Mutagenesis technology ethyl Methane Sulfonate (EMS) and cow manure application interval on growth and production cucumber (Cucumis sativa L.)

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ABSTRACT

This research aims to determine the effect of mutation induction of Ethyl Methane Sulfonate (EMS) and the time interval for applying cow manure to increase cucumber growth and yield. The research was conducted in the experimental field of the Faculty of Agriculture, Universitas Pembinaan Masyarakat Indonesia, Jalan Balai Desa Marindal II Pasar 12 Medan from June to September 2023. The research used a factorial Randomized Block Design, consisting of the first factor of the EMS induction application with 3 levels, namely E0 (without EMS as control), E1 (concentration 0.50%), E2 (concentration 0.70%), and the second factor was the provision of 2.4 kg cow manure compost/plot with 3 levels, namely I0 (no cow manure), I1 (1-week interval after planting), and I2 (2-week interval after planting). The parameters observed in this study included plant height (cm), flowering age (DAT), fruit weight persample (kg), and fruit weight perplots (kg). Diversity analysis used the ANOVA test and, if significantly different, continued with Duncan's Multiple Range Test (DMRT) at the 5% level. The research results showed that the EMS concentration at 12 WAP had a very significant effect on plant height, flowering age, fruit weight per sample, and fruit weight per plot, and the best EMS concentration was E2 (0.70%) by soaking the seeds for 3 hours. Two MST cow manure of 2.4 kg/plots had a very significant effect on plant height, flowering age, fruit weight persample, and fruit weight perplots. The interaction of the EMS mutation induction treatment and the dose of cow manure on cucumber plants had a very significant effect on plant height, flowering age, fruit weight per sample, and fruit weight per plot. Combination of E2I2 (0.70% immersion for 3 hours plus 2 WAP intervals at a dose of 2.4 kg/plots).

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1. INTRODUCTION

Mentimum is a family of cucurbitacea originating from North Asia and is famous throughout the world. This plant is included in the category of annuals that grow by creeping and can be planted in low or high altitudes with an altitude ranging from 0-1000 m above sea level (Febriani *et al.,* 2021). Cucumber has properties to treat canker sores, kidney stones, hypertension and facial care. The nutritional content per 100 g of cucumbers consists of 15 calories, 0.8 g of protein, 3 g of carbohydrates, 30 mg of phosphorus, 0.5 mg of iron, 0.02 thianin, 0.01 mg of riboflavor, 14 mg of acid, 0.3 mg of vitamin A, 0.3 mg of vitamin B1, 0.02 mg of vitamin B2 and 8.0 mg of vitamin C (Maizar, 2013). The low calorie content of cucumbers and abundant water in the fruit make cucumbers rich sources of vitamin C and flavonoids that function as antioxidants (Rini *et al.,* 2023).

Based on data compiled from the Central Statistics Agency (2018) cucumber production in Indonesia for 4 years has decreased, namely in 2014 by 477,989 tons, in 2015 by 447,696 tons, in 2016 by 430,218 tons, and in 2017 by 424,918 tons (BPS, 2018). Furthermore, cucumber production in North Sumatra province based on data from the Central Bureau of Statistics of North Sumatra (2018) in 2017 was 30,618 tons, in 2018 it was 27,547 tons, in 2019 it was 22,430 tons and in 2020 cucumber production was 24,628 tons (BPS, 2022). National and North Sumatran cucumber production looks fluctuating. It is suspected that there is still ineffective cucumber cultivation in Indonesia caused by several factors, namely the decline in soil quality caused by the use of inorganic materials, genes, and cucumber growth that is still not appropriate (Febriani *et al.,* 2021).

InSumarsono &; Sumekar, (2022) suggests that mutagenesis is an overhaul of the genetic makeup carried out by plants so that plants are expected to provide a superior genetic makeup in increased growth, disease resistance and increased plant production.

Mutation is a breeding activity that is useful for expanding the genetic diversity of a plant and with directed selection obtained the expected mutants. Mutase consists of natural and artificial mutases. Artificial mutase (induction) can be performed using physical mutagens or chemical mutagens. Chemical mutagens that are often used are: *Ethyl Methane Sulfonate* (EMS). EMS is widely used to induce some houseplants such as Kerk lily (Rolenti Togatorop *et al.,* 2016).

