The influence of the composition of biodiverse fertilizers plant vegetative soybean plant (*Glycine max* (L.) Merrill) in inceptisol

F Verawati*,1, Asmarlaili 2, T Sabrina3
Post Graduate of Agrotechology, Agriculture Faculty, University of Sumatera Utara, Jalan Prof A.Sofyan No.3 Kampus USU Padang Bulan Medan 20115
E-mail: felinaverawatisiburian@gmail.com

Abstract. Soybean (*Glycine max* (L.) Merril) is a food commodity containing the highest vegetable protein among nuts and cereals. Fertilizer is a material that contains living microorganisms from microbes in the soil. This study aims to determine the effect of biological fertilizer composition on soybean plant height (*Glycine max* (L) Merrill) on inceptisol. This research has been conducted experimental USU Medan experiment. This research uses Non-Factorial Factorial Random Design. Control Treatment (T0): Giving N2 = 1.85 gr / polybag, basic fertilizer application on P2O5 = 3.09 gr / polybag and K2O = 1.85 gr / polybag. Treatment (T1): Mycorrhiza (M) 20 g / plant + basic fertilizer, Treatment (T2) *Rhizobium* (R) 20 ml / plant. Treatment (T3): *Trichoderma* sp. 20 ml / plant. Treatment (T4): inoculum *Aspergillus* sp. 20 ml + Provision of basic fertilizer, Treatment (T5): Giving Mycorrhiza 20 gr / plant (M) + *Rhizobium* (R) + inoculum of *Aspergillus* sp. 20 ml. Treatment (T6) Giving *Aspergillus* sp. + *Rhizobium* (R) + *Trichoderma* 20 ml + basic fertilizer. Treatment (T7) Giving Mycorrhiza (M) + inoculum of *Aspergillus* sp. + *Trichoderma* 20 ml + base fertilizer. Treatment (T8) Giving Mycorrhiza 20 gr + *Rhizobium* + *Trichoderma* sp. + inoculum *Aspergillus* sp. 20 ml + basic fertilizer. Observed Variables: Plant Height and Weight of root nodule. The result of research indicate that T8 treatment is the best treatment in increasing plant height that is 55.17 cm and highest root nodule weight that is 7.43 gr, the lowest in the treatment of T0 plant height is 45.83 cm and treatment of root nodule weight 4.96 gr.

1. Introduction
Soybean (*Glycine max* (L.) Merril) is a major food commodity with the highest vegetable protein content among nuts and cereals. Vegetable proteins contained in soybeans range from 40% and contain calcium, phosphorus, iron, vitamins A, and B that are used for growth. According to data from BPS (2016), soybean productivity in North Sumatra Province in 2011 amounted to 11,413 tons/ha whereas in 2015 soybean productivity decreased by 5.303 tons/ha. The low productivity of soybeans, among others, is caused by natural factors, biotic and cultivation techniques.

Inceptisol soils include acid soils with underlying problems, such as low pH, low organic matter content, and low nutrient content, especially phosphorus (*P*). So it is necessary to make efforts to fix it on Inceptisol soil by means of chemical fertilizer and the addition of organic matter. [23] stated that the spread of inceptisol is evenly distributed throughout Indonesia. Starting from Aceh, North Sumatra, South Sumatra, Java, Bali, East Nusa Tenggara and Irian Jaya.
Element P is a macronutrient required by plant growth in large quantities. According to [9], the availability of P in the soil is affected by soil parent material, soil reaction (pH), C-organic soil, and soil texture. Plants take P from the soil solution in the form of primary orthophosphate ions (H$_2$PO$_4$) and secondary orthophosphate ions (HPO$_4^{2-}$) as they are available in the soil, especially on acid soil, so it is necessary to add P chemical fertilizer to increase the availability of P in the soil.

Biological fertilizers are materials that contain living microorganisms from microbes that are used to increase the number of microbes so as to increase the availability of nutrients for plants [22]. Biological fertilizers are very effective in providing nutrients and improving soil properties in favor of plant growth. The utilization of biological fertilizers combined with inorganic fertilizers gives a good prospect in increasing the productivity of the soil.

Trichoderma is a fungus associated with plants and often found endophytes in the roots and leaves. The selection of Trichoderma in this study due to the Trichoderma traits that are readily available, widely distributed, tolerant of growth inhibitors, grows rapidly, is competitive and produces abundant spores, thus facilitating the provision of these fungi as biological control ingredients [2]. Aspergillus is ubiquitous as a saprophyte. Colonies that easily produce their spores to brownish-yellowish, greenish or blackish and mysteriously white mycelium is no longer visible [8]. There are many species of Rhizobium B inhibitors on biological fertilizers but not all Rhizobium species can form root nodules and are symbiotic with all types of legumes.

