjoyed by all participants which are listed and/or invited with the following time frame:

1. Parallel session : August 24, 2022
2. General assembly : August 25, 2022

ICSAE-IX Stages



Parallel Session Guide

The parallel session will be held on August 24, 2022. Author can choose preferable presentation methods, either Oral or Poster presentation.

For oral presentation, authors should prepare and submit a pre-recorded video presentation. While, for poster presentation, authors should prepare and submit digital poster. Below are the guidelines for parallel sessions.

1. Oral Presentation

Author(s) will receive a Zoom link and virtual background a day before the conference via email, which is specific for their presentation room. On the conference day, the Committee will play video presentations in parallel for every 3 presenters. It will be continued with live discussion for 5 minutes led by Room Chair. Thus, we hope that all authors join the Zoom room during parallel session. Oral presentation schedule will be provided on the next page.

The presenters are free to choose preferred video recording platform, however we suggest using Zoom recording, because it is easy to use and has a small file size. You may adapt the methods from this link https://www.youtube.com/watch?v=kDfCq-pLZQI.

Recorded video presentation requirements:

- MP4 format
- Maximum size 30 MB
- Video duration maximum is 7 minutes
- Please introduce presenter name, for certificate purposes
- Submit video presentation through EasyChair

Please note that a presenter certificate will be given to the presenter recorded in the video. Another author who joined the parallel session will get a participant certificate. Presented manuscript and listed author will receive a manuscript certificate.

2. Poster Presentation

Digital poster shows can be accessed through the conference website (https://icsae.id). Discussion can be done by commenting on the web page.

Digital poster requirements:

- PDF format
- Maximum size 5 MB
- Paper size A3 vertical
- Kindly put on the poster: Presentation title, authorship and affiliation
- Submit digital poster through EasyChair

Please note that a presenter certificate will be given to the presenter previously selected in the EasyChair platform. Presented manuscript and listed author will receive a manuscript certificate.

General Assembly Session Guide

The ICSAE-IX general assembly will be held on August 25, 2022. Invited speakers talk, will be performed through Zoom live meeting, all authors can join and participate in the session. General assembly rundown will be on the next page.

During the general assembly, please follow the rules below.

- All authors listed in the manuscript can freely join in the general assembly
- During Zoom meeting, Participants are required to using proper ID indicating the real name
- Please use virtual background which will be share by committee a day before conference
- The attendance form will be shared by the committee during the conference, participants must fill the form to get participant certificate
- Please mute the microphone to avoid noise distraction
- The participants are welcome to ask the question via chatroom with the following format (Name_Affiliation_To Whom_Question)

General Assembly Rundown

Date 25 August 2022

SESSION	TIME (GMT+7)	ACTIVITIES	PERSON IN CHARGE
Opening	07.30-08.00	Registration and preparation	Committee
	08.00-08.05	Opening	MC
	08.05-08.10	Indonesian National Anthem	Committee
	08.10-08.16	Welcome Address	Dean Faculty of Agriculture
	08.16-08.22	Welcome Address	Chief of Research and Community Services Institute
	08.22-08.30	Opening Remarks	UNS-Rector
Invited Speaker 1	08.30-08.35	Preparation and announcements	MC
	08.35-09.15	**Talk of Dr. Serkan Ates**	Moderator
	09.15-09.30	Q n A	Moderator
	09.30-09.35	Closing for Session 1 and remarks	Moderator
Invited Speaker 2	09.35-09.40	Preparation and announcements	MC
	09.40-10.20	**Talk of Assoc. Prof. Ts. Dr Shamsiah Abdullah***	Moderator
	10.20-10.35	Q n A	Moderator
	10.35-10.40	Closing for Session 2 and remarks	Moderator
Invited Speaker 3	10.40-10.50	Preparation and announcements	MC
	10.50-11.30	**Talk of Prof. Ferry Jie**	Moderator
	11.30-11.45	Q n A	Moderator
	11.45-11.50	Closing Session 3 and remarks	Moderator
Break	11.50-13-00	Announcements and break	Committee
Invited Speakers 4 and 5	13.00-13.15	Preparation and announcements	MC
	13.15-13.55	**Talk of Dr. Alexandra Crosby**	Moderator
	13.55-14.35	**Talk of Dr. Andi Setiawan**	Moderator
	14.35-14.50	Q n A	Moderator
	14.50-15.00	Closing remarks	Moderator
Closing	15.00-15.15	Announcements and closing	MC