In addition to using the mutagenesis method, increasing production can also be done by providing organic matter to improve soil structure and provide additional nutrients. Organic fertilizer is fertilizer derived from organic waste that has gone through a decomposition process. According to Rahmadina (2019), that the application of organic matter as organic fertilizer can increase nutrients, increase chemical, physical capabilities and increase soil microbial activity. According to Rinaldi *et al.,* (2021), organic fertilizer is the most effective fertilizer to overcome dry land conditions because it contains a number of essential nutrients, namely elements N, P, K, other sources of elements such as C, Zn, Cu, Mo, Ca, Mg, and Si, and can improve the chemical, physical, and biological properties of the soil. On the other hand, organic fertilizers also have several disadvantages including having to go through the process of mineralization and immobilization of nutrients, so that nutrients are slowly available to plants (Gusmiatun &; Marlina, 2018). According to Risal (2020), macronutrient needs in the cultivation process of curly onion plants can be met by using cow dung compost containing 0.40-2% N, 0.20-0.50% P and 0.10-1.5% K.

Based on the information above, the author is interested in conducting a study entitled Mutagenesis Technology (*Ethyl Methane Sulfonate*) and Intervals of Cow Manure Application to the Growth and Production of Cucumbers (*Cucumis Sativa* L.).

2. METHOD

This research uses a quantitative experimental approach. Experimentation is a quantitative research method used to determine the effect of treatment on plant growth under controlled conditions. In order for conditions to be controlled, experimental research uses control plants and often experimental research is carried out in the laboratory and in the field.

The research was carried out in the agricultural experimental garden of Universitas Pembinaan Masyarakayat Indonesia (UPMI), Jl. Balai Desa Marindal II Pasar 12 Medan. The study will be conducted from June to September 2023. The ingredients used in this study consisted of cucumber seeds of Zatavy F1 variety, *Ethyl Methane Sulfonate* (EMS), aquades, cow manure. The tools used consist of: cotton, label paper, digital cameras, hoes, machetes, tape meters, scales, bamboo, and treatment boards, handsprayer, drills, tape measure, molten paper, rope, cotton, research labels, bamboo, analytical scales, and stationery.

This study used a Factorial Group Random Design consisting of 2 factors, namely: Factor 1. EMS concentration (E) with 3 treatment levels

E0 = without EMS (control)
E1 = 0.50% EMS concentration
E2 = 0.70% EMS concentration

Factor 2. Giving cow manure interval dose of 2.4 kg / plot with 3 treatment levels

I0 = Without cow manure

I1 = interval 1 week after planting (1 MST)

I2 = interval of 2 weeks after planting (2 MST)

Data collection techniques are carried out by observing the growth and production of cucumber plants and measuring directly. Observation variables include: plant height (cm), flowering age (days), fruit weight per sample (kg), and fruit weight per plot (kg).

Data analysis for the fingerprint test is used to test the effect of treatment on the tested parameters. If it shows a real effect, then a further test is carried out with Duncan's Multipe Range Test (DMRT) at a significance level of 95%.

3. RESULTS AND DISCUSSION

The results of data analysis using the Group Random Design (RAK) method are contained in a list of fingerprints for several parameters observed, namely: (1) Plant height aged 4, 8, 12 MST; (2) Flowering age (days); (3) Sample fruit weight (kg) age 12 MST; and (4) Fruit weight per plot (kg) age 12 MST.

3.1 Application of EMS concentration to cucumber crop production

3.1.1 Plant height (cm)

The application of EMS concentration was able to increase the height growth of plants whose observations were carried out at the age of 4, 8, and 12 MST.

Table 1. Average Height of Plants Aged 4, 8, 12 MST Given EMS Concentration

EMS Concentration (E)	Plant height (cm)		
	4 MST	8 MST	12 MST
E0 (0%)	14.53 b	57.39 C	152.92 C
E1 (0.50%)	15.41 b	67.08 b	173.98 b
E2 (0.70%)	17.07 a	81.87 a	185.98 a

Noted : Numbers followed by unequal lowercase letters in the column show a very noticeable difference at the 5% test level (DMRT)

Table.1 shows the application of EMS concentration in E2 treatment (0.70%) had a very significant effect on plant height of 185.98 cm compared to E1 (0.50%) 173.98 cm and E0 (control) 152.92 cm for an observation age of 12 MST (weeks after planting). This situation also had the same effect on the age of previous observations, namely 4 and 8 MST. The relationship of these results is in the figure below:

