# Effect of Planting Media Composition and Arbuscular Mycorrhizal Fungi `(AMF) on Growth and Root Infection of Potato Seed G0 Granola Cultivars

**Rama Adi Pratama[1*], Ai Yanti Rismayanti[2]**

[1] Department of Agrotechnology, Faculty of Agriculture, Universitas Jenderal Soedirman
Jl. HR Boenyamin , Purwokerto Utara, Banyumas, Jawa Tengah , Indonesia
[*]**Correspondence** : E-mail: rama.adi@unsoed.ac.id, Phone +62-81320997505
[2] Department of Agrotechnology, Faculty of Agriculture, Universitas Garut
Jl. Samarang No. 52 A, Tarogong Kaler, Garut, Jawa Barat, Indonesia

## ABSTRACT

*G0 potato seed production in Indonesia was still deficient and continues to decline. This study aims to determine the interaction between the composition of the planting medium and AMF on the growth of G0 potato seeds. This experiment was conducted from April to June 2020 in Cikajang, Garut, West Java province. This experiment was conducted with two treatment factors using Randomize Block Design (RBD) factorial pattern 4x4, two replications. There are 4 levels of planting media composition ($t_1$= compost (control), $t_2$= compost and husk charcoal (1:1), $t_3$= compost and husk charcoal (2:1), $t_4$= compost and husk charcoal (3:1)) . There are 4 levels of AMF ($m_1$= 0 g/Plot (control), $m_2$= 150 g/Plot, $m_3$= 300 g/Plot, $m_4$= 450 g/Plot). The experimental results showed that the composition of the growing media independently showed no significant difference in all observed parameters. The AMF showed significant differences in the observed parameters of plant height 30 days after planting (DAP), the number of leaves at 30 and 60 DAP, stem diameter at 45 DAP, root length at 80 DAP, and infection at 85 DAP. The best treatment was $m_4$ = 450 g/plot that gave the highest of plant height, number of leaves, stem diameter, root length, and root infection.*

***Keywords:*** *seed, potatos, mycorrhiza, planting media.*

## INTRODUCTION

All Indonesian people make food crops as source of staple food due to they have excellent nutritional content and have been staple foods for generations. Food crops, as the primary source of consumption for the Indonesian people, have been modified in a food diversification program by switching from food crops such as rice to other crops such as potatoes.

Potato is a plant with a balanced nutritional content that can adequately support food diversification programs (1). The provision of the food diversification program is not in line with the declining level of potato production. Potato production in Indonesia in 2017 decreased by 1.16 million tons with average productivity of 15.4 tons/ha. This condition is different from the total production in 2016, reaching 1.21 million tons with average productivity of 18.25 tons/ha. Based on the data above, potato productivity decreased by 2.85 tons/ha compared to 2016 (2).

This decline in potato productivity is due to the use of poor and low-quality potato seeds and the propagation and availability of seeds that are still very lacking, which are the main factors causing the decline in potato crop productivity (3). G0 potato seeds come from in vitro results in a virus-free laboratory and are then propagated through an acclimatization process under controlled conditions, followed by a seeding process in a screen house with good quality. By using of these seeds in ~~potato~~ cultivation practice enables to increase in potatoes' growth and production.

The availability of potato seeds, especially G1 seeds, is still deficient because of the seed propagation process.

Many still ignore the determination of the correct planting media and good nutrient intake for plants. Farmers still use seeds from cultivation instead of the result of seed propagation, such as screen seeding houses. Efforts to produce good potato seeds in large quantities must consider several aspects, including selecting a good and appropriate planting media, one of which is compost and husk charcoal.

Compost is an organic material that can be used as an excellent planting medium to support growth because it contains abundant nutrients that can increase crop production (4). On the other hand, husk charcoal use and growing media can support plant growth. Husk charcoal is a natural material that can help plants meet their water needs because it has very high water holding and binding capacity, which helps increase plant growth and productivity (5).

The application of Arbuscular Mycorrhizal Fungi (AMF) is an effective alternative in supporting the availability of nutrient supply for plants. AMF can maximize nutrient absorption in the soil (6), assist in the absorption of nutrients, especially phosphate (P), which Al and Fe elements can bind, improve soil structure, and maximize water uptake to support growth of the plants (4).