under confirmation

Oral Presentation Schedule

Room 1. Agricultural Production, Biotechnology and Economics

Date : 24 August 2022
Place : Zoom

Time (GMT+7)	Activities/ID	Title
07.30-08.00	Presenters and participants enter the room	
08.00-08.10	Opening by Room Chair	
08.10-08.17	ID 30	Genetic Variability, Correlation and Path Coefficient among Agronomic Characters of Soybeans [Glycine max (L.) Merr.] Lines *Heru Kuswantoro and Juli Santoso*
08.17-08.24	ID 37	Co-compost Biochar as a Soil Ameliorant for Improving Soil Chemical Properties and Maize Yield in Acidic Upland East Lampung *Neneng Nurida and Jubaedah Jubaedah*
08.24-08.31	ID 45	Efficacy of moringa leaf extract and cow manure to soybean growth and yield *Haryuni, Isnan Yuda Atmaja, Teguh Supriyadi, Sapto Priyadi, Agus Budiyono and Mrihrahayu Rumaningsih*
08.31-08.36	Discussion	
08.36-08.43	ID 72	Phenotype Performance of M1 Generation of Bima Shallot (Allium cepa L. var. Ascalonicum) result of Ethyl Methane Sulfonate induced *Zulfahmi, Dedi Affandi, Mahmuzar, Rosmaina and Gusrinaldi*
08.43-08.50	ID 81	Genetic diversity of strawberry (Fragaria x ananassa) var. Earlibrite mutant as revealed by ISSR molecular marker induced by gamma rays irradiation *Hidayatul Arisah, Darmawan Saptadi, Sumeru Ashari, Dita Agisimanto and Farida Yulianti*
08.50-08.57	ID 82	Screening of simple sequence repeats (SSR) primers from mutated plants from Indigofera zolligeriana *Juwartina Ida Royani, Dudi Hardianto and Tri Handayani*
08.57-09.02	Discussion	
09.02-09.09	ID 105	The effect of giving various doses of KCL fertilizer on the growth and yield of red ginger (Zingiber officinale var. Rubrum) *Supriyono, Ahmad Taufik, Sulandjari and Djoko Purnomo*
09.09-09.16	ID 124	Upland Rice Growth on Giving of Biochar and Organic Fertilizer *Muji Rahayu, Amalia Sakya, Aprilia Nurmalasari and Kartika Aprilya*
09.16-09.23	ID 130	The Effect Of Liquid Organic Fertilizer On Growth And Yield Of Porang (Amorphophallus Muelleri Blume) *Supriyono, Talitha Syahda, Puji Harsono and Sulandjari*
09.23-09.28	Discussion	
09.28-09.35	ID 155	The Use of Biochar and Biofilm Biofertilizer (BiO2) to Increase Rice Yield *Sudadi Sudadi, Tri Wida Rachmadani, Vita Ratri Ratri Cahyani and Slamet Minardi*
09.35-09.42	ID 179	Effects of Different Organic Fertilizers on Growth and Yield Potential of Solanum melongena (Eggplant) *Nur Ikram Aliff Mahamad, Siti Nurul Atikah Abu Samah and Muhammad Noor Azizan Mohd Khidzir*
09.42-09.49	ID 205	Optimisation of Yield on Peanut-Sorghum Intercropping in Dry Land, North Lombok *Akhmad Zubaidi, Dwi Ratna Anugrahwati, Herman Suheri, I Komang Damar Jaya and Suwardji*
09.49-09.54	Discussion	
09.54-10.20	Break	

Abstract ICSAE-IX ID 072

Phenotype Performance of M1 Generation of Bima Shallot (Allium cepa L. var. Ascalonicum) result of Ethyl Methane Sulfonate induced

Zulfahmi[1,3,*], D Affandi[1], Mahmuzar[2], Gusrinaldi[1], and Rosmaina[1,3]

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[2]Faculty of Economic and Social Science, Universitas Islam Negeri Sultan Syarif Kasim Riau, Jl. HR.Soebrantas KM 15 No. 155, Panam, Pekanbaru 28295, Riau, Indonesia
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Abstract. The diversity of crops can be produced via mutagen induction. Ethyl methane sulfonate is a chemical mutagen which often applied to increase variability in the crop including shallot. The purpose of this study was to investigate the phenotype performance of Bima varieties of Shallot (*Allium cepa* var Ascalonicum) result of an Ethyl Methane Sulfonate induced. This study used a randomized complete block design, with the treatment of five levels of EMS concentrations. Data obtained were analyzed of variance and if EMS treatment was significant difference that will proceed to Duncan Multiple ranged Test. The present study found that EMS treatment was significantly different for all parameters ($p < 0.05$). The first generation (M1) of Bima shallot exhibited a gradual decrease in growth vegetative and yield with the increasing of EMS concentration than control. The reduction of these parameters may be caused by genetic changing and physiologically damage as consequences of EMS treatments. Among EMS treatments, the concentration of 100 ppm displayed a higher value for all parameters compared to 200, 300, and 400 ppm of EMS. The result of this study can be utilized as a source of genetic material in plant breeding activities to produce a high-quality variety in the future.