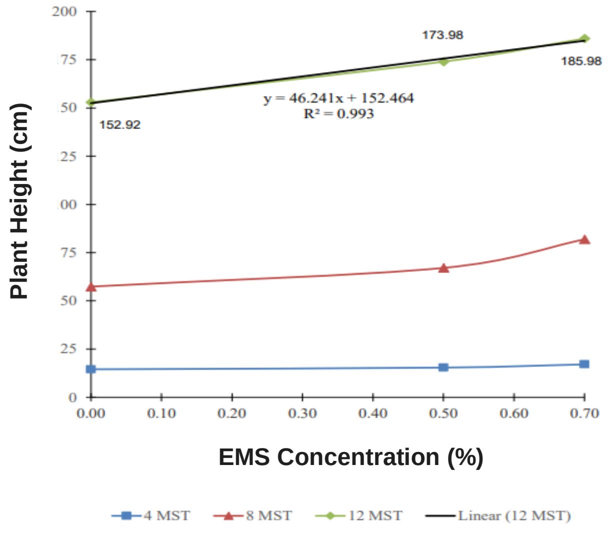

Figure 1. High Response of Plants Aged 4, 8, 12 MST Given EMS Concentration

Based on Figure 1 at the observation age of 12 MST shows a positive linear relationship between plant height (y) cm and EMS concentration (x) % with regression equation:

$$y = 46.241x + 152.464 ; R^2 = 0.993$$

Application of 0.70% EMS concentration yields the largest average plant height and without EMS produces the smallest average plant height.

3.1.2 Flowering Age (days)

The application of EMS concentration was able to increase the growth of flowering life with the average appearance of the first flowers at 28.26 HST (28 HST).

Table 2. Average Flowering Age Given EMS Concentration

EMS Concentration (E)	Flowering age (days)
E0 (0%)	25.06 C
E1 (0.50%)	27.07 b
E2 (0.70%)	28.26 a

Noted : Numbers followed by unequal lowercase letters in columns showed a very noticeable difference at the 5% test level (DMRT)

Table 2 shows the application of EMS concentration in E2 treatment (0.70%) had a very significant effect on flowering age of 28.26 HST compared to E1 (0.50%) 27.07 HST and E0 (control) 25.06 HST. The relationship of these results is in the figure below:

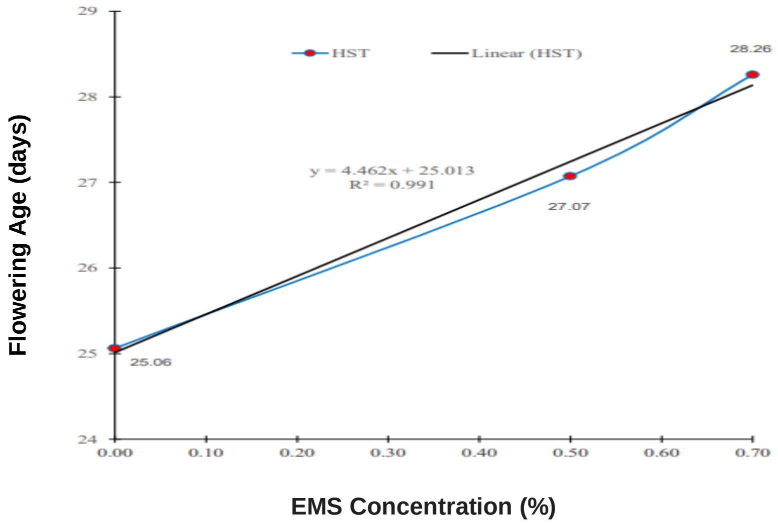

Figure 2. Flowering Age Response Given EMS Concentration

Figure 2 shows a positive linear relationship between flowering age (y) days and EMS concentration (x) % with regression equation:

$$y = 4.462x + 25.013 ; R 2 = 0.991$$

Application of 0.70% EMS concentration yields the largest average flowering age and without EMS results in the smallest flowering age.

3.1.3 Sample fruit weight (kg)

The application of EMS concentration was able to increase the growth of fruit weight per sample whose observations were carried out at the age of 12 MST.