2. Materials and Methods
This research was conducted at Experimental Garden of Faculty of Agriculture, University of North Sumatra. This research uses a factorial randomized design (RAK) consisting of 9 treatments, namely: Control Treatment (T0): Provision of fertilizer N$_2$ = 1.85 gr / polybag, basic fertilizer application on P$_2$O$_5$ = 3.09 gr / polybag and K$_2$O fertilizer = 1.85 gr / polybag. Treatment (T1): Mycorrhizae (M) 20 g / plant + Basic fertilizer treatment (T2) Rhizobium (R) 20 ml / plant. Treatment (T3): Trichoderma sp. 20 ml / plant. Treatment (T4): inoculum Aspergillus sp. 20 ml + Basic fertilizing Treatment (T5): Giving Mycorrhizae 20 gr/plant (M) + Rhizobium (R) + Giving of Aspergillus inoculum, sp 20 ml. Treatment (T6) Giving Aspergillus inoculum, sp + Giving Rhizobium (R) + Giving Trichoderma 20 ml + Providing base fertilizer. Treatment (T7) Giving Mycorrhiza (M) + Giving Aspergillus sp. inoculum + Trichoderma 20 ml + basic fertilizer application. Treatment (T8) Giving Mycorrhiza 20 gr + Giving Rhizobium + Giving Trichoderma sp. + Giving Aspergillus inoculum, sp 20 ml + Providing basic fertilizer. Very Variable: High Plant Plants.

3. Results and Discussion
3.1. Plant height (cm)

| Treatment | Plant Height (cm) |
|-----------|------------------|
| T0 (Control) | 45.83 a          |
| T1 (Mycorrhizae 20 gr) | 50.00 ab         |
| T2 (Rhizobium 20 ml) | 50.33 ab         |
| T3 (Trichoderma 20 ml) | 49.83 ab         |
| T4 (Aspergillus 20 ml) | 52.33 ab         |
| T5 (Mycorrhizae 20 gr + Rhizobium + Aspergillus sp. 20 ml) | 49.50 ab         |
| T6 (Aspergillus sp + Rhizobium + Trichoderma sp. 20 ml) | 49.33 ab         |
| T7 (Mycorrhizae 20gr + Aspergillus sp + Trichoderma sp. 20 ml) | 46.17 b          |
| T8 (Mycorrhizae 20gr + Rhizobium + Trichoderma sp. + Aspergillus sp. 20 ml) | 55.17 b          |

Description: The numbers followed by the same letter on the same row or column are not significantly different according to the DMRT Test at the 5% level.
Based on table 1 it can be seen that the highest plant T8 (Mycorrhizae + Rhizobium + Trichoderma sp. + Aspergillus sp.) is 55.17 cm has no significant effect and the lowest control treatment (T0) is 45.83 cm. This is presumably because the application of biological fertilizers in the soil can facilitate the growth and development of roots in plants and increase the biological activity of beneficial soil microorganisms. The bioactive substances produced by microorganisms have helped to absorb better nutrients for plant growth. Giving inoculation to plants can show an increase in phosphorus content in the roots. Interdependent and synergistic effects on P and N uptake, an interaction between the VAM Mushroom and the symbiotic sympathetic N₂ binding Rhizobium bacteria when considering inoculation [14].

### 3.2. The weight of soybean root nodules

#### Table 2. Effect of Composition of Provision of Biological Fertilizer Against The weight of soybean (Glycine max (L.) Merrill) root nodules

| Treatment                                      | The Weight of root nodules (gr) |
|------------------------------------------------|---------------------------------|
| T0 (Control)                                   | 5.74 a                          |
| T1 (Mycorrhiza 20 gr)                          | 6.06 a                          |
| T2 (Rhizobium 20 ml)                           | 6.95 a                          |
| T3 (Trichoderma 20 ml)                         | 5.37 a                          |
| T4 (Aspergillus 20 ml)                         | 5.61 a                          |
| T5 (Mycorrhiza 20 gr + Rhizobium + Aspergillus sp. 20 ml) | 5.97 a                          |
| T6 (Aspergillus sp. + Rhizobium + Trichoderma sp. 20 ml) | 4.96 a                          |
| T7 (Mycorrhizae 20gr + Aspergillus sp. + Trichoderma sp. 20 ml) | 5.76 a                          |
| T8 (Mycorrhizae 20gr + Rhizobium + Trichoderma sp. + Aspergillus sp. 20 ml) | 7.43 a                          |

Description: The numbers followed by the same letter on the same row or column are not significantly different according to the DMRT Test at 5%

The result of weights of soybean root nodules due to the giving of each treatment according to the data of table 2 that, the weight of root nodules of Grobogan varieties with different treatments, there is a treatment of control (T0) 1, mycorrhiza (T1), Rhizobium (T2), Trichoderma (T3), Aspergillus (T4), treatment (T5) Aspergillus sp. + Giving Rhizobium (R) + Giving Trichoderma 20 ml. Treatment (T7) Giving Mycorrhiza (M) + Giving Aspergillus in inoculum, sp + Trichoderma sp. Treatment (T8) Giving Mycorrhiza + Giving Rhizobium + Giving Trichoderma sp. + Giving of Aspergillus sp. inoculum. This is thought to be due to the different treatment of soybean varieties grobogan in forming root nodules so that the results obtained there is the highest number of root nodule weight on T8 treatment (Giving Mycorrhiza + Giving Rhizobium + Giving Trichoderma sp. + Giving of Aspergillus sp. inoculum) that is 7.43 gr and there is the lowest treatment at treatment of T6 that is 4.96 gr.

