AGRITROPICA
Journal of Agricultural Sciences

Content available at :
https://ejournal.unib.ac.id/index.php/jagritropica/index

ISSN 2621-217X (PRINT) ISSN 2621-699X (ONLINE)

The Growth of White Corn Plant with Several Phospor Fertilizers and Mycorrhiza Application in Inceptisol at Lumban Lobu Village, Bonatua Lunasi Subdistrict Toba Samosir District-Sumatera Utara

Andrew Hans Prima, Bintang, Hardy Guchi, Benny Hidayat*
Departement of Agrotechnology, Faculty of Agriculture, USU, Medan 20155
*Corresponding author : bendayat@gmail.com

ABSTRACT : The criteria of P available on Inceptisol soil are low, so P fertilizer and mycorrhiza application is needed to increase P available on the soil. This research aim was to determine the growth of white corn plants by various P fertilizers and mycorrhiza application in Inceptisol soil at LumbanLobu Village, BonatuaLunasiSubdistrict, TobaSamosir District Sumatera Utara. The method used was Factorial Randomized Block Design with two factors and two repetitions. The first factor is the source of P consists of 7 treatments: P0 (control); P1 (TSP fertilizer); P2 (phosphate rock fertilizer); P3 (chicken manure); P4 (cow manure); P5 (guano fertilizer) and P6 (rice husk biochar) and the second factor is mycorrhiza with two treatments: M0 (0 g / plot) and M1 (30g / plot). Parameters observed were plant height, organic C content, soil H_2O pH and degree of mycorrhiza infection. The research results showed that the application of P sources did not significantly increase the growth of white corn plants. The application of mycorrhiza significantly increased the degree of root infection and the interaction of P sources and mycorrhiza significantly increased the degree of root infection.

Keywords : P sources, mycorrhiza, inceptisol, white corn.

Citation to this paper should be made as follows :
A. H. Prima, Bintang, H. Guchi, B. Hidayat. 2018. The Growth of White Corn Plant with Several Phospor Fertilizers and Mycorrhiza Application in Inceptisol at Lumban Lobu Village, Bonatua Lunasi Subdistrict Toba Samosir District- Sumatera Utara. *Agritropica: Journal of Agricultural Science.* 1 (2): 93-99. DOI: https://doi.org/10.31186/J.Agritropica.1.2.93-99

INTRODUCTION

White corn is one type of local corn that is used as a staple food for people in Maluku Barat Daya district. White corn crop is also found at Nusa Tenggara Timur (Timor Island, Sumba and Flores), Nusa Tenggara Barat (Sandubaya), Central Java (Blora, Temanggung), East Java (Madura) Sulawesi Selatan (Jeneponto, Bulukumba), Bantaneng, and Selayar, Sulawesi Tengah, Sulawesi Tenggara, and Gorontalo. The average yield of white corn in Indonesia is less than 4 tons / hectare while the SrikandiPutih 1 variety is able to produce 5.0-6.0 tons per hectare (Indriyani, 2013). The spreading of white corn in Sumatera Utara began as a pilot at Celawan village in collaboration with the Faculty of Agriculture, University of Sumatera Utara and PTPN IV in the Bina Desa program.

LumbanLobu village is a village where the majority of the people are farmers. In this village many farmers grow rice, corn, cassava and yam. The results of these crops are partly consumed and some are sold, other than that they are given to livestock. Corn plants grow well in this village but white corn plants not ever been planted yet in this area. According to research by Yosephine, et al (2012)

LumbanLobu village is located at coordinates 2030'26.96" North latitude - 9909'41.37" East longitude and is at an altitude of 1017 m above sea level.

Phosphorus (P) is a macro nutrient which is very important for plant growth, but its content in plants is lower than nitrogen (N), potassium (K), and calcium (Ca). Plants absorb P from the soil in the form of phosphate ions, especially $H_2PO_4^-$ and HPO_4^{2-}which are in the soil solution. $H_2PO_4^-$ ions are more commonly found in more acidic soils, whereas at a higher pH (greater than 7) the HPO_4^{2-} form is more dominant. In addition to these ions, plants can absorb P in the form of nucleic acids, phytoh and phosphine (Elfiati, 2005).

The working principle of mycorrhiza is to infect the host plant root system, producing braid intensively so that plants containing mycorrhiza will be able to increase nutrient absorption capacity (Hanafiah, 2009). Mycorrhiza symbiosis contributes to increased phosphatase activity. This is due to the direct contribution of the external mycelium and the indirect effect on increasing the P status of the plant (Nasution, et al, 2014).

Because food needs are still quite high, the author was interested in introducing white corn plants in this location with the application of P sources and mycorrhiza.

MATERIALS AND METHODS

This research was carried out in July 2017 to November 2017 in LumbanLobu Village in plot 1x1m, Toba Samosir District and at Research and Technology Laboratory of the Faculty of Agriculture, University of Sumatera Utara, Medan.

