UDC 579

EFFECT OF LOCAL MICROORGANISM (MOL) CONCENTRATION OF BAMBOO ROOT ON THE GROWTH AND YIELD OF EDAMAME PLANT (GLYCINE MAX (L.) MERR.)

Sudiyarmawan I Wayan, **Aiman Umul***, **Sriwijaya Bambang**
Department of Agrotechnology, Faculty of Agroindustry, Yogyakarta Mercu Buana University, Yogyakarta, Indonesia
*E-mail: umul@mercubuana-yogya.ac.id

ABSTRACT
Edamame is soybeans that are harvested young so they are often called vegetable soybeans. Indonesia is one of the countries that have an ideal climate for edamame cultivation so the potential for edamame is development is still not sufficient, so it is necessary to increase. The use of local microorganisms can increase the growth and yield of Edamame. Local microorganisms, often referred to as MOL, are liquids obtained from the fermentation of various sources of organic matter, for example is bamboo roots. The addition of MOL will increase the number of beneficial soil microbes in supporting plant growth and yield. This study aims to determine the growth response and yield of edamame with various concentrations of MOL. The research was carried out from September to November 2021 in Kepuhan, Argorejo, Sedayu, Bantul, Indonesia. The height of the research site is 87.5 meters above sea level with the type of vertisol. The study used a completely randomized block design, one factor, 6 treatments, 3 replications. The treatments tested were MOL concentrations of 5 ml/l, 7 ml/l, 9 ml/l, 11 ml/l and 13 ml/l and NPK (16:16:16) as a control. The results showed that the growth of edamame in all treatments was not different. The gave of MOL of root bamboo as much as 9 ml/l is the best treatment followed gave by 7 ml/l, 13 ml/l, 5 ml/ l, 11 ml/l, and the lowest treatment without addition MOL ie NPK 16:16:16in the variable of pod weight and 100 seeds weight.

KEY WORDS
Bamboo root, local microorganism (MOL), edamame, vegetable soybean, vertisol, plant growth promoting rhizobacteria, edamame.

Edamame is a legume plant that contains high protein and nutrients. The protein content is high 11.5g/100g (Zeipiņa et al., 2017) or 18.4 g/160g (Maringo, 2021), higher than lima beans and other nuts. Edamame soybeans are different from ordinary soybeans because edamame is harvested when the pods are young, i.e. when they are approximately 80% filled (Zeipiņa et al., 2017, Triana and Reza, 2012, Sari et al., 2021) to 90% (Purnama et al., 2018) with the characteristic that the pods are still green, have a savory and sweet taste. The need for edamame is still high domestically (Purnama et al., 2018), as well as its main export to Japan is still wide open. With this fact, the productivity of edamame needs to be developed (Sari et al, 2021, Purnama et al., 2018).

Plant productivity can be increased in various ways, one of which is by utilizing organic matter. Excessive use of inorganic fertilizers and shifting of agricultural waste for other purposes and no longer taking it to the ground has resulted in a lot of land losing carbon sources. Carbon sources in the soil are needed as an energy source for soil organisms (Ruswitawati et al., 2018). Soil organisms act as decomposers of materials in the soil so that they become plant nutrients, as growth promoters, controlling pests and plant diseases, and as biological fertilizers (Powlson et al., 2001).

Habituation of farmers who no longer return agricultural waste to the soil and excessive use of fertilizers, especially inorganic fertilizers, has an impact on the number of soils experiencing soil sickness (sick soil), soil fatigue (soil fatigue), and inefficient use of inorganic fertilizers (Murnita and Taher, 2021). Many soils in Indonesia contain less than 1% of organic matter even though ideally it is more than 2% (Ruswitawati et al., 2018, Pirngadi, 2009). With this condition, organic farming is one of the potential technologies to improve soil structure

and fertility (Murnita and Taher, 2021). To support organic agriculture, the role of microorganisms is needed, one of which is obtained from local microorganisms. Local microorganisms are microorganisms obtained from various natural sources, one of which is bamboo roots. Bamboo is widely found in forest and rural areas in Indonesia. Local microorganisms from bamboo roots contained microorganisms that can increase plant growth and increase plant resistance to disease.