Keywords: Shallot, Morphology, Mutation, Breeding

CERTIFICATE

This is to certify that

Dr. Zulfahmi, M.Si.

has participated as ***"PRESENTER"*** at the **9th International Conference on Sustainable Agriculture and Environment (ICSAE-IX)**

24-25 August 2022 | Surakarta, Indonesia

Vice Rector
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Prof. Dr. Ir. Ahmad Yunus, M.S.
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Chairman of ICSAE-IX

Dr. agr. Ir. Sigit Prastowo, S.Pt., M.Si., IPM., ASEAN Eng.
(Universitas Sebelas Maret)

CERTIFICATE

This is to certify that the following paper titled

Phenotype Performance of M1 Generation of Bima Shallot (Allium cepa L. var. Ascalonicum) result of Ethyl Methane Sulfonate induced

authored by

Zulfahmi, D Affandi, Mahmuzar, Rosmaina and Gusrinaldi

has been **presented** at the **9th International Conference on Sustainable Agriculture and Environment (ICSAE-IX)**

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(Universitas Sebelas Maret)

The 9th International Conference on Sustainable Agriculture and Environment (ICSAE-9)

The 9th International Conference on Sustainable Agriculture and Environment (ICSAE-9)

24-25 August, 2022
Surakarta, Indonesia

This conference was held by
Research and Development Centre for Biotechnology and Biodiversity (P3BB) Universitas Sebelas Maret
in collaboration with:
Indonesia Diaspora Network - United
Faculty of Agriculture, Universitas Sebelas Maret, Indonesia
Faculty of Art and Design, Universitas Sebelas Maret, Indonesia
Faculty of Economic and Business, Universitas Sebelas Maret, Indonesia

Brief of the meeting

International Conference on Sustainable Agriculture and Environment, abbreviated ICSAE, is a circuit meeting held since 2013. This conference is internationally recognized around the globe for its topic on sustainable agriculture and the environment. As we know, agriculture and the environment are essential for human beings, especially for food resources and other materials needed. It's also not just about food, agriculture, and the environment are involved in economics, politics, design, and many related areas. This year, on August 24-25, 2022, this conference is held online in Surakarta, Indonesia, and is known as ICSAE-9. Sustainable is the keyword in agricultural and environmental management to assure global food security and maintain the high quality of human life. Accordingly, this conference is held to identify ideas, practices, and policies that constitute our concept of sustainable agriculture and the environment. We aim to provide a platform for researchers, academics, and practicing professionals worldwide to present their research and professional development activities in agriculture, environment, food, and other relevant subjects.

Two years of the Covid-19 pandemic circumstances have taught us that the online method of delivering the conference effectively broadens the conference participant and disseminates the result. In ICSAE-9, we invite speakers to share their valuable information and knowledge. All the presentation mechanism was done by using the Zoom meeting online platform. There were 4 plenary sessions, 6 rooms for participants to present their specific topics, and a poster session. The ICSAE-9 received 162 papers presented virtually in oral and poster format. Per the presenter, the oral format was allocated for 10 minutes and 5 minutes Q n A, while the posters were presented digitally through the ICSAE website. To be more flexible, all the presentations from the presenter were recorded and uploaded to YouTube. Hence participants (commonly the non-registered ones) that can't attend life can see the presentation in their flexible time. This is also the solution for the participants who don't have a proper internet connection.

At last, we would like to thank all the committee and all the participants for their contribution to the ICSAE-9. We do hope we can meet again in the future meeting.

ICSAE-9 Chair

List of committees

Steering Committee
- Ahmad Yunus. Faculty of Agriculture, Universitas Sebelas Maret, Indonesia
- Samanhudi. Faculty of Agriculture, Universitas Sebelas Maret, Indonesia
- Sri Hartati. Faculty of Agriculture, Universitas Sebelas Maret, Indonesia

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Peer Review Statement

To cite this article: 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1114** 011002

Peer Review Statement

All papers published in this volume have been reviewed through processes administered by the Editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal published by IOP Publishing.