## MATERIAL AND METHODS

The experiment was conducted in Simpang Village, Cikajang District, Garut Regency which has an altitude of 1200 m above sea level (m asl). The experiment was carried out from April 2020 to June 2020. The materials and tools used were potato seed G0 cultivar Granola, AMF type *Glomus claroideum, Glomus mosseae, Acaulospora rogusa, Glomus fasciculatum, Acaulospora colosica and Glomus etunicatum*, compost, husk charcoal, scales, sprayers, hoe, rope, stationery, ruler, plastic, meter, calliper, scissors, microscope etc.

There were two treatment factors in this experiment using the experimental method of 4x4 factorial Random Block Design (RBD) with two replications.

There are four levels of compost and husk charcoal (t) planting media composition: $t_1$= control, $t_2$= (1:1), $t_3$= (2:1), $t_4$= (3:1). There are four levels of AMF dose (M) namely: $m_1$= 0 g/Plot (control), $m_2$= 150 g/Plot, $m_3$= 300 g/Plot, $m_4$= 450 g/Plot. The implementation of the research includes land preparation, seed preparation, composting, husk charcoal, application of planting media composition, AMF application, planting and maintenance.

Before planting, the land must be cleared of anything that can interfere with plant growth in order to obtain land that is ready for planting and free from physical (rocks, garbage, etc.) or biological (weeds or plant residues) disturbances. The seeds used were potato seeds of the G0 Granola L cultivar which had been prepared beforehand. The seeds were planted in experimental plots that had previously been inoculated with Arbuscular Mycorrhizal Fungi (AMF) in plot arrays with the number of seeds per hole, namely one seed and planting was best done in the morning. Control of potato pests and diseases depends on what pests and diseases attack the field.

The parameters for observation consisted of plant height, number of leaves, rod diameter, number of branches, leaf area, root length and root infection. Observations were made at different times according to the parameters of the observations and the conditions of the plants in the field.

The results of the analysis of variance were then subjected to the F test to determine the level of difference between each treatment, if it turned out that the F count was greater than the F table, then it was continued with Duncan's Multiple Range Test (DMRT) at the 5% level. The software used in the analysis is MS Excel.

## RESULT

### Plant height

The data obtained showed no interaction between t and m treatments on the potato plant height in each observation period. However, the AMF treatment factor gave a significant independent effect on the 30 DAP observation period. The average value of plant height is in Table 1.

**Table 1. Effect of Planting Media Composition and AMF on plant height**

| Treatments | 15 DAP | 30 DAP | 45 DAP |
|---|---|---|---|
| $t_1$ | 10.70 a | 28.47 a | 44.65 a |
| $t_2$ | 9.36 a | 31.10 a | 46.23 a |
| $t_3$ | 9.30 a | 30.95 a | 45.07 a |
| $t_4$ | 10.73 a | 32.07 a | 46.93 a |
| $m_1$ | 9.40 a | 27.73 a | 45.32 a |
| $m_2$ | 9.39 a | 27.67 a | 45.35 a |
| $m_3$ | 10.34 a | 33.00 b | 46.15 a |
| $m_4$ | 10.97 a | 34.19 b | 46.47 a |

Notes: Number followed by the same letter at the same age shows insignificant difference based on DMRT 5% (Duncan Multiple Range Test)

### Number of Leaves

There is no interaction between the t and m treatments on the number of leaves of the Granola cultivar potato in each observation period. However, the AMF treatment gave a significant effect on number of leaves at the age of observation 30 and 60 DAP (Table 2).

