

Application of *Streptomyces* sp. and *Trichoderma* sp. for Promoting Generative Plants Growth of Cherry Tomato (*Lycopersicon cerasiformae* Mill.)

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ABSTRACT

Production of cherry tomatoes in Indonesia is still low, which might be due to the inappropriate planting and maintenance processes. This research applied biological agent microorganisms *Streptomyces* sp. and *Trichoderma* sp. as Plant Growth Promoting Microorganisms (PGPM) in sustainable agricultural systems. This study aimed to determine the effect of the concentration of microorganisms *Streptomyces* sp. and *Trichoderma* sp. on the growth and production of cherry tomato plants on the polybag scale. The study was arranged with different concentrations of microorganisms *Streptomyces* sp. and *Trichoderma* sp. These concentration applied consisted of 1 : 0 : 0 : 1 ; 2 : 2 : 3 ; 1 and without PGPM, each repeated four times. The results showed that the treatment of PGPM *Streptomyces* sp. and without *Trichoderma* sp. (1:0) resulted in the shortest flowering period (33.99 days after planting). Meanwhile, the treatment without *Streptomyces* sp. and *Trichoderma* sp. (0 : 1) produced the highest solid weight fruit (69.82 grams/plant).

Keywords: Biological, Growth, Microorganisms, Production

ABSTRAK

Produksi tanaman tomat cherry di Indonesia masih rendah hal ini dapat terjadi proses penanaman dan pemeliharaan yang kurang tepat. Penelitian ini menggunakan mikroorganisme agen hayati *Streptomyces* sp. dan *Trichoderma* sp. sebagai Plants Growth Promoting Microorganism (PGPM) dalam sistem pertanian berkelanjutan. Tujuan penelitian ini untuk mengetahui pengaruh konsentrasi mikroorganisme *Streptomyces* sp. dan *Trichoderma* sp. terhadap pertumbuhan dan produksi tanaman tomat cherry. Penelitian disusun dengan Rancangan Acak Kelompok (RAK) dengan faktor konsentrasi mikroorganisme *Streptomyces* sp. dan *Trichoderma* sp. Faktor perlakuan tersebut yaitu Kosentrasi 1 : 0 : 0 : 1 ; 2 : 2 : 3 ; 1, dan tanpa pemberian PGPM masing masing diulang sebanyak empat kali. Hasil penelitian menunjukkan awal bunga muncul terpendek 33,99 hari setelah tanam pada perlakuan pemberian PGPM *Streptomyces* sp. dan tanpa *Trichoderma* sp. (1:0). Perlakuan pemberian PGPM Konsentrasi tanpa *Streptomyces* sp.: dengan *Trichoderma* sp. (0:1) menghasilkan berat buah pertanaman tertinggi dengan nilai rata rata 69,82 gram.

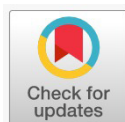
Kata Kunci: Hayati, Pertumbuhan, Mikroorganisme, Produksi

INTRODUCTION

Indonesian people know the Cherry tomato plant for its nutritional content and good benefits for health. Cherry tomato plants belong to annual plants that can be harvested many times in one year. Cherry tomato crop production reached 962,849 tons in 2017 (Kementerian Pertanian, 2017). Tomato crop production in 2014 and 2015 decreased by 7.74% and 4.17%, respectively, which had not met national demand, so 11 tons of tomato imports were needed (Direktorat Jenderal Hortikultura,

2015). The declining tomato crop production can occur due to the decreasing agricultural land (Pusat Data dan Sistem Informasi Pertanian, 2014). Therefore, an effort is needed to change the strategy to get optimal results.

In addition to paying attention to the environmental conditions, the cultivation of cherry tomato plants also needs to consider the needs of nutrients in plants, as well as providing fertilizers containing micronutrients and macro nutrients



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that function as activators for various enzymes and help the plant growth and development (Yanti et al., 2013). One of the efforts that can be made to improve the quality and quantity of cherry tomato plants is to add microorganisms that act as PGPM and biological agents. The application of these microorganisms is considered the most promising technology for sustainable agriculture. However, it requires effective adoption and standardization of bio formulations for applications in the field. PGPM also acts as a biological agent and is very promising for successful implementation in sustainable agriculture (Verma et al., 2019).

Trichoderma sp. is an antagonistic fungus that has a role as a biological agent and decomposing organism of organic matter. *Trichoderma* sp. use can increase shallot plants' growth and control diseases that attack plants (Yanti et al., 2019). The filtrate from *Trichoderma viridae* VKF3 derived from mangrove soils can produce a fairly high IAA and suppress pathogens' development (Kumar et al., 2017). Putri et al., (2018) reported that using *Streptomyces* sp. as a growth booster could increase plant height, the number of productive branches, and the roots volume by 27.3%, 24.3%, and 20.7%, respectively. According to Tamreihao et al., (2016), in addition to acting as a biocontrol, the biological agency *Streptomyces* sp. has a role in increasing plant growth. Using biological agents *Streptomyces* sp. as a growth promoter can increase plant height, the number of productive branches, and root volume.

