Amount of applications biofertilizer and biological control agents (*Beauveria bassiana* Vuill) on growth and yield of red chili (*Capsicum annuum* L.)

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**Abstract.** High chili production is inseparable from proper fertilization and control of pests and plant diseases. This is done because red chili is a plant that is quite susceptible to attack by pests and diseases, resulting in disruption of growth and decreased production of red chili. Efforts that can be made to overcome this problem are by applying biofertilizer and entomopathogenic fungi (*Beauveria bassiana*) as biological control agents. The application is expected to increase the production of red chili plants and reduce the use of inorganic fertilizers and chemical pesticides. The research objective was to determine the effect of amount of applications biofertilizer and biological control agents on red chili production. This study used a factorial completely randomized design consisting of two factors where the first factor was amount of applications biofertilizer and the second was amount applications of biological control agents. Each factor consists of four levels, namely zero time, one time, twice, and three times applications. The results showed that amount of applications three times of biofertilizer and biological control agents tended to give the best response to the yield of red chili.

1. **Introduction**

The production of red chili in Riau in 2016 was 12,003 tonnes with a planting area of 1,775 ha of red chili, while in 2017 the production had increased to 15,813 tonnes and the area of red chili cultivation which also increased was 2,236 ha [1]. However, the high production of red chili in Riau is also determined by the high use of inorganic fertilizers and chemical pesticides by local farmers. According to [2], the use of inorganic fertilizers does result in a fairly high increase in plant productivity, but the use of it for a long period of time is generally bad, because it can leave residues on plant production and are not environmentally friendly. [3] also stated that inorganic fertilizers have shortcomings, namely poor micro nutrients, can damage the soil and are expensive. Therefore, it is necessary to add biofertilizer based on cellulolytic bacteria based on liquid organic waste as an effort to reduce the use of inorganic fertilizers.

Biofertilizer used in this study contain a consortium of cellulolytic bacteria based on rice washing waste. The six bacterial isolates used consisted of two bacterial isolates from rice straw (*Bacillus cereus* JP6 and *Bacillus cereus* JP7), two isolates from oil palm empty bunches (*Proteus mirabilis* TKKS3 and *Proteus mirabilis* TKKS7), and two isolates from acacia litter (*Providencia vermicola* SA1 and *Bacillus cereus* SA6) [4]. The use of rice water as a carrier for biofertilizer is due to the fact...
that rice water contains nutrients that can help in the growth of red chili. According to [5], rice water contains 0.015% N, 16.306% P, 0.02% K, 2.944% Ca, 14.252% Mg, 0.027% S, 0.0427% Fe% and 0.043% B1. [6] reported that giving rice water waste volume of 60 ml polybag-1 produced the best growth and production of tomato plants, while [7] reported that giving 10 ml of biofertilizer from rice water showed the highest response to the length parameter of red chili namely 14.54 cm and the weight per fruit of the red chili plant is 3.33 g.

Pest control is also important in the cultivation of red chili plants, given that one of the difficulties in red chili cultivation is the problem of pests and diseases. Some of the main pests that can attack red chili plants are armyworms (Spodoptera litura) and whitefly (Bemici tabaci). These pests can cause a decrease in red chili production. The results of a survey in West Java conducted by [8], showed that armyworms (Spodoptera litura) and tryps are the main pests in the dry season, while in the rainy season anthracnose disease (Colletotrichum sp.).

Utilization of potential natural enemies has an important role in suppressing the abundance of pest populations is one of the integrated pest control strategies (IPM). One of the natural enemies that can be used to control pests in red chili biologically is the entomopathogenic B. bassiana. The fungus has advantages such as showing excellent effectiveness with mortality above 85% in insects, fast fungal colonization, no poison in treated plants, can be applied by spray and seed treatment methods, and increases plant growth [9]. According to [10], B. bassiana was effective in controlling Aphis gossypii with up to 77.71% controlling ability. The fastest and highest mortality rate is 80.00% at the spore concentration of 106 on the 4th day after application [11].