**Table 2. Effect of Planting Media Composition and AMF on number of leaves**

| Treatments | 15 DAP | 30 DAP | 45 DAP |
|---|---|---|---|
| $t_1$ | 10.00 a | 56.73 a | 81.40 a |
| $t_2$ | 11.08 a | 54.67 a | 82.96 a |
| $t_3$ | 9.02 a | 60.56 a | 84.17 a |
| $t_4$ | 11.00 a | 58.13 a | 83.56 a |
| $m_1$ | 9.83 a | 53.25 a | 80.60 ab |
| $m_2$ | 10.56 a | 58.46 ab | 78.31 a |
| $m_3$ | 11.23 a | 55.38 a | 85.54 b |
| $m_4$ | 9.48 a | 63.29 b | 87.62 b |

Notes : Number followed by the same letter at the same age shows insignificant difference based on DMRT 5% (Duncan Multiple Range Test)

### Rod Diameter

The data obtained showed no interaction between the t and m treatments on the stem diameter of the Granola cultivar potato in each observation period, but the AMF treatment significantly affected the 45 DAP (Table 3).

**Table 3. Effect of Planting Media Composition and AMF on rod diameter (cm)**

| Treatments | 15 DAP | 30 DAP | 45 DAP |
|---|---|---|---|
| $t_1$ | 0.27 a | 0.53 a | 0.70 a |
| $t_2$ | 0.31 a | 0.60 a | 0.80 a |
| $t_3$ | 0.30 a | 0.54 a | 0.77 a |
| $t_4$ | 0.30 a | 0.61 a | 0.83 a |
| $m_1$ | 0.29 a | 0.54 a | 0.67 a |
| $m_2$ | 0.29 a | 0.56 a | 0.74 ab |
| $m_3$ | 0.29 a | 0.56 a | 0.85 b |
| $m_4$ | 0.30 a | 0.61 a | 0.87 b |

Notes: Number followed by the same letter at the same age shows insignificant difference based on DMRT 5% (Duncan Multiple Range Test)

### Number of Branches

From the data obtained, there was no interaction between the t and m treatments on the number of branches of the Granola cultivar potato, and there was no significant independent effect on observations 70 (Table 4).

**Table 4. Effect of Planting Media Composition and AMF on number of branches**

| Treatments | Number of Branches |
|---|---|
| $t_1$ | 16.27 a |
| $t_2$ | 17.25 a |
| $t_3$ | 17.63 a |
| $t_4$ | 16.19 a |
| $m_1$ | 16.71 a |
| $m_2$ | 16.23 a |
| $m_3$ | 17.60 a |
| $m_4$ | 16.79 a |

Notes: Number followed by the same letter at the same age shows insignificant difference based on DMRT 5% (Duncan Multiple Range Test)

The data obtained showed no interaction between the composition of the growing media and Arbuscular Mycorrhizal Fungi (AMF), and there is no significant effect at the 70 DAP. The average value of the leaf area is shown in Table 5.

**Table 5. Effect of Planting Media Composition and AMF on Leaf Area**

| Treatments | Leaf Area |
|---|---|
| $t_1$ | 191.39 a |
| $t_2$ | 192.85 a |
| $t_3$ | 182.22 a |
| $t_4$ | 161.31 a |
| | |
| $m_1$ | 170.82 a |
| $m_2$ | 178.89 a |
| $m_3$ | 183.33 a |
| $m_4$ | 194.72 a |

Notes: Number followed by the same letter at the same age shows insignificant difference based on DMRT 5% (Duncan Multiple Range Test)

## Root Length and Root Infection

From the data obtained, there is no interaction between the t and m treatments on the root length and root infection of the Granola cultivar potato in the observation period 80 and 85 DAP respectively. However, the AMF had a significant effect both on the root length during the observation period of 80 DAP. and root infection at 85 DAP (Table 6).

**Table 6. Effect of Planting Media Composition and AMF on Root Length and Root Infection**

| Treatments | Root Length (cm) | Root Infection (%) |
|---|---|---|
| $t_1$ | 19.50 a | 62.50 a |
| $t_2$ | 19.25 a | 70.00 a |
| $t_3$ | 20.88 a | 55.00 a |
| $t_4$ | 20.25 a | 52.50 a |
| $m_1$ | 17.63 a | 25.00 a |
| $m_2$ | 20.38 b | 57.50 b |
| $m_3$ | 20.25 b | 70.00 bc |
| $m_4$ | 21.63 b | 87.50 c |

Notes: Number followed by the same letter at the same age shows insignificant difference based on DMRT 5% (Duncan Multiple Range Test)

## DISCUSSION

### Plant Height

The growing media composition in all observation periods did not show significantly different. The use of compost alone or in combination with husk charcoal gave an equal average value of plant height allegedly because compost and husk charcoal have almost the same nutrient content, so they have the same role on plant growth, especially in stems.