This research was conducted to determine the response of growth and yield of Edamame planted with vertisol soil to the application of mole concentration of bamboo roots. It is hoped that this research will obtain information on the most optimal concentration that can support the growth and yield of edamame.

MATERIALS AND METHODS OF RESEARCH

The experiment was carried out on vertisol soil in Kepuhan Hamlet, Argorejo Village, Sedayu District, Bantul Regency, Yogyakarta Special Region, with an altitude of 87.5 meters above sea level, from September to December 2021. The materials used in this study were edamame seeds of Ryoko variety, cow manure, Betung variety bamboo roots, brown sugar water, rice bran, ABC brand shrimp paste, and 16:16:16 NPK fertilizer, and fresh elephant grass (*Pennisetum purpureum*).

The experiment used a completely randomized block design, single factor with 6 treatments, 3 replications. The treatments tested were bamboo root mole concentrations of 5 ml/l, 7 ml/l, 9 ml/l, 11 ml/l and 13 ml/l and NPK (16:16:16) 100 kg/ha as a control. The data obtained were analyzed variance 5% level. If there is a significant difference, it is further tested with Duncan's Multiple Range Test.

METHODS OF RESEARCH

Land Preparation

Soil tillage is carried out based on conventional methods by hoeing 15-20 cm deep (Agrifarming, 2021). Soil that has been processed is then made manually with a length of 1 m, a width of 1 m, a height of 50 cm for four rows of plants. Between the beds made a 60 cm wide trench. Cow manure is leveled on the land surface at 1 kg/bed or 10 tons/ha (Darini et al., 2020). The beds are then covered with black plastic mulch and garden holes are made with a distance of 25 x 25 cm2 (BBPP Lembang, 2015).

Preparation and Application of Local Microorganisms Origin (MOL) of Bamboo Root

The MOL of bamboo root preparation uses the modified method of Samosir and Gusniwati, 2004. Making MOL using a modified method from Samosir and Gusniwati, 2004. Using a hoe, take 1 kg of bamboo roots and the surrounding soil (Husen, 2004) finely ground, add 1.5 ounces of brown sugar, 2.5 liters of coconut water, and bran 1 kg (Samosir and Gusniwati, 2014), the mixture is then put into a plastic container and closed. The container is equipped with a hose that is connected to the water in the bottle. Fermentation was carried out for 15 days, with daily stirring (Samosir and Gusniwati, 2014 and Roeswitawati, et al., 2018), filtered. The use of local microorganisms by pouring 250 ml/plant into the plants according to the treatment, every week for 8 weeks (Roeswitawati, et al., 2018).

Edamame (*Glycine max* (L.) Merril) planting and care

The planting hole that has been prepared is filled with approximately 3 cm of edamame seeds. Each planting hole was given 4 seeds. Watering is done using water every morning and evening taking into account the weather. After 2 weeks after planting (WAP), one plant was left in each planting hole by selecting the best plant. Plant replacement is carried out on plants whose growth is not normal or dies no later than 2 weeks after planting using spare plants of the same age. Pest control was carried out by using insecticides with the active ingredients chlorpyrifos and cypermethrin given every week. Growing weeds were pulled out

manually by hand. Harvesting of edamame is done at the age of 65 days after planting simultaneously by picking the pods. Harvest criteria are pods that have been filled/widened by about 80%-90%, still fresh green (Zeipiņa et al., 2017, Triana and Reza, 2012, Sari et al., 2021, Purnama et al., 2018)

Observation of variable

The variable of observations includes growth and yield. Growth variable was carried out by measuring plant height at 2,3, 4.5, and 6 weeks after planting, flowering time/ flowering age by observing 50% of the flowering population, fresh weight and dry weight of plants, and effective root nodules at the end of vegetative growth (Darini et al., 2020). The yield variable was observed by measuring pod weight and the number of pods per plant, and the weight of 100 seeds (Zeipina et al., 20017; Sirisomboon et al., 2009).