The use of biofertilizer and biological control agents is expected to have a good effect on red chili plants. Therefore it is necessary to know amount of applications of the use of biofertilizer and biological control agents in red chili plants. Based on this background, this study aims to determine the effect of amount of biofertilizer and biological control agents application on the growth and production of red chili.

2. Materials and methods
The research was conducted at Experimental Garden, Faculty of Agriculture and Soil Laboratory, Faculty of Agriculture, Universitas Riau, Kampus Bina Widya KM 12.5, Simpang Baru, Tampan District, Pekanbaru City, Indonesia. This research was conducted from January to May 2020.

The materials used in the study were local varieties of red chili seeds, rice water, inceptisol top soil, the six isolates of cellulolytic bacteria, 70% alcohol, plastic wrap, plastic, spiritus, tissue, label paper, aluminum foil, aquades, Nutrient Broth (NB), brown sugar, cotton, water, Urea, SP-36, KCl, B. bassiana fungi isolate, broken corn, and sugar. The tools used in this research were polybags size 35 cm x 40 cm, meter, bucket, polynet, digital scales, analytical scales, oven, petri dishes, test tube, stirring rod, erlenmeyer, dropper pipette, ose needle, bunsen, hot plate, autoclave, shaker, baby polybags, laminar or enkas, knives, stakes, labels, hoes, raffia ropes, 20 mesh sieves, lawn mowers, hoes, machetes, stationery and other supporting tools.

This research was carried out experimentally using a factorial completely randomized design (CRD) in which the first factor was amount of biofertilizer from a consortium of cellulolytic bacteria based on 10 ml of organic liquid waste (P) and the second factor was biological control agents. with a dose of 30 gl-1 (A). Each factor consists of 4 levels, namely zero times, once (at planting), twice (at planting and 30 days after planting), and three times (at planting, 30 and 60 days after planting). These two factors will be obtained as many as 16 treatment combinations and repeated three times to obtain 48 experimental units. Each experimental unit consists of two plants, so that the total of plants used is 96 plants. Data obtained from this study were analyzed statistically with analysis of variance, then further tested using the Duncan Multiple Range Test (DMRT) at the 5% level.
3. Results and discussion

3.1. Red chili growth response
The results of variance showed that amount of applications of biofertilizer and biological control agents had no significant effect on plant height, dichotomy height and flowering age. The application of amount of biofertilizer had a significant effect on all parameters of the observation and the application of amount of applications of biological control agents had an effect on the parameters of flowering and harvesting age. The results of Duncan's multiple distance further test at the 5% level can be seen in table 1.

| Observation      | Amount of applications biofertilizer | Amount of applications biological control agents | Average |
|------------------|--------------------------------------|---------------------------------------------------|---------|
|                  | Zero Times                          | One time                                          | Three times |         |
| Plant height     | 28.67 c                              | 33 bc                                             | 38.1 bc     | 35.95 bc | 33.93 B |
|                  | 39.25 ab                            | 35.8 bc                                           | 35.82 bc    | 38.12 bc | 37.2 AB  |
|                  | 36.57 bc                            | 42.4 ab                                           | 39.55 ab    | 42.07 ab | 40.14 A  |
|                  | 34.53 bc                            | 42.8 ab                                           | 38.73 ab    | 47.23 a  | 40.82 A  |
|                  | Average                             |                                                  |           |         |        |
|                  | 34.59 B                             | 38.5 AB                                           | 38.89 AB    | 40.00 A  |         |
| High Dichotomy  | 14.85 c                             | 15.4 abc                                          | 16.7 abc    | 14.77 c  | 15.43 B  |
|                  | 16.97abc                            | 15.7 abc                                          | 16.3 abc    | 17.42 abc | 16.6 AB  |
|                  | 15.97abc                            | 17.3 abc                                          | 18.5 abc    | 18.05 abc | 17.44 A  |
|                  | 15.12 bc                            | 19.3 ab                                           | 18.0 abc    | 19.53 a  | 17.99 A  |
|                  | Average                             |                                                  |           |         |        |
|                  | 15,725 A                            | 16.9 A                                            | 17.39 A     | 17.4417 A|         |
| Flowering Age    | 49.83 f                             | 41.8 cde                                          | 46.17 ef    | 41.83cede | 44.92 B  |
|                  | 40.5bcde                            | 41.3 cde                                          | 40.6bcde    | 38.0 abcd | 40.12 A  |
|                  | 43.0 cde                            | 37.2 abc                                          | 37.3 abc    | 37.00 abc | 38.62 A  |
|                  | 44.17def                            | 38.6abcde                                         | 34.50 ab    | 33.83 a  | 37.79 A  |
|                  | Average                             |                                                  |           |         |        |
|                  | 44.37 B                             | 39.75 A                                           | 39.67 A     | 37.67 A  |         |
| Harvest Age      | 100 e                               | 90 abcd                                           | 94.83 de    | 90.3abcde | 93.83 B  |
|                  | 86.7abcd                            | 95.33 de                                          | 93.83 de    | 91 bcde  | 91.7 AB  |
|                  | 94 de                               | 95.2 de                                           | 82 abc      | 88 abcd  | 89.7 AB  |
|                  | 95.67 de                            | 91.7 cde                                          | 80.83 ab    | 80.67 a  | 87.46 A  |
|                  | Average                             |                                                  |           |         |        |
|                  | 93.04 B                             | 93.08 B                                           | 89.12 AB    | 87.54 A  |         |