Table 3. Average Weight of Fruit Per Age Sample 12 MST Given EMS Concentration

EMS Concentration (E)	Sample fruit weight (kg)
E0 (0%)	0.431 c
E1 (0.50%)	0.711 b
E2 (0.70%)	0.881 a

Noted: Numbers followed by unequal lowercase letters in the column show a very noticeable difference at the 5% test level (DMRT)

Table.3 above shows the application of EMS concentration in E2 treatment (0.70%) has a very significant effect on the weight of the sample fruit 0.881 kg compared to E1 (0.50%) 0.711 kg and E0 (control) 0.431 kg. The relationship of these results is in the figure below:

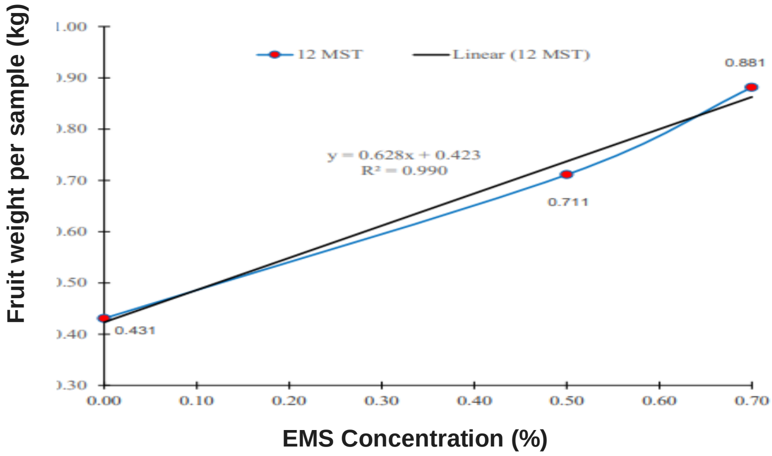

Figure 3. Graph Of The Average Number Of Fruits Against Bokashi Fertilizer Application

Based on Figure 3 at the observation age of 12 MST shows a positive linear relationship between the weight of the sample fruit (y) kg and the concentration of EMS (x) % with the regression equation:

$$y = 0.628x + 0.4235 ; R^2 = 0.990$$

The application of 0.70% EMS concentration produces the largest average sample fruit weight and without EMS produces the smallest average sample fruit weight.

3.1.4 Sample fruit weight (kg)

The application of EMS concentration was able to increase the growth of fruit weight per plot whose observations were carried out at the age of 12 MST. The whole plant is weighed all its fruits in one plot.

Table 4. Average Fruit Weight Per Plot Aged 12 MST Given EMS Concentration

EMS Concentration (E)	Fruit weight per plot (kg)
E0 (0%)	0.767 c
E1 (0.50%)	1,315 b
E2 (0.70%)	1,727 a

Remarks : Numbers followed by unequal lowercase letters in the column show a very noticeable difference at the 5% test level (DMRT)

Table.4 above shows the application of EMS concentration in E2 treatment (0.70%) has a very significant effect on fruit weight per plot of 1.727 kg compared to E1 (0.50%) 1.315 kg and E0 (control) 0767 kg. The relationship of these results is in the figure below:

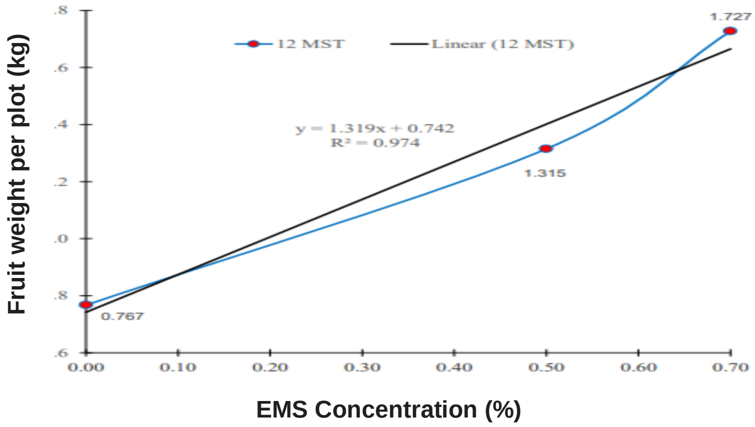

Figure 4. Fruit Weight Response Per Plot Aged 12 MST Given EMS Concentration

Based on Figure 4 at the observation age of 12 MST shows a positive linear relationship between fruit weight per plot (y) kg and EMS concentration (x) % with regression equation:

$$y = 1.319x + 0.742 \; ; \; R^2 = 0.974$$

The application of 0.70% EMS concentration yielded the largest average fruit weight per plot and without EMS produced the smallest average fruit weight per plot.

3.2 Application of cow manure intervals to the yield of cucumber crops

3.2.1 Plant height (cm)

The application of cow manure intervals was able to increase the height growth of plants whose observations were carried out at the age of 4, 8, and 12 MST.