RESULTS AND DISCUSSION

Plant Heights

Based on the analysis of plant heights aged 2,3, 4, 5, and 6 weeks after planting, the concentrations of Mole (5 ml/l, 7 ml/l, 9 ml/l, 11 ml/l, 13 ml/l) and NPK 16:16:16 100kg/ha did not show a significant difference, and only at the age of 5 weeks, there was a significant difference. At the age of 5 weeks after planting, giving the highest moles of 13 ml/l and 7 ml/l (Figure 1).

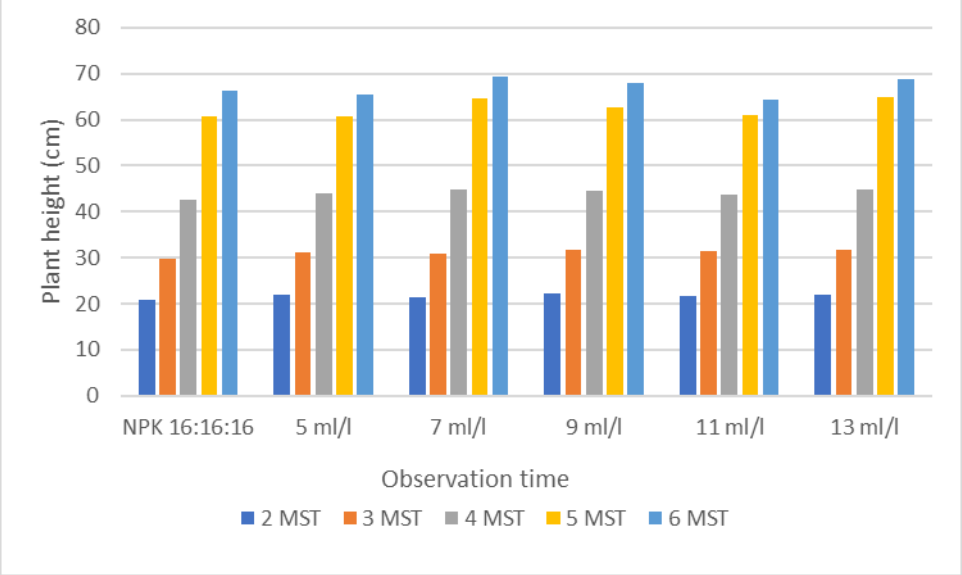

Figure 1 – The average height of edamame plants aged 2, 3,4,5, and 6 weeks after planting with the provision of NPK 16:16:16 and various concentrations of Microorganism local of root bamboo

Edamame plant height at the age of 2 weeks after planting ranged from 20 cm - 21 cm and at the 6th week the height of edamame reached 60-68 cm (Figure 1). The average height of the edamame according to the description of edamame is 50-70 cm (Saragih, 2002) and higher than edamame grown on volcanic soil, which is 42-53 cm (Daini et al., 2020). As in a study conducted by Ichwan et al., 2021, edamame plant height did not differ in all treatments because the land already contained nutrients to support edamame vegetative growth. Furthermore, Yang et al., 2021 and Zeipina et al, 2017 stated that soybean plant height was controlled by environmental factors, genetic factors, seasons, and agrotechnological factors. The environmental factors that play the most role are the average day-length, average maximum temperature, pH, and available nitrogen and these environmental factors are the same on research, resulting in the same edamame height. Environmental conditions and nutrients in vertisol soils are better than in volcanic soils,

causing edamame planted in volcanic soils to have lower plant height (Zeipina, et al., 2017). Edamame plant height will be better if it is combined with MOL, organic fertilizers, and inorganic fertilizers (Murnita and Taher, 2021).