Note: The numbers followed by the same lowercase letter are not significantly different according to the DMRT test at the 5% level

Table 1 shows that amount of applications of biofertilizer and biological control agents three times gave the best results for each parameter. However, it was not significantly different from amount of applications once and twice, except in the zero time treatment application of biofertilizer and biological control agents. This is presumably because the biofertilizer from the consortium of cellulolytic bacteria based on rice water and local biological control agents B. bassiana are able to provide the nutrients and resistance needed for plants to increase vegetative growth.

The application of biofertilizer gave a significant difference to the height growth of red chili plants. The treatment of amount of applications of biofertilizer for three times was not significantly different from the treatment of one and two applications of biofertilizer, but it was significantly different from the treatment without the application of biofertilizer. Application of biofertilizer three times gave the best results at plant height, namely 40.82 cm. This is because biofertilizer from the consortium of cellulolytic bacteria based on rice water can provide additional nutrients needed for the height increase of red chili plants.
According to [12], plants will thrive if the nutrients needed by plants are available in sufficient quantities and can be absorbed by plants for photosynthesis to produce photosynthesize and assimilates which are used for vegetative growth of plants. This is in line with the opinion of [13] which states that the element N is the main nutrient for plants, especially the formation and growth of vegetative which can stimulate the growth of roots, stems, leaves and plant height.

On the average parameter of flowering age, red chili plants at the time of this study ranged from 33.83 to 46.17 days after planting (DAT). The availability of nutrients during the vegetative to generative growth process greatly determines the success of the flower until it reaches the fruit. According to [14], the nutrient P has a role in accelerating the formation of flowers, ripening of fruits and seeds. The same P content in each available biofertilizer causes the results of observations for each parameter to not be significantly different.

Although the average flowering age was not significantly different, the flowering age of red chili in this study was faster than the description of the plants so that it resulted in a faster harvesting age. Research results by [15] showed that a faster flowering age is good for red chili plants because a faster flowering is usually followed by a shorter harvest age. The average harvesting age of red chili at the time of the study was 80.67 to 95.67 DAS, while the harvest age in the description was 85-95 DAS.

The use of *B. bassiana* as a biological agent had no significant effect on the response to plant growth. This is in accordance with the statement [16] in their research that the application of *B. bassiana* has no significant effect on plant height, total of leaves, total of flowers and total of pods of soybean plants. This is because *B. bassiana* is an entomopathogenic fungus, meaning that it can infect and even cause death in insects [17], besides that *B. bassiana* fungus is also an aggressive parasite for various types of insects and attacks both in the larval and adult stages so that the fungus this has no effect on plant height. According to [18] in their research stated that *B. bassiana* lives attached to or becomes a parasite on the target insects only and does not affect plant growth. So it can be said that the biological agent *B. bassiana* can only play an indirect role, as protection against pest attacks.