Table 5. Average Height of Plants Aged 4, 8, 12 MST Fed With Cow Manure Intervals

Cow manure interval (I)	Plant height (cm)		
	4 MST	8 MST	12 MST
I0 (0 MST)	14.58 b	58.30 C	159.24 C
I1 (1 MST)	15.63 AB	67.50 b	171.82 b
I2 (2 MST)	16.81 a	80.55 a	181.83 a

Noted : Numbers followed by unequal lowercase letters in the column show a very noticeable difference at the 5% test level (DMRT)

Table.5 above shows that the application of cow manure interval in I2 treatment (2 MST) had a very significant effect on plant height of 181.83 cm compared to I1 (1 MST) 171.82 cm and I0 (control) 159.24 cm for an observation age of 12 MST. This situation also had the same effect on the age of previous observations, namely 4 and 8 MST. The relationship of these results is in the figure below:

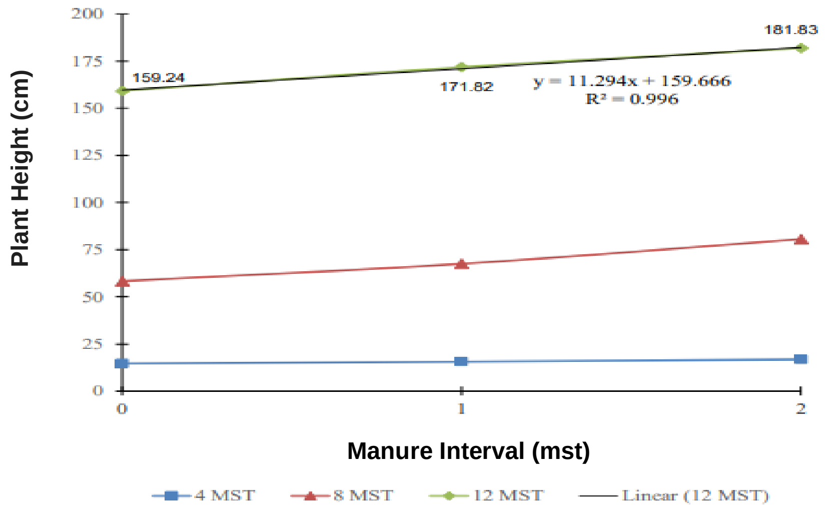

Figure 5. High Response of Plants Aged 4, 8, 12 MST Fed With Cow Manure Intervals

Based on Figure 5 at the observation age of 12 MST shows a positive linear relationship between plant height (y) cm and cow manure interval application (x) MST with regression equation:

$$y = 11.294x + 159.666 \; ; \; R^2 = 0.996$$

The application of cow manure intervals of 2 MST yielded the largest average plant height and cow manure yielded the smallest average plant height.

3.2.2 Flowering age (days)

Applying cow manure intervals can increase the growth of flowering age with the average appearance of the first flowers at 28.56 HST or 28 HST.

Table 6. Average Flowering Age Given Intervals of Cow Manure

Cow manure interval (I)	Flowering age (days)
I0 (0 MST)	24.81 C
I1 (1 MST)	27.03 b

I2 (2 MST)	28.56 a

Remarks : Numbers followed by unequal lowercase letters in the column show a very noticeable difference at the 5% test level (DMRT)

Table.6 above shows that the application of cow manure intervals in I2 treatment (2 MST) had a very noticeable effect on flowering age of 28.56 HST compared to I1 (1 MST) 27.03 HST and I0 (control) 24.81 HST. The relationship of these results is in the figure below:

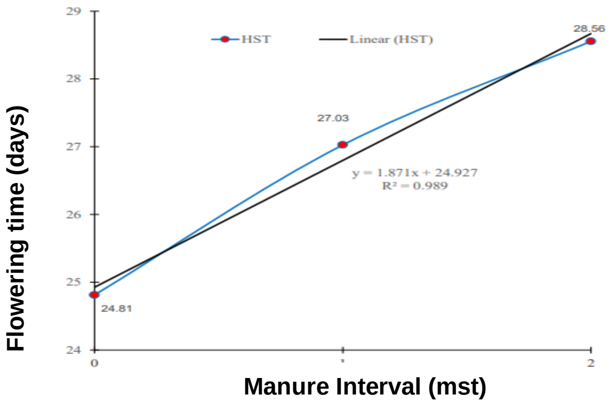

Figure 6. Flowering Age Response Given Cow Manure Intervals

Figure 6 shows a positive linear relationship between flowering age (y) days and cow manure interval (x) MST with regression equation:

$$y = 1.781x + 24.927 ; R 2 = 0.989$$

Applying cow manure intervals of 2 MST yielded the largest average flowering age and without fertilizer yielded the smallest average flowering age.