The material used in this research was white corn seeds as indicator plants, mycorrhiza fungi as phosphate-providing microorganisms; TSP fertilizer and Rock Phosphate as source of P inorganic fertilizers, Guano Fertilizer, cow manure and chicken manure and Biochar made from rice husk as source of P organic fertilizer; urea and KCL fertilizer as basic fertilizer, inceptisol soil from LumbanLobu - Toba Samosir as planting media; and other supporting materials.

The tools used in this research were watering can for watering the plants, analytic scales to weigh the fertilizers and the weight of plant fresh weight and plant dry weight, meter to measure plant height, and other supporting tools.

This research used a randomized block design (RBD) method with two factors and two replications, Factor I was source of P (P) consists of 7 types: P0 (Without P), P1 (TSP Fertilizer 32.60 g / plot equal to 150 kg P_20_5/ha), P2 (Rock Phosphate Fertilizer 53.57 g / plotequal to 150 kg), P3 (Chicken Manure Fertilizer 2 kg / plot aqual to 2 ton/ha), P4 (Cow Manure Fertilizer 2 kg / plotaqual to 2 ton/ha), P5 (Guano Fertilizer 155.44 g / plotequal to 150 kg), P6 (Biochar of Rice Husk 2 kg / plot2 ton/ha) and factor II was mycorrhiza (M) consisting of 2 levels: M0 (without mycorrhiza) and M1 (30 g / plant)

The research results with the significant effect of treatment were continued by Duncan's Multiple Range Test with a level of 5%.

The implementation of the research was started from taking soil material and soil preparation, initial soil analysis, bed preparation, s such as cow manure, chicken manure and biochar carried out 14 days

before planting, of TSP, Rock Phosphate and Guano fertilizer during planting, of basic fertilizer, planting and insertion, determination of plant samples with mycorrhiza s, plant maintenance, final soil analysis and harvesting.

The observed parameters were plant height, organic C content, soil pH and degree of mycorrhiza infection.

RESULTS AND DISCUSSION

Plant Height (cm)

The results of the variance test showed that the application of P sources, mycorrhiza and the interaction of P sources and mycorrhiza did not significantly increase plant height. The average height of corn plants 2-6 weeks before planting in the treatment of P sources and mycorrhiza can be seen in Table 1.

Based on the results of research that has been done, the application of P sources and mycorrhiza had no significant effect on increasing plant height. This was presumably because at the beginning of the plant growth was still relatively slow so that there did not seem to be a clear difference in plant growth.

Table 1. Corn plant height with P sources and mycorrhiza treatment in observation age at 2-6 weeks after planting

MST	P Sources	Mycorrhiza		Average
		0 gram	30 gram	
		.....cm.....		
2	Control	22,23	11,98	17,10
	TSP Fertilizer	18,65	20,78	19,71
	Rock Phosphate Fertilizer	22,75	15,98	19,36
	Chicken Manure	24,60	19,90	22,25
	Cow Manure	21,53	23,03	22,28
	Guano Fertilizer	16,10	16,73	16,41
	Rice Husk Biochar	23,63	15,23	19,43
	Average	21,35	17,66	19,51
4	Control	59,40	35,68	47,54
	TSP Fertilizer	67,05	66,90	66,98
	Rock Phosphate Fertilizer	67,23	58,15	62,69
	Chicken Manure	68,05	60,75	64,40
	Cow Manure	66,85	58,38	62,61
	Guano Fertilizer	41,98	46,38	44,18
	Rice Husk Biochar	68,43	59,53	63,98
	Average	62,71	55,11	58,91
6	Control	105,58	74,05	89,81
	TSP Fertilizer	126,48	130,18	128,30
	Rock Phosphate Fertilizer	115,10	110,98	113,04
	Chicken Manure	110,15	106,28	108,21
	Cow Manure	121,40	100,53	110,96
	Guano Fertilizer	90,68	102,38	96,53
	Rice Husk Biochar	118,65	122,40	120,53
	Average	112,58	106,68	109,63

In addition, when viewed from the initial soil pH of 4.99 which is classified as acidic pH, the pH of acidic soil cannot be absorbed by plants therefore causing the growth of corn plants is not real. This is consistent with the Padang (2013) literature, which stated that corn plants absorb relatively small amounts of P than the absorption of N and K nutrients. The pattern of P accumulation of corn plants is almost the same as the accumulation of N nutrients. In the initial phase, P accumulation growth is relatively slow, but after 4 weeks of age it increases rapidly, supported by the literature of Ginting, et al (2013) which stated that in acid soils with a pH of 5.5 is dominated by Fe^{3+} and Al^{3+} cations which can react with P-Soluble, tether or absorb it, and remove it from the solution so that it is not available for plants.