1. Type of peer review: Single anonymous
2. Conference submission management system: Morressier
3. Number of submissions received: 162
4. Number of submissions sent for review: 161
5. Number of submissions accepted: 110
6. Acceptance Rate (Submissions Accepted / Submissions Received × 100): 67.9 %
7. Average number of reviews per paper: 1.03
8. Total number of reviewers involved: 18
9. Contact person for queries:
   Name: Dr. Sigit Prastowo
   Affiliation: Universitas Sebelas Maret
   Email: prastowo@staff.uns.ac.id

Phenotype performance of M1 generation Bima Shallot (*Allium cepa* var ascalonicum) result of Ethyl Methane Sulfonate induced

Phenotype performance of M1 generation Bima Shallot (*Allium cepa* var ascalonicum) result of Ethyl Methane Sulfonate induced

Zulfahmi[1,3]*, D Affandi[1], Mahmuzar[2], Gusrinaldi[1], and Rosmaina[1,3]

[1]Department of Agrotechnology, Faculty of Agriculture and Animal Science, Universitas Islam Negeri Sultan Syarif Kasim Riau, Jl. HR.Soebrantas KM. 15 No. 155, Simpang Baru, Panam, Pekanbaru 28295, Riau, Indonesia
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Abstract. The diversity of crops can be produced via mutagen induction. Its result can be utilized as a source of genetic material in the plant breeding activities to produce a high-quality variety. The purpose of this study was to investigate the phenotype performance of Bima varieties of Shallot (*Allium cepa* var ascalonicum) result of Ethyl Methane Sulfonate induced. This study used a randomized complete block design, with the treatment of five levels of EMS concentrations. Data obtained were analyzed of variance and if EMS treatment was significant difference that will be proceeded to Duncan Multiple ranged Test. The present study found that EMS treatment differed significantly for all parameters ($p< 0.05$). The first generation of Bima shallot exhibited growth inhibition and decrease of yield with increasing of EMS concentration than control. The reduction of these parameters may be caused by genetic changing and physiologically damage as consequences of EMS treatments. The EMS treatment 0f 100 ppm displayed a higher value for all parameters compared to 200, 300, and 400 ppm of EMS.

1. introduction

Shallots are one of the important horticultural crops in Indonesia after chili and tomato. Shallot is needed by the people for cooking, spices, vegetables, and medicines. The high demand and unstable production of shallot due to abiotic stresses and pests and diseases caused shallot prices to be fluctuated, it about is Rp 20.000 – 80.000 /kg. In Riau Province, the shallot of the Bima variety has been cultivated by many farmers and has good adaptation compared to other varieties, even though the production is still not yet optimal. According to the Central Bereau of Statistics of Riau Province [1], the mean productivity of shallots was around 4 tons/ha, while the average national productivity is 9.5 tons/ha. Therefore, increasing the shallot productivity must be implemented via the improvement of cultivation practices and genetic quality of bulb for planting materials.

Shallots are generally propagated vegetatively by bulbs, so genetic material generated tends to have relatively narrow genetic diversity. The availability of genetic material with narrow diversity particularly will limit selection in breeding activities. So, expand the genetic variability of shallots is required. Increasing the genetic diversity of the shallot can be done through the induction of physical and chemical mutagens, as applied by [2, 3, 4, 5]. Ethyl methanesulfonate (EMS) is a generally used chemical mutagen in plant breeding that can cause point mutations with higher frequency and produce genetic variation from which desired mutant may be selected.

EMS induces alkylation of guanine, and induces nucleotide substitution or base change, which consequently changes the codon sequence; because the G pair is alkylated, resulting in a GC to AT transition, this transition occurs due to alkylation at the O_6 position of the guanine [6]. EMS as a mutagen has been reported influence the morphology, anatomy, physiology and biochemistry of plant, depend on concentration of EMS. Many studies reported that increasing of MS concentration caused gradually reduction of plant morphology such as reported in rapeseed [7], *Chrysanthenum indicum* var. Aromaticum [8], and Okra [9]. This study aimed to observe the phenotype performance of the Bima variety of shallots result of Ethyl methane sulfonate induced.

2. Material and methods

2.1. Shallot collection and experimental design

Bima shallot was obtained from local agriculture shop. The experiment was arranged in following random complete block design (RCBD) with four treatments, e.g. 0 ppm, 100 ppm, 200 ppm, 300 ppm, and 400 ppm of Ethyl methane sulfonate (EMS) and 12 replications. Health bulbs were presoaked in EMS liquid according to concentration above for four hours to allow uptake of EMS mutagens. Untreated bulbs was used as a control treatment. The treated and control bulbs were planted on well prepared plots. The plot size was 1.0 m long and 0.90 m wide, consisting of three row per plot. The bulbs was planted at spacing 20 x 20 cm between rows and plants, respectively. Organic fertilizer was applied at rate 10 ton ha^{-1} two week before planting. Nitrogen, phosphorous, and Kalium were applied in form NPK fertilizer, with dose five gram per week during one month. All the other management practice were uniformly applied to all plots.