3.2.3 Sample fruit weight (kg)

The application of cow manure intervals was able to increase the growth of fruit weight per sample whose observations were carried out at the age of 12 MST.

Table 7. Average Weight of Fruit Per Age Sample 12 MST Given Cow Manure Interval

Cow manure interval (I)	Sample fruit weight (kg)
I0 (0 MST)	0.609 b
I1 (1 MST)	0.688 a
I2 (2 MST)	0.726 a

Noted: Numbers followed by unequal lowercase letters in the column show a very noticeable difference at the 5% test level (DMRT)

Table.7 above shows that the interval of cow manure in I2 (2 MST) treatment had a very significant effect on the sample fruit weight of 0.726 kg compared to I1 (1 MST) 0.688 kg and I0 (control) 0.609 kg for an observation age of 12 MST. The relationship of these results is in the figure below:

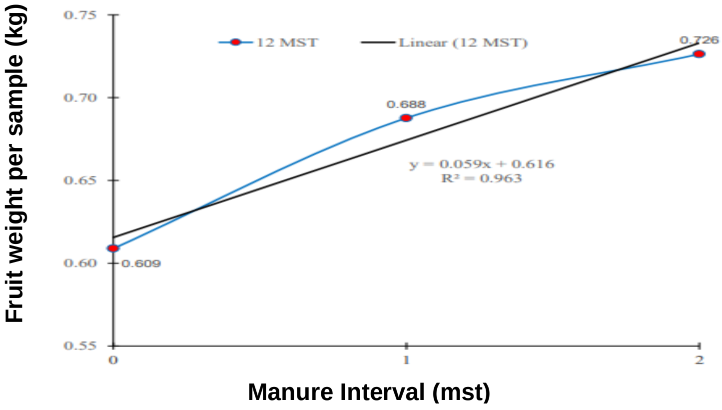

Figure 7. Fruit Weight Response Per Age Sample Of 12 MST Given Cow Manure Interval

Based on Figure IV.7 at the observation age of 12 MST shows a positive linear relationship between the weight of the sample fruit (y) kg and the cow manure interval (x) MST with the regression equation:

$$y = 0.059x + 0.616 ; R 2 = 0.963$$

Applying a cow manure interval of 2 MST yielded the largest average sample fruit weight and without fertilizer yielded the smallest average fruit weight per sample.

3.2.4 Fruit weight per plot (kg)

The application of cow manure intervals was able to increase the growth of fruit weight per plot whose observations were carried out at the age of 12 MST.

Table 8. Average Fruit Weight Per Plot Aged 12 MST Given Cow Manure Intervals

Cow manure interval (I)	Fruit weight per plot (kg)
I0 (0 MST)	1,145 b
I1 (1 MST)	1,293 a
I2 (2 MST)	1,371 a

Noted : Numbers followed by unequal lowercase letters in the column show a very noticeable difference at the 5% test level (DMRT)

Table.8 above shows that the application of cow manure interval in I2 treatment (2 MST) had a very significant effect on fruit weight per plot of 1,371 kg compared to I1 (1 MST) 1,293 kg and I0 (control) 1,145 kg for an observation age of 12 MST. The relationship of these results is in the figure below:

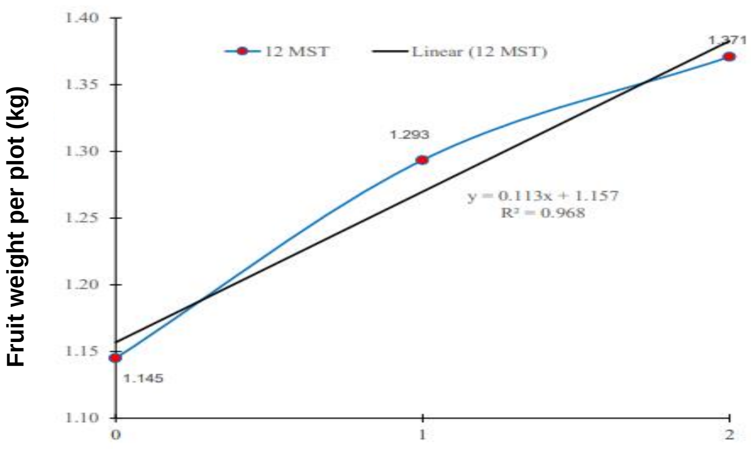

Figure 8. Fruit Weight Response Per Plot Aged 12 MST Given Cow Manure Interval

Based on Figure 8 at the observation age of 12 MST shows a positive linear relationship between fruit weight per plot (y) kg and cow manure interval (x) MST with regression equation:

$$y = 0.113x + 1.157 ; R 2 = 0.968$$

Applying a cow manure interval of 2 MST yielded the largest average sample fruit weight and without fertilizer yielded the smallest average fruit weight per sample.