Plant Dry Weight (g)

The results of the variance test showed that the application of P sources, mycorrhiza and the interaction of P sources and mycorrhiza did not significantly increase the dry weight of the plants. The average of plant dry weight in the treatment of P sources and mycorrhiza can be seen in Table 2.

Based on the results of the research that has been done, the application of P sources and mycorrhiza had no significant effect on increasing plant weight. Plant dry weight is in line with plant height growth. In the parameters of plant height growth, unreal results were obtained. This is influenced by soil pH, as it is known that the initial soil pH is 4.99 which is classified as acidic pH causes P cannot be absorbed by plants. This was in accordance with the literature of Santoso and Sofyan (2002) which stated that many plants cannot grow well on soil that has a low P content. P fixation is a major problem in volcanic soils and acid dry soils with a clay texture containing many Al and Fe oxides, supported by the literature Ginting, et al (2013) which stated that in acid soils with a pH of 5.5 is dominated by Fe^{3+} and Al^{3+} cations which can react with P-Soluble, tether or absorb it, eliminate it from the solution so that it is not available to plants.

Table 2. Dry weight of plants with P sources and mycorrhiza treatment

P Sources	Mycorrhiza		Average
	0 gram	30 gram	
	.....ppm.....		
Control	16,68	22,02	19,35
TSP Fertilizer	22,19	28,33	25,26
Rock Phosphate Fertilizer	22,57	27,92	25,24
Chicken Manure	59,40	45,08	52,24
Cow Manure	30,22	36,43	33,32
Guano Fertilizer	23,40	25,88	24,64
Rice Husk Biochar	32,22	32,10	32,16
Average	29,52	31,11	30,31

Table 3. Soil pH (H_2O) with P sources and mycorrhiza treatment

P Sources	Mycorrhiza		Average
	0 gram	30 gram	
	.....-.....		
Control	5,90	5,98	5,94
TSP Fertilizer	6,00	5,99	5,99
Rock Phosphate Fertilizer	5,76	6,21	5,98
Chicken Manure	6,43	5,99	6,21
Cow Manure	6,66	6,35	6,50
Guano Fertilizer	5,76	6,05	5,90
Rice Husk Biochar	6,29	6,16	6,22
Average	6,11	6,10	6,11

Soil pH (H_2O)

The results of the variance test showed that the application of P sources, mycorrhiza and the interaction of P sources and mycorrhiza did not significantly increase soil pH. The average value of soil pH in the treatment of P sources and mycorrhiza can be seen in Table 3.

Based on the results of research that had been carried out, the application of P sources and mycorrhiza had no significant effect on increasing soil pH with highest pH on cow manure lowest pH on control .

The different of value pH was caused of different P source and addition of water in the watering processof plants, the presence of mycorrhiza and the presence of rain in that time span. This was in accordance with the literature of Hardjowigeno (2003) which stated that the factors that affect soil pH are parent material, climate, organic matter, and human treatment.

Degree of Mycorrhiza Root Infection (%)

The results of the variance test showed that the application of mycorrhiza and the application between P sources and mycorrhiza significantly increased the degree of root infection meanwhile the application of P sources did not significantly increase the degree of root infection. The average degree of root infection in the treatment of P sources and mycorrhiza can be seen in Table 4.

Table 4. Degree of root infection with P sources and mycorrhiza treatment

P Sources	Mycorrhiza		Average
	0 gram	30 gram	
	.....%.....		
Control	15,00 g	80,00 a	47,50
TSP Fertilizer	25,00 ef	67,50 b	46,25
Rock Phosphate Fertilizer	15,00 g	52,50 c	33,75
Chicken Manure	25,00 ef	42,50 d	33,75
Cow Manure	30,00 e	45,00 d	37,50
Guano Fertilizer	20,00 fg	52,50 c	36,25
Rice Husk Biochar	20,00 fg	40,00 d	30,00
Average	21,43 b	54,29 a	37,86

Remarks: Numbers followed by different notations indicate significantly different in the levels of 5%.

Based on the results of the research that had been done, the application of mycorrhiza had a significant effect in increasing the degree of mycorrhiza infection. The used of mycorrhizae produced 54.29% degree of mycorrhiza infection and without mycorrhiza used produced 21.43% degree of mycorrhiza infection. The higher the degree of mycorrhiza infection can indicate the more active mycorrhiza infected the roots and expand the area of root uptake to water and nutrients. This was in accordance with the literature of Nasution, et al (2014) which stated that mycorrhiza have the ability to associate with almost 90% of plant species and help in increasing the efficiency of nutrient absorption, especially phosphorus in marginal land and supported by the literature of Hanafiah, et al (2009) which stated that the working principle of mycorrhiza is to infect the host root system, to produce hyphae intensively so that plants containing mycorrhiza will be able to increase nutrient absorption capacity.