2.2. Observation parameters.

The plant height, number of leaves, number of tiller, bulbs diameter, bulbs weight, fresh bulbs weight per clump, dry bulbs weight per clump were measured with following IPGRI guidance [10].

2.3. Data Analysis

Data obtained were analyzed by one way ANOVA while Duncan's multiple range test at significant different level of 0.05 and 0.01was used for the comparisons among the means of treatments. All analysis used SAS 9.1 Software

3. Results and discussion

The results of the variance analysis showed that the EMS concentrations were highly significant different in all tested parameters ($P< 0.001$), as shown in Table 1. This indicated that EMS treatment was powerful mutagen in inducing mutation and creating genetic variability in shallot of Bima variety. Our results were similar to Joshi et al. [2] and Singh et al. [11], who obtained the same result in onion cultivar when using EMS mutagen.

Table 1. Mean square of variance analysis on the effect of EMS treatment on shallot of Bima variety

Source of variation	df	Plant Height	Number of Leaves	Number of Tillers	Bulbs Diameter	Bulbs Weight	Bulbs Fresh Weight/Clump	Bulbs Dry Weight/Clump
Treatment	4	462.19 ***	511.09 ***	21.26 ***	256.79 ***	76.91 ***	3438.46 ***	3287.40 ***
Block	2	5.67	121.70	6.72	9.22	2.49	638.95	481.53

Note : *** indicated significant different at $P < 0.001$.

Plant height exhibited significant differences among treatments (Figure 1). The data revealed that there was no significant difference in plant height for 100 ppm, 200 ppm, 300 ppm and 400 ppm. The highest plant height value was observed in control treatment and tended to decrease with increasing EMS concentration. The percentage reduction in plant height ranged from 21.81-27.73% compared to control (Figure 1). EMS concentration of 400 ppm displayed the highest percentage reduction.

The number of leaves showed significant differences among treatments (Figure 2). The data displayed that control was significant difference in the number of leaves with 100 ppm, 200 ppm, 300 ppm and 400 ppm. The highest number of leaves value was obtained in the control treatment and

decreased gradually with increasing EMS concentration. The percentage reduction in the number of leaves varied from 25.48-37.28% compared to control (Figure 2). EMS concentration of 400 ppm exhibited the highest percentage reduction, followed by 300 ppm of EMS treated.

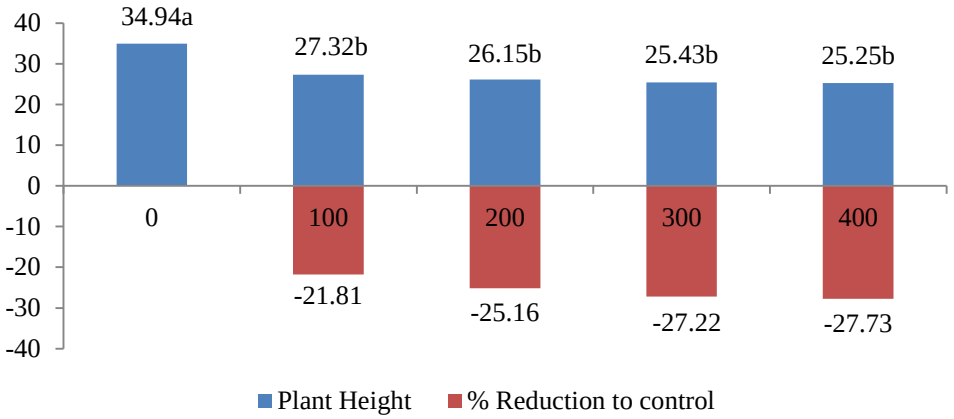

Figure 1. The average value and percentage of reduction of plant height at EMS treatment and control plants.