Flowering Age

From the analysis, the flowering age did not show any difference in all treatments (Table 1). Edamame flowering age 27 to 28 days after planting, one day later than the description (Saragih, 2002) which is 26 days. As in plant height, although flowering age is influenced by environmental conditions, in this study all treatments did not show significant differences. No difference in flowering time with MOL concentrations of 5,7,9,11 and 13 ml/l as well as with NPK 16:16:16, possibly caused genetic factors from the Ryoko variety edamame more dominant than environmental factors (Cho et al., 2016) as well as nutritional conditions in the soil that are not different (Wada, 2010).

Effective Nodule Total

The results of the analysis of the number of effective root nodules of edamame showed that there was a significant difference between treatments (Figure 2). The administration of 9 ml/l Mole concentration resulted in the highest number of pods and the lowest was the effective administration of 5 and 4 ml/l concentrations. By the statement to Sari et al., 2021), some microbes will synergize with Rhizobium, increasing the effectiveness of Rhizobium. According to (Han et al., 2009) local microorganisms from bamboo roots are dominated by bacteria Lysinibacillus, Bacillus, and Burkholderia. Furthermore, it was also mentioned that bamboo roots contained the most rhizosphere bacteria, then rhizoplane, and the least endophytic bacteria. A certain number of microbes are able to synergize ideally with Rhizobium so that the administration of 9 ml/l mol is the ideal number of microbes capable of synergizing with Rhizobium which causes the highest number of effective root nodules (Figure 2). Bacteria from the Bacillus group found in MOL were able to stimulate the formation of effective root nodules and synergize to support the development of Rhizobium (Han et al., 2009) so that edamame given NPK produced fewer effective root nodules compared to those given MOL 9 ml/l, 11 ml/l, and 13 ml/l, although still higher than 5 ml/l and 7 ml/l (Figure 3).

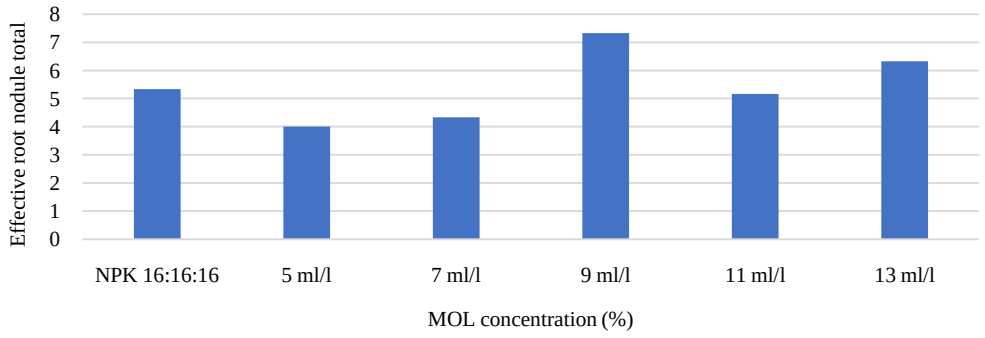

Figure 2 – The number of effective root nodules of edamame with different concentrations of MOL of bamboo root

Furthermore, the 2005 Soil Research Institute team stated that the application of NPK fertilizer (16:16:16) 100 kg/Ha contained relatively high N so that it could inhibit N fixation by Rhizobium bacteria in soybean plants.

Plant fresh weight, plant dry weight, and root volume

The results of the analysis of plant fresh weight, plant dry weight, root dry weight, and root volume there were no significant differences in all treatments (Table 2). The MOL concentration was not able to increase plant fresh weight, plant dry weight, and root volume.

Fresh weight and dry weight of edamame with NPK fertilization and MOL concentration from bamboo roots showed no difference.