### 3.2. Red chili production response

The results of variance showed that amount of applications of biofertilizer from the consortium of cellulolytic bacteria based on rice water and local biological control agents *B. bassiana* had no significant effect on all observation parameters, both fruit length, fruit weight, total of fruits per plant and fruit weight per plant. Amount of applications biofertilizer significantly affected all the observed parameters. However, amount of applications biological control agents affected the parameters of flowering and harvesting age. The results of Duncan's multiple distance further test at the 5% level can be seen in table 2.

Table 2 shows that the response to the yield of red chili plants with the combination of amount of applications of biofertilizer from the consortium of cellulolytic bacteria based on rice water and amount of applications of local *B. bassiana* three times gave results that were not significantly, but different with amount of applications one time and twice and different real without the application of fertilizer and biological control agents.

In this study, total of fruits per plant of red chili was in line with the weight of fruit per plant. The greater the total of fruit, the higher the fruit weight per plant. This is consistent with the results of research by [19], which states that the total of fruits correlates with fruit weight per plant, the higher the total of fruits, the higher the fruit weight per plant. [20] added that the more the total of fruits formed, the higher the fruit weight per plant.

The total of fruit and fruit weight per plant of red chili produced in this study were relatively small, ranging from 21.17-62.36 g per plant (table 2). This value is smaller than the description, where the fruit weight per plant of red chili is 1-1.2 kg per plant. This is presumably because at the time of the research, there were 8 harvests because some treatments were no longer able to produce due to the lack of plant nutrient availability.
The resulting fruit length is relatively short. This is due to a lack of adequate nutrition for red chili plants. [21] stated that nutrient deficiency during growth causes plant metabolism to become inactive so that the cell differentiation process will be disrupted, which affects fruit weight and length of red chilies.

Table 2. Response of red chili production by applications of biofertilizer and biological control agents

| Observation                              | Amount of applications biofertilizer | Amount of applications biological control agents | Average |
|------------------------------------------|-------------------------------------|-----------------------------------------------|---------|
|                                          | Zero Times                          | One time                                      | Twice   | Three times |                 |
| Fruit Length                             |                                     |                                               |         |             |                  |
| Zero Times                               | 12.45 b                             | 14.49 ab                                      | 12.98 ab| 13.72 ab    | 13.41 B         |
| One time                                 | 14.32 ab                            | 13.97 ab                                      | 12.95 ab| 13.67 ab    | 13.7 B          |
| Twice                                    | 14.39 ab                            | 14.04 ab                                      | 13.93 ab| 13.59 ab    | 14.0 AB         |
| Three times                              | 14.2 ab                             | 14.772 a                                     | 14.96 a | 15,265 a    | 14.8 A          |
| Average                                  | 13.841 A                            | 14.321 A                                      | 13.71 A | 14.06 A     |                  |
| Fruit Weight                             |                                     |                                               |         |             |                  |
| Zero Times                               | 2.155 c                             | 2.617 bc                                      | 2.7 ab  | 2.71 ab     | 2.55 B          |
| One time                                 | 2.899 ab                            | 2.73 abc                                      | 2.68 ab | 2.72 ab     | 2.76 AB         |
| Twice                                    | 2.74 abc                            | 2.839 ab                                      | 2.87 ab | 2.85 ab     | 2.81 AB         |
| Three times                              | 2.894 ab                            | 2.867 ab                                      | 3.03 ab | 3.26 a      | 3.01 A          |
| Average                                  | 2.662 A                             | 2.762 A                                       | 2.831 A | 2.885 A     |                  |
| Total of fruits per plant                |                                     |                                               |         |             |                  |
| Zero Times                               | 8.33 c                              | 17.2 abc                                      | 12.7 ab | 8.83 bc     | 11.75 B         |
| One time                                 | 14.3 abc                            | 19 abc                                        | 11.17 bc| 12.8 bc     | 14.33 B         |
| Twice                                    | 19.5 abc                            | 22.5 ab                                       | 22.5 ab | 24.83 ab    | 22.33 A         |
| Three times                              | 14.3 ab                             | 24.7 ab                                       | 25.17 ab| 25.67 a     | 22.46 A         |
| Average                                  | 14.12 B                             | 20.83 A                                       | 17.88 AB| 18.04 AB    |                  |
| Fruit weight per plant                   |                                     |                                               |         |             |                  |
| Zero Times                               | 21.17 c                             | 38.56 abc                                     | 34.3 ab | 24.56 bc    | 30.81 B         |
| One time                                 | 36.4 abc                            | 46.25 abc                                     | 33.7 ab | 25.79 bc    | 34.40 B         |
| Twice                                    | 36.8 abc                            | 39.93 abc                                     | 56.14 ab| 35.3 abc    | 42.0 AB         |
| Three times                              | 32.7 abc                            | 51.29 abc                                     | 50.2 abc| 62,363 a    | 49.13 A         |
| Average                                  | 32.94 A                             | 44,008 A                                      | 43,599 A | 35.84 A     |                  |