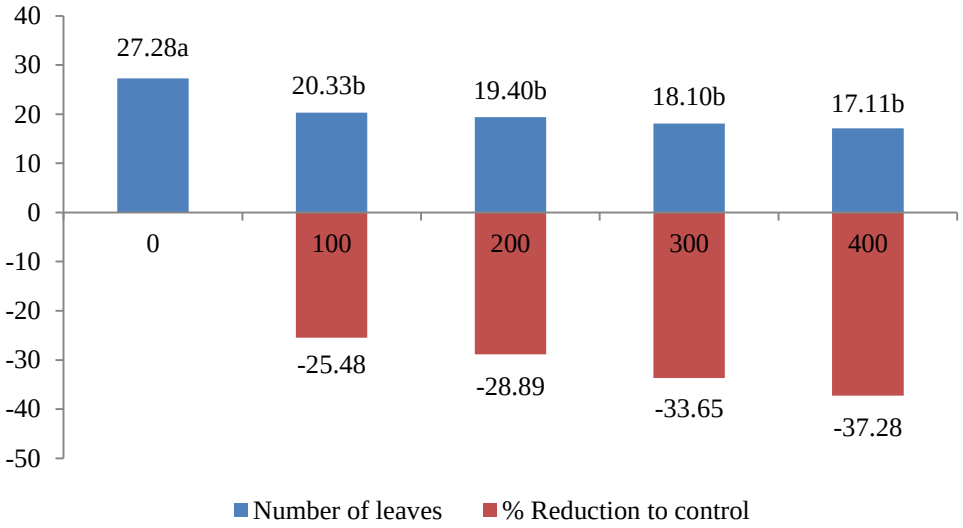

Figure 2. The average value and percentage of reduction of the number of leaves at EMS treatment and control plants.

The number of tillers exhibited significant differences among treatments (Figure 3). The data revealed that there was no significant difference in the number of tillers for control, 100 ppm, and 200 ppm, as well as 400 ppm and 300 ppm and 200 ppm. The highest number of tiller values was observed in the control treatment and tended to decrease with increasing EMS concentration. The percentage decreases in the number of tillers varied from 11.57-35.58% compared to control (Figure 3). The highest reduction in the number of tillers was obtained in the EMS concentration of 400 ppm, followed by 300 ppm.

The bulbs diameter was significant differences among treatments (Figure 4). The data revealed that there was no significant difference in the bulbs diameter for 100 ppm and 200 ppm, as well as 300 ppm and 400 ppm of EMS concentration. The highest bulbs diameter values found in the control treatment and tended to decrease with increasing EMS concentration. The percentage reduction in the number of tillers varied from 24.87-39.01% compared to control (Figure 4). The highest reduction in

the bulbs diameter was obtained in the EMS concentration of 400 ppm (39.01%), followed by 300 ppm (38.25%).

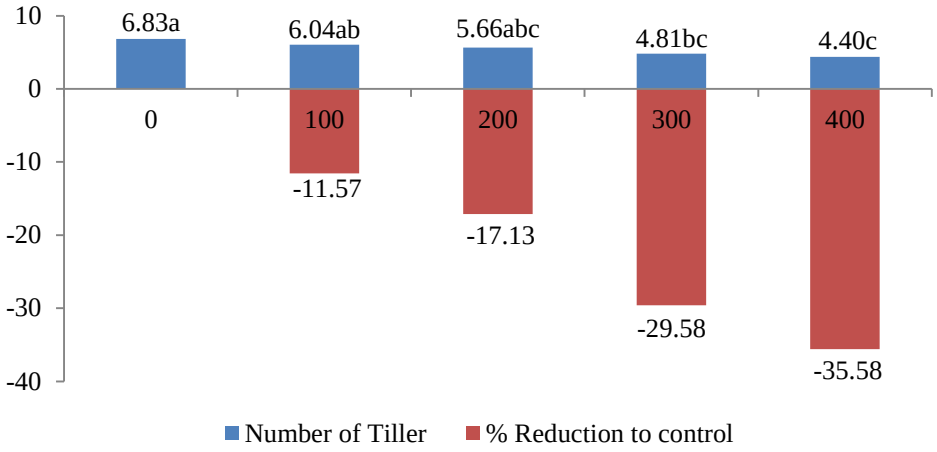

Figure 3. The average value and percentage of reduction of the number of tillers at EMS treatment and control plants.