The absorption of nutrients in the planting medium by plants greatly affects the vegetative growth of plants such as plant height (7). The photosynthetic reaction, potassium acts as an activator in various enzymes and plays a role in the process of reforming starch and protein (8). Of course, these three elements are needed by plants to stimulate growth, one of which is plant height.

From the results obtained that the FMA at the age of 15 and 45 DAP were not significantly different at all treatment factor levels. In contrast, at the age of 30 DAP, the $m_1$ factor level was not significantly different from the m2 factor level but was significantly different from the m3 factor level and $m_4$ factor level. The level of the $m_4$ factor at the age of 30 DAP when the plant height growth process increased resulted in a higher value than the levels of other factors. It is suspected that large doses of AMF at the $m_4$ level can increase the nutrient absorption process so that it can support plant vegetative growth, one of which is plant height.

By maximizing nutrient uptake from the soil, AMF can increase plant growth, such as potato plant height (9).

**Number of Leaves**

The data obtained showed that planting media composition at all treatment levels was not significantly different in all observation periods. It is assumed that all treatment levels are able to meet the nutrient intake needs of plants such as N and P which play a role in leaf growth so that they have the same level of influence on the observation parameters of the number of leaves.

The nitrogen and phosphate elements play a very important role in plant growth, one of which is the growth of the number of leaves (10). Due to the presence of N and P elements in compost and husk charcoal which function in supplying nutrients so as to increase the growth of the number of leaves.

The results of the analysis of the variance of the AMF treatment factors at the age of 15 DAP gave the results that at all levels of the treatment factors were not significantly different. The $m_1$ factor level was not significantly different from the $m_2$ and m3 factor levels but was significantly different from the m4 factor level at the age period of 30 DAP. The m2 factor level was not significantly different from the m1 factor level but was significantly different from the m3 and m4 factor levels in the 60 DAP age period. At 30 and 60 DAP ages, the $m_4$ factor level produced an average number greater than the other factor levels. This result shows that leaf growth is greatly increased at this period and has entered the peak stage of growth, which requires a large amount of nutrient intake. At the $m_4$ level, it is thought to be very effective in helping the absorption of nutrients by plants because at the $m_4$ level, it has a high enough AMF content so that it can stimulate and assist roots in reaching and taking nutrients, especially P elements to the maximum to increase leaf growth.

The nutrients are needed in the process of leaf cell division and leaf formation, especially phosphorus which can spur the growth process (11). The AMF can provide phosphorus that is retained by Al and Fe elements by forming very fine external hyphae that can enter the soil widely which can increase the uptake of nutrients, especially phosphorus so that it can stimulate leaf growth (12).

**Rod Diameter**

From the data obtained, the effect of the composition of the planting media at all levels of treatment factors at all age periods of observation was not significantly different. This condition was due to the similarity of nutrient content in compost and husk charcoal at all treatment factors, which caused the same effect on the growth of potato plant stem diameter.

The use of compost and husk charcoal in planting media can support an increase in the division, elongation and enlargement of plant cells so that plant growth, especially stem size and stem diameter will increase (13).

Analysis of the variance of AMF treatment factors in the observational age period of 15 and 30 DAP was not significantly different at all levels of treatment factors. The observation period was 45 DAT, the m1 factor level was not significantly different from the m2 factor level, but was significantly different from the m3 and m4 factor levels. The m4 factor level at the age of 45 DAP showed a higher average score than the other factor levels. It is suspected that the level of m4 at this age period in the absorption of nutrients by plants is very maximal due to the assistance of AMF stimulation which helps the roots to reach and absorb nutrients, especially P from the planting medium, which is then supplied to all parts of the stem to support the process of cell enlargement and stem formation to the maximum.