Note: The numbers followed by the same lowercase letter are not significantly different according to the DUNCAN test at the 5% level

Although the fruit length parameter gave insignificantly different results for all treatments, applications three times showed the highest response to the fruit length parameter, namely 15.265 cm and the weight per fruit according to the description, namely 3.26 g. The application of rice water biofertilizer is considered to increase soil fertility because the bacteria contained in this dose can work optimally in remodeling and facilitating intake of nutrients needed by plants.

The P content in rice water is sufficient to respond to fruit length and weight per red chili so that it produces a length and weight that matches the description. According to [22] it is stated that the P element is one of the essential nutrients needed by plants for growth and yield, if the need for P elements in plants is met, the plant will produce lots of fruit and quality. [23] added that the element P will affect the amount absorbed by plants, and play a role in accelerating the formation or purification of fruit, flowers and seeds.

The availability of P is thought to have originated from the presence of the bacteria Providencia vermicola in the consortium used. Providencia vermicola bacteria is a potential phosphate solubilizing bacteria, so it is suspected that it is active in contributing P elements in biofertilizer.

Apart from the P element which plays a role in the fruit formation process, the K element is also needed in the fruit formation process. According to [24], the K element plays a role in increasing size of fruit and influencing the success of flowers into fruit. [25] added that fruit is influenced by the K nutrient which functions for the transport of carbohydrates, as a catalyst in the formation of protein,
increases levels of carbohydrates and sugar in fruit, makes plant seeds fuller and denser, and improves fruit quality such as a better shape.

Character length, fruit diameter and thickness of red chili fruit flesh have a large effect on yield characters in red chili plants, the greater the diameter and length of a fruit, the greater the weight per fruit tends to be [26]. The results of the research by [27] stated that the provision of rice water had a significant effect on increasing the wet weight of orchid plants by around 900 grams.

The role of the biological agent *B. bassiana* is not seen directly in the yield of red chili plants, however, this biological agent acts as protection for red chili plants. This is consistent with the statement of [28] which states that the endophytic fungus *B. bassiana* plays an indirect role by suppressing microbes.

4. Conclusions
The amount of applications of biofertilizer based on rice water and local biological control agents *B. bassiana* did not take effect on all observed parameters on red chili. Amount of applications biofertilizer and biological control agents three times the applications gave the best response to all observed parameters compared to the treatment without application of fertilizer and biological control agents. Amount of applications three times of biofertilizer and biological control agents gave the best response to the growth and yield of red chili.