The fresh weight of plants after going through the oven decreased by about 75-80% (Table 2). This decrease is due to the loss of water in the air when in the oven so that only the total assimilate remains fresh weight and dry weight of edamame in all treatments showed no difference, this was because the nutrients for edamame growth could be met from the land. The research area before planting has been given cow manure of 10 tons/ha so that the growth of edamame nutrients has been fulfilled (Darini et al., 2020). Treatment of NPK 100 kg/ha without the addition of MOL gave no different growth because the dose of NPK 100 kg/h was by the dose for edamame growth (Bogor Soil Research Team, 2005). The dry weight of the plant is in harmony with the part that is below the soil, namely the roots. High root dry weight will be followed by high plant weight, or vice versa because the function of roots is to absorb nutrients that will be used for plant growth. If the roots are good, it will result in good growth as well as be marked by an increase in the dry weight of the plant.

Pod weight, pods total, and weight of 100 seeds

The results of the analysis of the variable weight of pods per hectare and weight of 100 seeds showed a difference but not different in the observed variable pods total (Table 3). The weight of pods per Ha and the weight of 100 seeds showed a significant difference. As stated by Pandiyangan and Rasyad, 2017, the pod's total is more dominated by genetic traits although there are also environmental influences. The application of 9 ml/l MOL gave the highest pod weight of 19.5 tons/ha and the lowest was 13.7 tons/ha of NPK fertilizer. The weight of the pods produced is higher from research Ichwan et al., 2021, is 14 tons/ha, this is due to the conversion to Ha based on the calculation of sample plants, not from the harvest area.

The weight of 100 seeds at the application of 9 ml/l MOL was the best, and the lowest was in the treatment with NPK fertilizer. MOL functions as a Plant Growth Promoting Rhizobacteria (PGPR) containing microbes capable of dissolving phosphate so that it becomes available phosphate (Aiman et al., 2015), and one of the microbes in bamboo roots is Bacillus (Han et al., 2008). Bacillus is one of the bacteria found in the roots that are able to dissolve soil Phosphate, increase nitrogen fixation, and produce siderophores that promote plant growth and suppress pathogen growth (Hashem et al., 2019). In addition, the MOL will increase the total of beneficial microbes for plants (Jumriani). et al., 2017).

CONCLUSION

From the results of the study, it can be concluded that the edamame plant with gave of local microorganisms (MOL) from bamboo roots 5 ml/l, 7 ml/l, 9 ml/l, and 13 ml/l, as well as 16:16:16 NPK fertilization, gave no different growth on the variable plant fresh weight, plant dry weight, and root dry weight. The concentration of microorganisms local (MOL) from bamboo roots of 9 ml/l gave the best results on the variable weight of pods per Ha and weight of 100 seeds followed by 5ml/l, 7 ml/l, 11 ml/l, 13 ml/l, and the lowest was NPK 16: 16:16.

ACKNOWLEDGMENTS

The authors would like to extend their sincere appreciation to the Center for research, development, and collaboration at Yogyakarta Mercu Buana University for funding this research.

REFERENCES

1. Agri Farming, 2022., Land Preparation Types; Methods; Objectives; Advantage: Land preparation types, and techniques in agriculture https://www.agrifarming.in/land-preparation-types-methods-objectives-advantages#Conventional_Tillage: 1-7