Giving AMF to plants can help increase the ability of roots to take nutrients, especially phosphorus, thereby helping to increase the photosynthesis process, which produces energy to stimulate plant growth, one of which is stem size (14).

The increase in stem size is strongly influenced by nutrients, especially phosphorus which supports the process of plant cell growth, especially stem growth and formation (15).

**Number of Branches**

From the data obtained, the composition of the growing media and AMF at all levels of the treatment factors were not significantly different at the age of the observation period of 70 DAP. Allegedly due to external factors that inhibit the growth of potato plant branches, one of which is plant pest organisms that have a negative impact on plants that can inhibit the process of plant development and growth. Pests and diseases can damage important plant organs such as roots, stems, leaves and branches so that these organs are damaged and do not function optimally and then die.

Plant-disturbing organisms cause damage to plant organs which causes a decrease in plant growth (16). The Insects can attack the stems and branches of plants (17). So that the stems and branches of the plant look brown in circular punctures, and over time the affected stalks and branches will break and die.

**Leaf Area**

The results of the data obtained were that the composition of planting media and AMF at all levels of treatment factors were not significantly different in the observation period of 70 DAP. It is suspected that the old age of the plant causes the leaves to not function optimally in photosynthesis, thereby inhibiting the process of plant leaf area growth.

The older plant age affects the plant's ability to photosynthesize, thereby inhibiting plant growth (18). The chlorophyll content is related to leaf area. If the chlorophyll content in the leaves decreases, the ability of the leaves to carry out photosynthesis will decrease, impacting the growth of the leaf area (19).

**Root Length**

The effect of planting media composition at all levels of treatment factors were not significantly different at 80 DAP observations. The application of compost singly or in combination with compost and husk charcoal resulted in the same average root length. Allegedly because it can absorb and hold water and air, circulation is quite good so that the growth and development of plant roots can grow optimally. The husk charcoal in planting media can help roots grow and develop optimally because husk charcoal has a fairly high air space and pores (20).

From the data obtained, the AMF level $m_1$ is significantly different from the factor levels $m_2$, $m_3$ and $m_4$. It is suspected that at the m1 factor level, it cannot provide a significant effect in stimulating root elongation because at the m1 factor level there is no AMF administration in the growing media. The $m_4$ factor level produces a large average value compared to the other factor level values. It is suspected that the root elongation process is strongly influenced by AMF, which can stimulate roots to grow and develop longer.

The Root elongation by AMF infection has an impact on increasing the ability of roots to expand or reach the area of nutrient uptake, which can stimulate the elongation of plant root size (21). The formation of AMF hyphae on plant roots can stimulate the root system and the process of elongation of plant roots because the expansion process of nutrient uptake will be higher (22).

**Root Infection**

The results of the data on the effect of the composition of the growing media showed that all levels of treatment factors were not significantly different. It is suspected that AMF can grow well in all given planting media composition treatments. AMF spores develop and grow well on the growing media used because they use organic materials such as compost and good husk charcoal to support the development of AMF Fungi. The application of AMF with the provision of organic matter helped the growth and development of AMF (23). The compounds contained in organic matter can stimulate the process of root infection by AMF and support the growth of spores and AMF (24).

The analysis of variance showed that the effect of AMF dose on the $m_1$ factor level was significantly different from the $m_2$, $m_3$ and $m_4$ factor levels. In contrast, the $m_2$ level was significantly different from the $m_4$ level. The $m_4$ factor level shows that the average number is greater than the other treatment factor levels. This result was due to the high level of AMF dosage in the m4 treatment being able to infect roots better and more effectively.

The AMF treatment in plants played a very good role in the root colonization process. Roots infected with AMF and forming external hyphae will be able to replace the role of roots in taking nutrients in the soil to the maximum so that it can stimulate maximum plant growth (25)

The ability of AMF to maximize nutrient uptake is closely related to the percentage level of AMF infection. The higher the application and infection of AMF to the roots, the higher the nutrient absorption process in plants (26). The growth of spores and the level of AMF infection are strongly influenced by the level of AMF given to plants (27).

Black spots on plant roots characterize the characteristics of roots infected by AMF. In addition to the presence of black spots on the roots, AMF infection can be seen in the presence of very fine external hyphae on plant roots.