References
[1] Badan Pusat Statistik Riau [Riau Central Bureau of Statistics] 2018 Riau dalam Angka 2017 [Riau in Figures 2017] (Pekanbaru: BPS-Statistics of Riau [Riau Central Bureau of Statistics])
[2] Musnamawar IE 2015 Pembuatan dan Aplikasi Pupuk Organik Padat [Manufacture and Application of Solid Organic Fertilizer] (Jakarta: Penebar Swadaya)
[3] Lingga P and Marsono 2004 Petunjuk Penggunaan Pupuk [Instructions for Use of Fertilizer] (Jakarta: Penebar Swadaya)
[4] Hapsoh, Wawan and Dini IR 2016 Aplikasi Pupuk Organik Dengan Teknologi Mikrob Mendukung Pertanian Terpadu Berkelanjutan Pada Lahan Gambut [Application of Organic Fertilizer with Microbial Technology Supports Food Crop Based Sustainable Integrated Agriculture on Peatlands] (Pekanbaru: Universitas Riau)
[5] Wulandari GM, Muhartini S and Trisnowati S 2012 Pengaruh air cucian beras merah dan beras putih terhadap pertumbuhan dan hasil selada (*Lactuca sativa* L.) [Effect of washing water for brown and white rice on growth and yield of lettuce (*Lactuca sativa* L.) *Vegetalika* 1 2 pp 1-12
[6] Wati M, Damhuri and Safilu 2017 Pengaruh pemberian air beras terhadap pertumbuhan dan produktivitas tanaman tomat (*Solanum lycopersicum* L.) [Effect of rice water on the growth and productivity of tomato (*Solanum lycopersicum* L.)] *J. Ampibi* 2 1 pp 49-56
[7] Hapsoh, Dini IR, Salibiah D and Kusmiati 2019 Growth and pepper yields (*Capsicum annuum* L.) by giving a formulation of biological fertilizers of cellulolytic bacteria based on organic liquid waste *J. Phys. Conf. Ser.* 1351 012097 pp 1-12
[8] Adiyoga W, Basuki RS, Hilman Y and Udiarto BK 1996 Studi baseline identifikasi dan pengembangan teknologi PHT pada tanaman cabai di Jawa Barat [Baseline study on the identification and development of IPM technology in red chili plants in West Java] *Proc. of the Conf. on the Prep. of Integrated Pest Manag. Prison National Prog. PHT* pp 421-50
[9] Trizelia and Winarto 2016 Keanekaragaman jenis cendawan entomopathogen endofit pada tanaman kakao (*Theobroma cacao*) [Diversity of endophytic entomopathogenic fungi in cocoa (*Theobroma cacao*)] *Proc. of the National Seminar on Indonesian Biodiversity Society* 2 2 pp 277-81
[10] Fadhilah LN and Asri MT 2019 Keefektifan tigajenis cendawan entomopathogen terhadap serangga kutu daun *Aphis gossypii* (Hemiptera: Aphididae) pada tanaman cabai [The effectiveness of three types of entomopathogenic fungi against *Aphis gossypii* (Hemiptera: Aphididae) aphids in red chili plants] *Lentera Bio* 8 1 pp 56-60
[11] Wowiling BP 2015 Pemanfaatan jamur Beauveria bassiana terhadap serangga Aphis sp. pada tanaman cabai [Utilization of Beauveria Bassiana Fungus Against Aphis Sp On Red Chili Plants] (Manado: Sam Ratulangi University)

[12] Tambunan ER 2009 Respon Pertumbuhan Bibit Kakao (Theobroma Cacao L) Pada Media Tumbuh Subsoil Dengan Aplikasi Kompos Limbah Pertanian Dan Pupuk Anorganik [Growth Response Of Cacao Seedlings (Theobroma cacao L) On Subsoil Growing Media With The Application Of Agricultural Waste Compost And Inorganic Fertilizers] (Medan: Universitas Sumatera Utara)

[13] Napitulu D and Winarno L 2010 Pengaruh peemberian pupuk N dan K terhadap pertumbuhan dan produksi cabai [The effect of N and K fertilizer application on the growth and production of peanuts] J. Hortikultura 20 1 pp 27-35

[14] Munir R and Arifin Y 2010 Pertumbuhan dan hasil mentimun akibat pemberian pupuk kandang dan gandasil B [Cucumber growth and yield due to the application of chicken manure and gandasil B] J. Jerami 3 2 pp 63-70

[15] Cahya EBN, Nurbaiti and Deviona 2014 Pendugaan genetik tanaman cabai di lahan gambut [Estimation of genetic parameters for chili plants in peatlands] J. Online Faculty of Agriculture Universitas Riau 1 2 pp 1-14

[16] Hasibuan R, Yuniarsih C, Indriyati and Purnomo 2014 Efikasi Beauveria bassiana terhadap hama kutu daun (Aphis glycines Matsumura) dan pengaruhnya terhadap organisme nontarget dan pertumbuhan tanaman kedelai [The efficacy of Beauveria bassiana against aphids (Aphis glycines Matsumura) and its effects on non-target organisms and the growth of soybean plants] J. Agrotek Tropika 2 2 pp 177–80