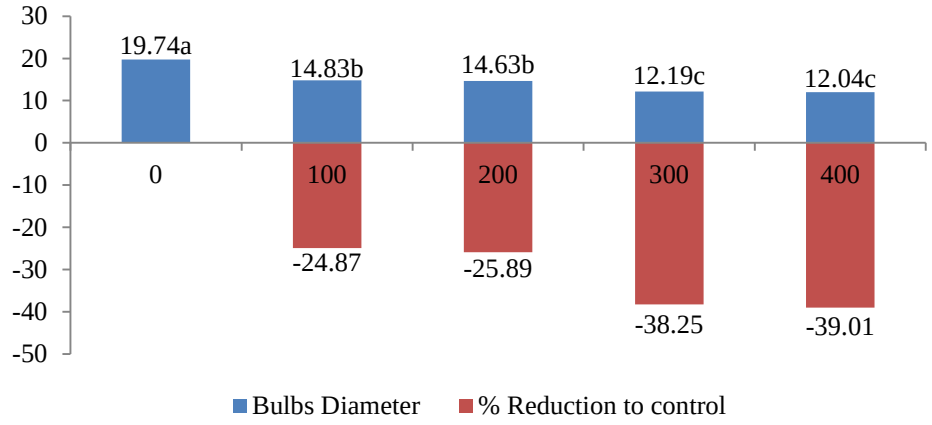

Figure 4. The average value and percentage of reduction of bulbs diameter at EMS treatment and control plants.

The bulbs weight exhibited significant differences among treatments (Figure 5). The data showed that there was no significant difference in bulbs weight for 100 ppm, 200 ppm, and 300 ppm as well as 200 ppm, 300 ppm and 400 ppm of EMS concentration. The highest bulbs weight values was observed in the control treatment and decreased gradually with increasing EMS concentration. The percentage reduction in the bulbs weight ranged from 50.68-69.11% compared to control (Figure 5). The highest reduction in the bulbs weight was obtained in the EMS concentration of 400 ppm (69.11%), followed by 300 ppm (67.41%).

The bulbs fresh weight per clump and bulbs dry weight per clump showed significant differences among treatments (Figure 6 and 7). The data showed that there was no significant difference in the bulbs fresh weight per clump and bulbs dry weight per clump for 100 ppm, 200 ppm, and 300 ppm as well as 200 ppm, 300 ppm and 400 ppm of EMS concentration. The highest bulbs fresh weight per clump and bulbs dry weight per clump were observed in the control treatment, e.g. 39.94 g and 36.52 g, respectively, as well as decreased gradually with increasing EMS concentration. The lower bulbs fresh weight per clump and bulbs dry weight per clump were obtained in the 400 ppm treatment, e.g. 10.33 g and 8.22 g, respectively. The percentage decreases in the bulbs fresh weight per clump and bulbs dry weight per clump ranged from 50.65-74.14% and 54.57-77.49%, respectively, compared to

control (Figure 6 and 7). the highest reduction in both parameters was obtained in the EMS concentration of 400 ppm.

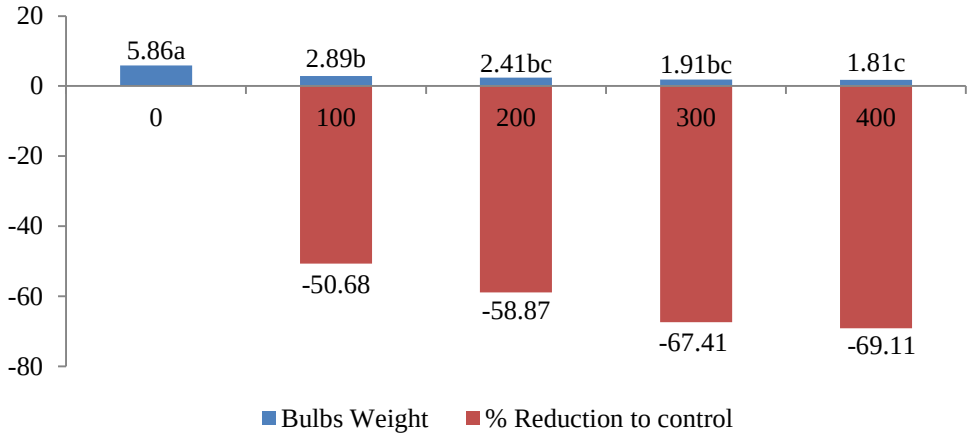

Figure 5. The average value and percentage of reduction of bulbs weight at EMS treatment and control plants.