2. Aiman, U., Tantriati, Sriwijaya, B. 2017. Pemberian Macam Konsorsium Bakteri Hasil Isolasi Tumbuhan Pantai pada Kangkung (Ipomoea reptans Poirs.). Planta Tropika, Jurnal Agrosains (Journal of Agro Science) V(1): 1 – 6
3. BBPP Lembang. 2015. Memiliki Prospek Pasar yang Bagus. http://www.bbpp-lembang.info. Diakses pada tanggal 7 Oktober 2018.
4. Cho, Lae-Hyeon, Yoon, J and An, G., 2016. The control of flowering time by environmental factors, The Plant Journal (2017) 90, 708–719.
5. Darini, M.T., Widata, S., Ratri, W.S., 2020. Response of vegetable soybean (Glycine max L. Merr.) plant by application of integrated fertilizers in volcanic soil, Asian J. Plant Sci., 19 (13): 246-251.
6. Han, J., Xia, D., Li, L., Sun, L., Yang, K., and Zhang, L., 2009, Plant Microbe Interactions: Diversity of Culturable Bacteria Isolated from Root domain of Moso Bamboo (Phyllostachys edulis), Microb Ecol 58:363–373
7. Hasyem, A., Tabassum, B., Abd_Allah, E.F., 2019. Bacillus subtilis: A. plant-growth promoting rhizobacterium that also impacts biotic stress, Saudi Journal of Biological Sciences (26) : 1291-1297
8. Husen, E. 2004. Prosedur Pengambilan Contoh Tanah Untuk Analisis Mikrobia, Balai Penelitian Tanah, Pusat Penelitian dan Pengembangan Tanah dan Agroklimat, Badan Penelitian dan Pengembangan Pertanian, https://balittanah.litbang.pertanian.go.id/ind/dokumentasi/leaflet/ Diakses 20 Febrauri 2022.
9. Ichwan,B., M. Ridwan., Eliyanti, Irianto and Pebria, C., 2021. Respons Kedelai Edamame Terhadap Berbagai Jarak tanam dan Doses Pupuk Kotoran Ayam , Jurnal Media Pertanian, 6(2) 98-103.
10. Jumriani,K., Patang, Mustarin, A., 2017. Pengaruh Pemberian Mol Terhadap Pertumbuhan Dan Produksi Tanaman Kangkung Darat (Ipomea reptans Poir) The effect of giving MOL toward growth and production of kale (Ipomea reptans Poirs), Jurnal Pendidikan Teknologi Pertanian, Vol 3(2017), 519-529
11. Maringo, C., 2021., Is edamame good for you? Nutrition, calories, recipes, benefits, and all you need to know, Newsletter Medical News Today, 22 December 2021
12. Murnita and Taher, Y.A., 2021. Dampak Pupuk Organik Dan Anorganik Terhadap Perubahan Sifat Kimia Tanah Dan Produksi Tanaman Padi (Oriza Sativa L.) Effect Of Organic And Inorganic Fertilizers On Soil Chemical Properties And Rice Plant Production(Oriza sativa) MENARA Ilmu Vol. XV (02): 67-76
13. Pandiangan, D.N., and Rasyad,A., 2017. Yield Potential And Grain Quality Of Soybean (Glycine max(L.) Merr.) Varieties Grown On Four Time Application Of Nitrogen Fertilizer, Jurnal JOM Faperta, Vo; 4 (2): 1-14
14. Pirngadi K., 2009. Peran Bahan Organik dalam Peningkatan Produksi Padi Berkelanjutan Mendukung Ketahanan Pangan Nasional. Pengembangan Inovasi Pertanian 2(1) : 48-64
15. Powlson, D.S., Hirsch, P.R., and Brookes,P.C., 2001., The Role of Soil microorganisms in soil organic matter conservation in the tropics, Nutrient Cycling in Agroecosystems 61: 41-51.
16. Purnama, S.M., Cheng, C., Hanani AR., N, 2018. The Export Performance of Indonesian Edamame in Japan Market, Scholar Journal of Economics, Busines and Management (SJEBM), http://saspjournals.com/sjebm, 590-596.
17. Roeswitawati,D., Ningsih, Y.U., and Muhidin, 2018. The Effect of Local Microorganism (MOL) Concentration of Banana Hump and Fruit Waste on The Growth and Yield of Broccoli Plants (Brassica oleracea), Advance in Engineering Research,4th International Conference on Food and Agriculture Resources, Atlantis Press, Volume 172: 310-314.
18. Saragih, B. 2002. Lampiran keputusan menteri pertanian no. 421/Kpts/Tp.240/7/2002, tanggal 3 Juli 2002 Deskripsi kedelai varietas edamame R-305.
19. Sari, W.P., Adriani, D.E., and Nisa, C., 2021. Growth Response of Edamame Soybean (Glycine max (L.) Merr.) with Application of Urea and Rhizobium Biofertilizer on Peat Soil Media, TROPICAL WETLAND JOURNAL, 7 (1) 1-46, https://doi.org/10.20527/twj.v7i1.100