[17] Purnama H, Hidayati N and Setyowati E 2015 Pengembangan produksi pestisida alami dari Beauveria bassiana dan Trichoderma sp. menuju pertanian organik [Development of natural pesticide production from Beauveria bassiana and Trichoderma sp. towards organic farming] WARTA 18 1 pp 1–9

[18] Mandasari L, Hasibuan R, Hariri A and Purnomo 2015 Pengaruh frekuensi aplikasi isolat jamur entomopathogen Beauveria bassiana terhadap kutudaun (Aphis glycines Matsumura) dan organisme nontarget pada pertanaman kedelai [Effect of frequency of application of the entomopathogenic fungus isolate Beauveria bassiana on aphids (Aphis glycines Matsumura) and non-target organisms on soybean crops] J. Agrotek Tropika 3 3 pp 384–92

[19] Sharma VK, Semwal CS and Uniyal P 2010 Genetic variability and character association analysis in bell red chili (Capsicum annuum L.) J. of Horticulture and Forestry 2 3 pp 58-65

[20] Bernadius TWW 2002 Kiat mengatasi buah salak segaran (Salacca zalacca gaertner Voss) dengan perlakuan pra panen [Tips for dealing with fresh salak fruit (Salacca zalacca gaertner Voss) with pre-harvest treatment] Agritek 9 4

[21] Haryatini BA and Santoso M 2000 Pertumbuhan Dan Hasil Cabai Merah (Capsicum annuum L.) Pada Andisol Yang Diberi Mikoriza Pupuk Fosfor Dan Zat Pengatur Tumbuh [Growth and Yield of Red Chili (Capsicum annuum L) On Andisols Given Mycorrhizae, Phosphorus Fertilizers and Growth Regulators] (Malang: University of Brawijaya)

[22] He ZT, Griffin S and Cuttt WH 2004 Evaluation of soil phosphorus transformation by sequential, fractionation and phosphorus hydrolysis Soil sci. 169 pp 515-27

[23] Makarim EP, Maria and Razil R 2007 Pengaruh pupuk NPK mutiara dan pupuk kandang sapi terhadap pertumbuhan dan hasil tanaman cabai merah keriting varietas Arimbi (Capsicum annuum L) [The effect of NPK pearl fertilizer and cow manure on the growth and yield of curly red chili plants of Arimbi variety (Capsicum annuum L)] J. Agrifor 8 2 pp 191-8

[24] Drotleff T 2010 Potassium is important Keep almond orchards well-fertilized to avoid potassium depletion. J. Agric ProQuest 130 1 pp 3-4

[25] Shinta, Kristianti and Warisnu 2014 Pengaruh aplikasi pupuk hayati terhadap pertumbuhan dan produktivitas tanaman cabai rawit varietas bhaskara di PT Petrokimia Gresik [The effect of the
application of biofertilizer on the growth and productivity of cayenne pepper varieties of Bhaskara at PT Petrokimia Gresik [J. Sains dan Seni Poniit 2] pp 2337-3520
[26] Syukur M, Sujiprihati S, Yunianti R and Nida K 2010 Pendugaan komponen ragam, heritabilitas, dan korelasi untuk menentukan kriteria seleksi cabai [Estimation of variance, heritability, and correlation components to determine the red chili selection criteria] J. Hort. Indonesia 1 2 pp 74-80
[27] Purnami, NLGW, Yuswati H, Made AA and Astiningsih 2014 Pengaruh jenis dan frekuensi penyemprotan leri terhadap pertumbuhan bibit anggrek (Phalaeonopsis sp.) [Effect of type and frequency of spraying of leri on the growth of orchid seeds (Phalaeonopsis sp.)] Pasca Aklimatisasi E-Jurnal Agrotknologi Tropika 1 3 pp 22-31
[28] Gao FK, Dai CC and Liu XZ 2010 Mechanism of Fungal Endophytes in Plant Protection Against Pathogens African J of Microbiol Research 4 13 pp 1346-51

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