## CONCLUSION

1. There was no interaction between the treatment of the growing media composition and /Arbuscular Mycorrhizal Fungi (AMF) on all parameters observed in the growth of potato seeds G0.
2. There was an independent effect of AMF treatment on plant height 30 DAP, number of leaves 30 and 60 DAP, rod diameter 45 DAP, root length and observation of root infection on G0 potato seed growth. In the growing media composition, there was no significant independent effect on all parameters observed on the growth of G0 potato seeds.

## REFERENCES


1. Azima, N.S, Nuraini, A., Sumadi, Hamdani, J.S. 2017. Respons Pertumbuhan Dan Hasil Benih Kentang G0 Di Dataran Medium Terhadap Waktu Dan Cara Aplikasi Paklobutrazol (Growth And Yield Respons Of G0 Potato Seed To Times And Methods Of Paclobutrazol Applicatıon In Moderate Altitude). *Jurnal Kultivasi*, 16(2), 313–319.
2. Badan Pusat Statistik. 2017. Statistik Tanaman Sayuran Dan Buah -Buahan Semusim, Statistics Of Seasonal Vegetable Fruit Plants Indonesia.
3. Sayaka, B., & Hestina, J. 2011. Kendala Adopsi Benih Bersertifikat

Untuk Usahatani Kentang. Forum Penelitian Agro Ekonomi, 29(1), 27.

4. Prayudyaningsih, R., & Sari, R. 2016. Aplikasi Fungi Mikoriza Arbuskula (FMA) Dan Kompos Untuk Meningkatkan Pertumbuhan Semai Jati (*Tectona grandis* Linn F.) Pada Media Tanah Bekas Tambang Kapur. *Jurnal Penelitian Kehutanan Wallacea*, 5(1), 37–46.
5. Kusmarwiyah, R., & Sri Erni. 2011. Pengaruh Media Tumbuh Dan Pupuk Organik Cair Terhadap Pertumbuhan Dan Hasil Tanaman Seledri (*Apium graveolens* L.) *Jurnal Crop Agro*, 4 No.2(2), 7–12.
6. Talanca, H. 2010. Status Cendawan Mikoriza Vesikular-Arbuskular (MVA) Pada Tanaman. Prosiding Pekan Serealia Nasional, 353–357.
7. Sarief, E.S. 1986. Kesuburan dan Pemupukan Tanah Pertanian. Bandung: Pustaka Buana.
8. Lakitan, B. 1995. Fisiologi Pertumbuhan dan Perkembangan Tanaman. Jakarta: PT. Raja Grafindo Persero.
9. Astiko, W. 2009. Wahyu Astiko : Pengaruh Paket Pemupukan Berwawasan Lingkungan. 115–122.
10. Firmansyah, I., Syakir, M. dan Lukman L. 2017. Pengaruh Kombinasi N, P, dan K Terhadap Pertumbuhan dan Hasil Tanaman Terung (Solanum melongena L.). *Hortikultura*, 27 (1): 69-78.
11. Simanungkalit, R. D. M. 2001. Aplikasi Pupuk Hayati Dan Pupuk Kimia; Suatu Pendekatan Terpadu. *Bul Agrobiol* 4:56-61.
12. Setiadi, Y. 1990. Mengenal Fungi Mikoriza Dan Prospek Aplikasinya Sebagai Pupuk Biologis Untuk Meningkatkan Pertumbuhan Dan Kualitas Semai Tanaman Kehutanan. "System Produksi Bibit Sevara Missal", 18- 19 September 1996. Bogor.
13. Saban, R., Kesaulya, H., & Nendissa, J. I. 2018. Pengaruh Aplikasi Biostimulan Terhadap Pertumbuhan Dan Produksi Tanaman Sawi (*Brassica juncea* L.). *Jurnal Budidaya Pertanian*, 14(1), 41-46.
14. Gardner FP, Pearce RB, And M. R. 1991. Physiology Of Crop Plants. Diterjemahkan Oleh H.Susilo. Jakarta. Universitas Indonesia Press.
15. Lakitan, B. 2004. Dasar-Dasar Fisiologi Tumbuhan. PT. Raja Grafindo Persada. Jakarta.
16. Sembel, D. T. 2012. Dasar-Dasar Perlindungan Tanaman. Fakultas Pertanian Universitas Sam Ratulangi. Manado.
17. Budiman, A. . D. T. S., M.Tulung, V. M., M.Meray, M. Ratulangi, M., Hamming, G. C. Dan, & Shepard, B. M. 2010. Biologi Dan Tingkat Serangan Nesidiocoris Tenuis Reuter Pada Tanaman Tomat Di Sulawesi Utara. *Eugenia* 16(1): 1 -12
18. Musyarofah, N., Susanto, S., Aziz, S. A., & Kartosoewarno, S. 2007. Respon Tanaman Pegagan (*Centella asiatica* L. Urban) Terhadap Pemberian Pupuk Alami Di Bawah Naungan. *Jurnal Agronomi Indonesia (Indonesian Journal Of Agronomy)*, 35(3), 217–224.
19. Hamdani, J. S., Dewi, T. P., & Sutari, W. 2019. Pengaruh Komposisi Media Tanam Dan Waktu Aplikasi Zat Pengatur Tumbuh Terhadap Pertumbuhan Dan Hasil Benih Kentang (*Solanum tuberosum* L.) G2 Kultivar Medians Di Dataran Medium Jatinangor. *Jurnal Kultivasi*, 18(2), 875–881.
20. Agustin DA, Riniarti M, Duryat. 2014. Pemanfaatan limbah serbuk gergaji dan arang sekam sebagai media sapih untuk cempaka kuning (*Michelia champaca*). *Jurnal Sylva Lestari*, 2 (3):