Application of biological fertilizers may cause increased nodulation of plant roots and produce higher levels of nitrogen (N) and phosphorus (P) supply for plant growth and increase soybean crop production. The results of [9] study reveal that effective root nodules are able to fix N from the air and convert N to amino acids to be donated to soybean plants. Accumulation in plants can be associated with better nutrient mobilization by combining microbial inoculants with synergistic interactions that result in bushy plant growth. The number of pods per plant, long pods are also maximal in the same treatment. Similar results have also been reported by some workers in crops such as peanuts, garden peas and soybeans [11, 3, 7].

### 4. Conclusion

1. The application of biological fertilizer affected the growth of plant height and the weight of the root nodule, the highest result of T8 treatment (Giving Mycorrhiza + Giving Rhizobium + Giving Trichoderma sp. + Giving of Aspergillus sp. inoculum) was 55.17 cm and T8 (Giving of
Mycorrhiza + Giving *Rhizobium* + Provision of *Trichoderma* sp. + Giving *Aspergillus* sp. inoculum) is 7.43 gr, the lowest in the T0 treatment of plant height is 45.83 cm and the nodal root weights are 4.96 gr.

2. The use of biological fertilizers of several types, namely: mycorrhiza, *Rhizobium*, *Trichoderma* sp. and *Aspergillus* sp. appear to be significantly different from the effect without the treatment of biofertilizer on soybean crops.

References
[1] Almas Z, Khan M S and Zaidi A 2006 European J.Agron. 19 15
[2] Alfiani C 1990 Teallah Trichoderma as biological control agent (Jakarta: Deputy PDIT BPP Technology)
[3] Andayaningsih 2002 Jurnal Biowanata 4 1
[4] ArunaV and Narasa R S 1999 J.Oilseed Res.
[5] Asgharali M I and Noor E J 2003 Sarhad J. Agric. 19 56
[6] Baihaqi A, Nawawi M and Eternal A L 2013 Journal of Plant Production 1 30
[7] Central Bureau of Statistics 2016 Soybean Harvest Area by Province (ha) 1993-2015 https://www.bps.go.id Retrieved on August 7, 2017
[8] Dwidjoseputro 1988 Fundamentals of Microbiology (Jakarta: Djambatan) 38
[9] Hanafiah A S, Sabrina T and Guchi H 2009 Biology and Soil Ecology Faculty of Agriculture USU Field
[10] Herlina L and Dewi P 2010 Use of Active Compost Trichoderma Harzianum In Improving Chili Plant Growth (Semarang State University: Faculty of Mathematics and Natural Sciences)
[11] Kalhapure D J, Memane S A, Rasal P H and Pawar K B 2003 J.Maharashtra Agril. Univ. 28 161
[12] Maningsih G and Anas I 1996 Puslittanah 14 31
[13] Munir M 1996 Indonesia's main land, its characteristics, its classification, and its utilization (Jakarta: world victorio library)
[14] Rao N S S, Tilak K V B R and Singh C S 1986 Plant and Soil 95 351
[15] Rao N S S 1979 Chemically and biological ly fixed nitrogen potentials and prospect 1 -7. In N. S. Subba Rao (ed.) Recent advances biological nitrogen fixation Oxford IBH Publ.Co. New York
[16] Rizqiاني N F, Ambarwati E and Yuwono N W 2007 Journal of Soil Science and the Environment 7 43
[17] Rudresh D L, Shivaprakash M Kand Prasad R D 2004 J. Appl. Soil Ecol. 28 139
[18] Simarmata T, Hindersah R, Setiawati M, Fitriani B, Suratman P, Suryani Y and Arief D H 2004 A strategy of Utilization of CMA Fertilizer in Revitalizing Marginal and Irrigated Land Ecosystem (Lembang: Workshop Production of Inoculant CMA 22-23 July 2004)
[19] Sugito Y, Nuraini Y and Nihayati E 1995 Organic Farming System (Malang, University Brauwijaya: Faculty of Agriculture)
[20] Surtiningsih T, Farida and Nurhariyati T 2009 Berk.Penel 15 31
[21] Tarman P E 2006 Effect of the incubation period of antagonist fungus *Trichoderma herzianum* against the inhibitory development of fungal pathogens Fusarium oxysporum causes tomato wilt disease in vitro (Online)
[22] Wahyuni S T, Islami T, Sebayang H T and Hariyono B 2010 The effect of bio-fertilizer petrobio biofertilizer and N, P, K on growth of phyisic nut (*Jatropha curcas L.*)(University Brawijaya)