3.3 Interaction of EMS Concentration Application and Cow Manure Interval Application to Cucumber Crop Production

Statistical tests for each observed parameter showed that the addition of each treatment dose to both EMS concentration and cow manure interval provided very noticeable differences for plant height growth, flowering age, fruit weight per sample, and fruit weight per plot.

Table 9. Average interaction of EMS concentration with the application of cow manure intervals to the yield of cucumber crops

Treatment combination	Plant Height (cm)	Flowering Age (days)	Sample Fruit Weight (kg)	Fruit Weight Perplot (kg)
	12 MST	HST	12 MST	12 MST
E0I0	137.67 e	21.66 s	0.436 s	0.776 e

E0I1	156.26 s	24.97 C	0.448 s	0.797 e
E0I2	164.84 C	28.56 a	0.408 s	0.728 e
E1I0	161.74c d	25.89 BC	0.596 c	1,101 s
E1I1	178.00 b	27.44 ABC	0.765 b	1,415 C
E1I2	182.20 b	27.89 AB	0.773 b	1,429 c
E2I0	178.30 b	16.89 ABC	0.795 b	1,558 BC
E2I1	181.20 b	28.67 a	0.851 b	1,668 b
E2I2	198.44 a	29.22 a	0.998 a	1,956 a

Noted : Numbers followed by unequal lowercase letters in the column show a very noticeable difference at the 5% test level (DMRT)

Table.9 above shows that the treatment of EMS concentration (E2) of 0.70% plus the application of cow manure interval of 2 MST gives the maximum cucumber crop production and without treatment (control) is the minimum with the following results: The maximum plant height at the age of 12 MST was E2I2 treatment (198.44 cm) and the minimum plant height at E0I0 treatment (137.67 cm). The maximum flowering age was in the E2I2 treatment (29.22 HST) and the minimum flowering age in the E0I0 treatment (21.66 HST). The average flowering age in general is 26.80 (27) HST. The maximum fruit weight per sample age of 12 MST is E2I2 treatment (0.998 kg) and the minimum sample fruit weight at E0I0 treatment (0.436 kg). The maximum fruit weight per plot age of 12 MST is E2I2 treatment (1.956 kg) and the minimum sample fruit weight at E0I0 treatment (0.776 kg).

EMS treatment has a significant effect on cucumber plant observation variables, namely: (1) Plant height aged 4, 8, 12 MST; (2) Flowering age (days); (3) Sample fruit weight (kg) age 12 MST; and (4) Fruit weight per plot (kg) aged 12 MST, it is suspected that plant roots absorb water and nutrients to increase due to mutations that induce root system variability and change root function more effectively in the soil. According to Pratiwi *et al.,* (2013) Soaking seeds with EMS affects several growth characteristics. The results showed that the percentage of growing marigold seedlings at 21 days after seedling (HSS) decreased with increasing doses of EMS. The highest growing percentage was obtained by Marigold plants without treatment (control) which was 100% and the lowest was obtained Marigold plants given 0.9% EMS treatment which was 88.67%.

According to Laksono &; Fanata (2022) Induction of mutations in plants with EMS can lead to changes in genetic traits in plants to negative as well as positive. Mutation in the positive direction is a mutation desired by plant breeders while mutation in the negative direction is a change that is not desired by the breeder. EMS has a molecular weight of 124 g/mol. 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 to 7-ethylguanine paired with thymine (Andriyani &; Muslihatin, 2017).

According to Suteja *et al.,* (2019), mutation induction being one promising way to create variety in plant varieties. The main strategy in mutation-based plant breeding is to improve plant varieties that have adapted either by changing one or two key traits. These include traits such as plant height, plant age, and disease resistance, which contribute to increased yields and yield quality. Most of the material used for mutagenic treatment is multicellular organs, i.e. seeds, according to those carried out in this study.

In this study, mutations showed including short fruit mutants, long fruit mutants, small flower mutants, large flower mutants, opposite tendril mutants, and clustered leaf mutants compared to cucumber plants of control plants or without EMS treatment.