49-58
21. Wicaksono, M. I., Rahayu, M., & Samanhudi, S. 2014. Pengaruh Pemberian Mikoriza Dan Pupuk Organik Terhadap Pertumbuhan Bawang Putih. *Caraka Tani: Journal Of Sustainable Agriculture*, 29(1), 35.
22. Prihastuti. 2007. Isolasi dan Karakterisa Mikoriza Vesikuler-Arbuskuler Di Lahan Kering Masam, Lampung Tengah. Balai Penelitian Tanaman Kacang-Kacangan dan Umbi-Umbian (99-106), 2007.
23. Hidayat, C. 2013. Sinergisme Fungi Mikoriza Arbuskula Dan Mycorrhiza Helper Bacteria Dalam Meningkatkan Stabilitas Agregat Tanah, Pertumbuhan Dan Hasil Tanaman Kentang Pada Takaran Bahan Organik Berbeda. *Ijas*, Vol. 3, Pp. 78–82.
24. Vaidya, G.S., K. Shrestha, B. R. Khadge, N.C. Johnson, And H. W. 2007. Organic Matter Stimulates Bacteria And Arbuscular Mycorrhizal Fungi In Bauhinia Purpurea And Leucaena Diversifolia Plantation And Eroded Slopes In Nepal. *Restoration Ecology*. 16(1):79-87.
25. Hadianur, H., Syafruddin, S., & Kesumawati, E. 2016. Pengaruh Jenis Fungi Mikoriza Arbuscular Terhadap Pertumbuhan Dan Hasil Tanaman Tomat (*Lycopersicum esculentum* Mill). *Jurnal Agrista Unsyiah*, 20(3), 126–134.
26. Rossiana, N. 2003. Penurunan Kandungan Logam Berat dan Pertumbuhan Tanaman Sengon (*Paraserianthes falcataria* . (Nielsen)) Bermikoriza dalam Medium Limbah Lumpur Minyak Hasil Ekstraksi. Universitas. Padjajaran: Bandung.
27. Fitriyah, E. 2012. Pengaruh Mikoriza Dan Umur Benih Terhadap Derajat Infeksi, Serapan P, Pertumbuhan Dan Hasil Padi (Oryza Sativa L.) Dengan Metode SRI (System Of Rice Intensification). Majalah Ilmiah Solusi Unsika 10 (22) : 1-11 Ed.