Based on the results of the research that had been carried out, the interaction of P sources and mycorrhiza application had a significant effect in increasing the degree of mycorrhiza infection with the highest value of 80.00%, in the treatment of without P-source application but with 30 g of mycorrhiza and the lowest value was 15.00% in the treatment of without P sources + 0 g mycorrhiza application and in the treatment of phosphate rock fertilizer with 0 g mycorrhiza application. From the results above, it was obtained the highest results; without P source (80) followed by TSP fertilizer (67.50%), this was due to faster mycorrhiza colonization in the soil where P availability was low because of mycorrhiza would be more active to assist the roots to get P nutrients in the soil besides that the percentage of mycorrhiza infections was influenced by amount and types of fertilizers applied to the soil. This was in accordance with the literature of Putra, et al (2016) which stated that the use of media that contains little nutrients with high cation exchange capacity and the low of P availability elements will support the colonization ofarbuscularmycorrhiza fungi, supported by Muzar (2006) which stated that the high and low percentage of arbuscularmycorrhizal fungi (AMF) infections in the roots of corn plants is influenced by the amount of AMF and fertilizer given.

CONCLUSION

P-source application did not significantly increase the growth of white corn. The application of mycorrhiza significantly increased the degree of root infection and the application coincide P sources and mycorrhiza significantly increased the degree of root infection.

REFERENCES

Elfiati, D. 2005. Peranan Mikroba Pelarut Fosfat Terhadap Pertumbuhan Tanaman. Universitas Sumatera Utara, Medan.

Ginting, N., Lahuddin, M dan Bintang, S. 2013. Efek Interaksi Pemberian Silikat dan Mikoriza pada Andisol Terhadap P-Tersedia dan Pertumbuhan Tanaman Jagung (*Zea Mays* L.). Universitas Sumatera Utara, Medan.

Hanafiah, K. A. 2009. Dasar-Dasar Ilmu Tanah. PT. Raja Grafindo Persada. Jakarta.

Hardjowigeno, S. 1993. Klasifikasi Tanah dan Pedogenesis. Penerbit Akademi Pessindo. Jakarta.

Indriyani, L. O. 2013. Studi Komparasi Penggunaan Tepung Jagung dari Varietas yang Berbeda Terhadap Kualitas Kremus. Universitas Negeri Semarang, Semarang.

Marbun, S., Mariani, S dan Bintang, S. 2015. Aplikasi Mikroba Pelarut Fosfat dan Bahan Organik untuk Meningkatkan Serapan P dan Pertumbuhan Kentang pada Andisol Terdampak Erupsi Gunung Sinabung. Universitas Sumatera Utara, Medan.

Musfal. 2010. Potensi Cendawan Mikoriza Arbuskula untuk Meningkatkan Hasil Tanaman jagung. Balai Pengkajian Teknologi Pertanian Sumatera Utara, Medan.

Muzar, A. 2006. Respons tanaman jagung (*Zea mays* L.) kultivar Arjuna dengan populasi tanaman bervariasi terhadap mikoriza vesikular arbuskular (MVA) dan kapur pertanian superfosfat (KSP) pada Ultisol. Jurnal Akta Agrosia 9(2): 75−85.

Nasution, R M., T. Sabrina dan Fauzi. 2014. Pemanfaatan Jamur Pelarut Posfat dan Mikoriza untuk Meningkatkan Ketersediaan dan Serapan P Tanaman Jagung pada Tanah Alkalin. Universitas Sumatera Utara, Medan.

Padang, S. B. 2013. Respon Pertumbuhan dan Produksi Beberapa Varietas Tanaman Jagung (*Zea mays* L.) Terhadap Pemberian Pupuk N dan P. Universitas Sumatera Utara, Medan.

Putra, R. D., Delvian dan Deni, E. 2016. Pengaruh Inokulasi Mikoriza Arbuskula Terhadap Pertumbuhan Bibit Tanaman *Slow Growing* (Glodokan dan Tanjung). Universitas Sumatera Utara, Medan.

Santoso, D dan A. Sofyan. 2002. Pengelolaan hara tanaman pada lahan kering. Departemen Pertanian, Bogor.

Subagyo, H., S. Nata dan A. B. Siswanto. 2000. Tanah-Tanah Pertanian di Indonesia dalam Sumberdaya Lahan Indonesia dan Pengelolaannya. Pusat Penelitian Tanah dan Agroklimat, Badan Penelitian dan Pengembangan pertanian, departemen pertanian. Bogor.

Yosephine, I. O., Purba, M dan Fauzi. 2012. Klasifikasi Tanah Desa Sihiong, Sinar Sabungan, dan Lumban Lobu Kecamatan Bonatua Lunasi Kabupaten Toba Samosir Berdasarkan Taksonomi Tanah 2010. Universitas Sumatera Utara, Medan.