Cow manure treatment has a significant effect on cucumber plant observation variables, namely: (1) Plant height aged 4, 8, 12 MST; (2) Flowering age (days); (3) Sample fruit weight (kg) age 12 MST; and (4) Fruit weight per plot (kg) aged 12 MST, it is suspected that there is an increase in soil fertility so that the variables observed in mutant plants through mutagenesis in cucumber plants become better based on the addition of cow manure which is slowly released into the soil so that nutrients that are available continuously in the process of growth and production of cucumber plants are available. According to Warganda *et al.,* (2021), cucumber plants require nutrients to support growth and affect the production of cucumber plants. Giving a little organic matter cannot support plant growth so that it will affect the decrease in productivity of cultivated plants. Soil fertility is very important to note. Fertile soil will remain productive if it can be managed, and proper management techniques so as to provide the nutrients needed by plants. Later it affects the increase in the yield of cucumber crop production. Manure is an organic fertilizer that does not damage the environment. Cow manure has been widely used by farmers as a basic fertilizer in cultivating their crops so that they can thrive and produce good production. This is because cow manure serves as a provider of nutrients both macro and micro, besides that manure also plays a role in improving the physical, chemical and biological properties of the soil.

The interaction of EMS treatment and cow manure on cucumber plants provides a very noticeable difference for plant height growth, flowering age, fruit weight per sample, and fruit weight per plot. Treatment of 0.70% EMS (E2) concentration plus 2.4 kg/plot interval of 2.4 kg of cow manure / plot gave maximum cucumber crop production compared to no treatment (control). Seed treatment in mutations affected growth and production compared to controls based on differences in morphological characteristics of leaves, stems and plant height in cucumber fruit. It is suspected that the effect of adding organic fertilizer to the soil is to release nutrients and produce humus and increase soil CEC. In addition, the addition of cow manure to the growing medium can increase the activity of soil microorganisms and increase the availability of nutrients for plants in each phase of growth and production of cucumber plants.

Research Prasetyo &; Sinaga (2017) states that each ton of cow dung contains 22 kg N, 2.6 kg P and 13.7 kg K. Element N plays a role in the constituent of chlorophyll which can accelerate the results of photosynthesis. The results of photosynthesis overhauled through respiration will produce assimilate which is needed for the process of cell division. As photosynthesis increases, the amount of assimilate increases, the number and size of cells also increase. This process causes rapid flowering to occur. P elements contained in cow manure play a role in carrying out the process of photosynthesis in higher plants so that flowers appear earlier. This is in accordance with opinion Rizki &; Maizar, (2023) that P element for plants serves to stimulate root growth, accelerate flowering, ripening seeds and fruits. The flowering process will be faster if the needs of P elements by plants are met optimally. The combination of treatments in the study was mutually supportive for the growth and production of cucumber crops.

4. CONCLUSION

Based on the results of research in the field, the application of EMS concentration and the application of cow manure intervals to the results of cucumber crop production that have been analyzed obtained the following conclusions: The application of MMS concentration at the age of 12 MST has a very significant effect on plant height, fruit weight per sample, and fruit weight per plot. At 28 HST, the application of EMS concentrations had a very pronounced effect on flowering age. The best EMS concentration is E2 (0.70%) with soaking seedlings for 3 hours. The application of 2 MST cow manure intervals of 2.4 kg / plot had a very significant effect on plant height, fruit weight per sample, and fruit weight per plot. At the age of 28 HST, the application of cow manure has a very noticeable effect on flowering age. The best cow manure interval is I2 (2 MST) 2.4 kg/plot. The interaction of the two treatment combinations showed a very noticeable effect on plant height, flowering age, fruit weight per sample, and fruit weight per plot. Based on observations in the field, the combination of treatments that had a very real effect was E2I2 (0.70% soaking for 3 hours + interval of 2 MST dose 2.4 kg / plot). This is due to the response of both treatments being able to simultaneously support the growth and production of cucumber plants.

Managerial suggestions for further research from this research are as follows: Further research is needed on the treatment of EMS concentrations and the application of cow manure intervals to increase cucumber crop production. Farmers are advised to use an EMS concentration of 0.70% and apply a 2 MST cow manure interval of 2.4 kg / plot

Further research suggestions, for future research, the author provides suggestions: Regarding the effect of MMS concentration and the application of cow manure intervals on the growth and yield of cucumber plants, variations in the addition of EMS concentrations and variations in cow manure application were carried out.It is recommended to conduct research on cucumber planting in the rainy season or dry season to find optimal production results.

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