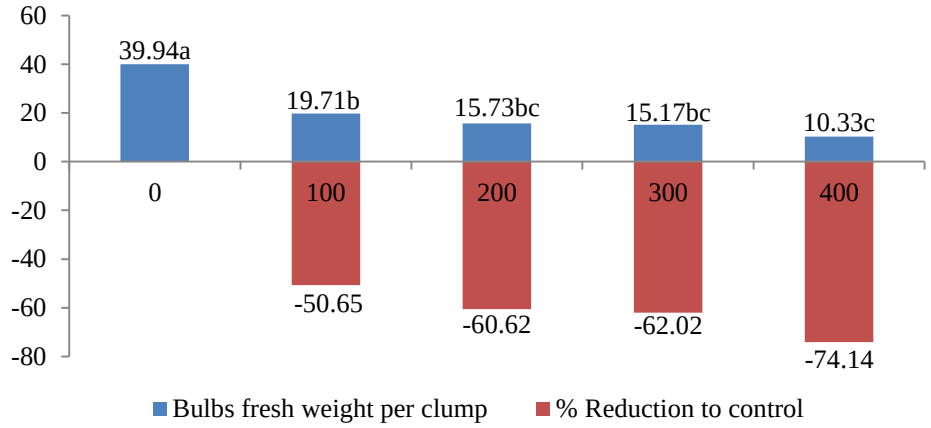

Figure 6. The average value and percentage of reduction of bulbs fresh weight per clump in EMS treatment and control plants.

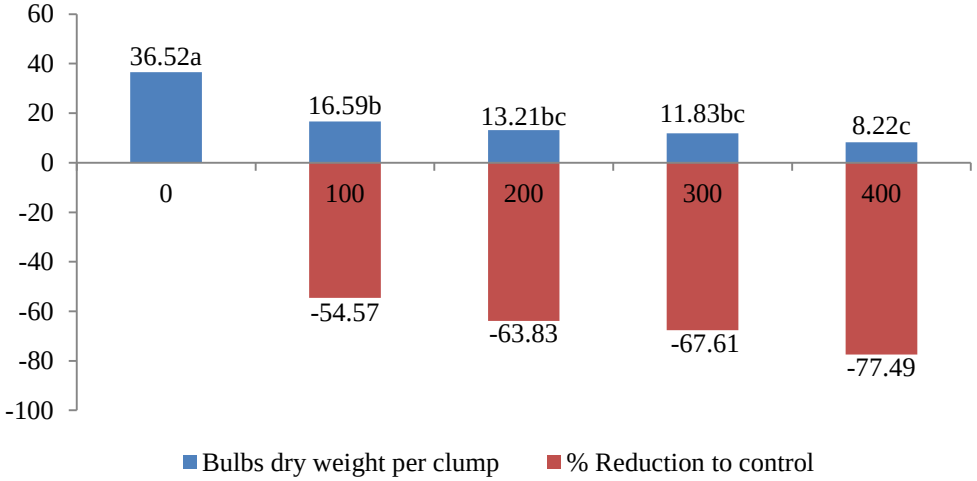

Figure 7. The average value and percentage of reduction of bulbs dry weight per clump at EMS treatment and control plants.

In the present study, all growth parameters like plant height, the number of tillers, and the number of leaves decreased gradually with increasing of EMS concentrations when compared to control. Our results were in agreement with Singh et al. [11], who found the reduction in plant height and number of leaves in garlic with increasing concentration of EMS. The reduction of growth parameters may be caused by a mutation in the DNA base due to alkylating of guanine base resulting in primarily G/C to A/T transitions, then alter amino acid generated, occurring trouble physiologically and the droop in auxin level so that cell differentiation is inhibited. On the other hand, an increase in the EMS concentration caused deleterious effects on the plant biological activities which might be due to the inactivation of cells because of mitotic disturbances or chromosomal aberrations at higher doses of EMS, leading to poor growth of the plants [12]. The reduction of plant height and the number of tillers have been also reported in other species when used EMS mutagen, such as in Basmati rice [13], *Sesamum indicum* [14], and *Polianthes tuberosa* [12].

In the M1 generation, all treated EMS revealed that bulbs diameter, bulbs weight, bulbs fresh weight per clump, and bulbs fresh weight per clump characters were progressively decreased with increasing dose of EMS when compared to control. It may be caused by the percentage mitotic abnormalities gradually increased with increasing concentrations of mutagens [15]. The similar result were reported by Badawi et al. [16] in potato, which number of tubers/plant, and total tubers weight/plant were decreasing by the increasing of EMS concentration. Bulbs diameter and bulbs weight of garlic were reported to be inconsistent with the increase chemical mutagens [17]. Fresh weight of bulbs and fresh weight of bulbs in garlic tend to increase with increasing concentration of physical mutagens [18].

4. Conclusion

The EMS concentration decreased the plant height, the number of leaves, bulbs diameter, bulbs weight, bulbs fresh weight per clump, and bulbs dry weight per clump compared to control plants. The EMS treatment of 100 ppm displayed a higher value for all parameters compared to 200, 300, and 400 ppm of EMS.

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