Samosir, A and Gusniwati, 2014. The Effect of Local Microorganisms from Fermented Bamboos Shoots (Bambosoideae) on Oil palm Seedlings Growth at pre Nursery, Vol 3 (1), https://online-journal.unja.ac.id, accessed 23 February 2022.
20. Sirisomboon, P., Hashimato, Y., & Tanaka, M. (2009). Study on non-destructive evaluation methods for defect pods for green soybean processing by near-infrared spectroscopy. Journal of Food Engineering. 93(4), 502 – 512. DOI: 10.1016/j.jfoodeng.2009.02.019.2.
21. Tim Balai Penelitian Tanah, Bogor, 2005. Rekomendasi Pemupukan Tanaman Kedelai Pada Berbagai Tipe Penggunaan Lahan, https://balittanah.litbang.pertanian.go.id/ind/dokumentasi/lainnya/rekomendasi%20kedelai%20terbaru.pdf, accessed 12 October 2021.
22. Wada, K.C. and Takeno, K. (2010) Stress-induced flowering. Plant Signal. Behav. 5, 944–947.
23. Yang, Q., Lin., G, Lv, H., Wang, C., Yang, Y and Liao, H., 2021. Environmental and Genetic Regulation of Plant Height in Soybean, MBC Plant Biology, Volume 21(63), 1-15
24. Zeipina, S., Alsina, I., and Lepse,L., 2017. Insight In Edamame Yield And Quality Parameters: A Review, Agricultural Science (Crop Science, Animal Science), Research For Rural Development Conference Paper, Volume 2: 41-45, https://www.researchgate.net/publication/323549462

APPENDIX

Table 1 – Everage of flowering age of edamame plants with gave of kind of treatment

Kind of Treatment	Flowering age (Day After Planting)
NPK 16:16:16	28,00 a
LMO concentration 5 ml/l	27,67 a
LMO concentration 7 ml/l	27,33 a
LMO concentration 9 ml/l	27,67 a
LMO concentration 11 ml/l	28,00 a
LMO concentration 13 ml/l	28,00 a

Note: The mean value followed by the same letter indicates that there is no sign the difference according to the 5% level of the F test

Table 2 – Average of Plant fresh weight, plant dry weight, and root volume with gave of kind of treatment

Kind of Treatment	Plant fresh weight (g)	Plant dry weight (g)	Root volume (ml)
NPK 16:16:16	41,28 a	5,23 a	7,47 a
MOL concentration 5 ml/l	47,00 a	5,93 a	7,92 a
MOL concentration 7 ml/l	53,00 a	6,81 a	7,98 a
MOL concentration 9 ml/l	45,67 a	5,46 a	7,58 a
MOL concentration 1 ml/l	37,33 a	4,97 a	7,55 a
MOL concentration 3 ml/l	55,00 a	7,04 a	8,57 a

Note: The mean value followed by the same letter indicates that there is no sign the difference according to the 5% level of the F test

Table 3 – The yield of Edamame with gave of kind of treatment

Kind of Treatment	Pod weight Ha (ton)	Pods total	Weight of 100 seeds (g)
NPK 16:16:16	13,7 f	49,6 a	61,9 c
MOL concentration 5 ml/l	15,5 d	51,7 a	63,4 b
MOL concentration 7 ml/l	18,4 b	51,1 a	63,3 b
MOL concentration 9 ml/l	19,5 a	55,3 a	64,0 a
MOL concentration 1 ml/l	14,1 e	47,2 a	63,9 b
MOL concentration 3 ml/l	16,9 c	51,5 a	63,1 b

Note: The average value followed by the same letter at the same colom shows that there is no significant difference according to DMRT