The use of bacteria *Streptomyces* sp. as biological agents has a role in reducing the application of inorganic fertilizers. The isolates of *Streptomyces* sp. are the biological agents of the fruit fly *Bactrocera* sp., which are potential as a PGPB for tomato and chili plants and can increase plant height, number of flowers, and number of fruits (Suryaminarsih et al., 2019). *Streptomyces griseorubens*, *Gliocladium virens* and *Trichoderma harzianum* are compatible,

and the association of these microorganisms can precipitate fusarium wilt disease (Suryaminarsih et al., 2015). *Streptomyces* sp. is a bacterium that has a role as a biological agent.

The use of microorganisms as biological agents and PGPM for plants can reduce the use of inorganic fertilizers because using microorganisms with good habitat management will be able to decompose organic matter into nutrients available for plants. These microorganisms as decomposers will also be available at all times, mainly used in sustainable agricultural systems so that it is expected that the needs of nutrients in plants can be met. The application of biological agents *Streptomyces* sp. and *Trichoderma* sp. at the proper doses and concentrations are expected to spur the growth and production of cherry tomato plants (*Lycopersicon cerasiformae* Mill.). Thus, this study aimed to determine the concentration of *Streptomyces* sp. and *Trichoderma*, which can promote the growth of cherry tomato plants in a sustainable and environmentally friendly farming system.

MATERIALS AND METHODS

The research was conducted in the trial field of the Faculty of Agriculture, Universitas Pembangunan Nasional Veteran East Java, from November 2020 to March 2021. This study used cherry tomato plants cv. Juliet and Plants Growth Promoting Microorganism *Streptomyces* sp. and *Trichoderma* sp. obtained from the Plant Health Laboratory of the Faculty of Agriculture, Universitas Pembangunan Nasional Veteran East Java. This study was arranged in a Randomized Block Design (RBD) with one treatment factor, namely the PGPM formula consisting of several concentrations and combinations of *Streptomyces* sp. and *Trichoderma* sp., namely without the administration of PGPM (Control), PGPM 1 (ST 1:0) containing *Streptomyces* sp., PGPM 2 (ST 0:1) containing *Trichoderma* sp.,

PGPM 3 (ST 2:2) containing *Streptomyces* sp. and *Trichoderma* sp. with a concentration of 2 : 2 and PGPM 4 (ST 3: 1) containing *Streptomyces* sp. and *Trichoderma* sp. with a concentration of 3 : 1.

Production Media and PGPM

The production media were made of Sugar Potato Extract (SPE). The composition of the SPE media was 250 grams of potatoes, 22.5 grams of sugar, and 1 liter of sterile distilled water. The manufacture of PGPM used the ratio of *Streptomyces* sp. and *Trichoderma* sp., which were propagated in the production media. A colony of *Streptomyces* sp. and *Trichoderma* sp. isolates were cut using a cork borer with a diameter of 0.5 cm. In the treatments of single biological agents, four colonies of *Streptomyces* sp. (PGPM1) and *Trichoderma* sp. (PGPM2) were added in 150 mL of SPE media. In the combination treatment of PGPM 3, two colonies of *Streptomyces* sp. and *Trichoderma* sp. were added in 150 mL of SPE media (ST 2:2). In the combination treatment of PGMP 4, the colonies of *Streptomyces* sp. and a colony of *Trichoderma* sp. were added in 150 mL of SPE media (TS 1:3). Meanwhile, in control treatment was prepared without addition of bioagents (K). Each treatment was shaken using IKA Yellow line RS 10 for 14 days.

Planting and Maintenance

Seeds of cherry tomato plants were sown on a soil medium and composted in a ratio of 1:2 using tray pots for 21-28 days. Afterward, the seedlings were transplanted to polybags measuring 35 cm x 35 cm containing garden soil planting media and compost ([Ramdani et al., 2018](#)). Transplanting was carried out after the seedlings were 30 days old, with one cherry tomato seedling/polybag. Fertilizing was carried out using 2 grams NPK fertilizer in each polybag seven days after planting (DAP) and 5 grams on 15, 30, 45, and 60 DAP.

The Application of PGPM *Streptomyces* sp. and *Trichoderma* sp.

PGPM *Streptomyces* sp. and *Trichoderma* sp. applied had been dissolved at 20 mL of PGPM in 980 mL of distilled water. PGPM solution was given at the time of transplanting by casting (200 mL/plant) and spraying (100 mL/plant) according to treatment at 7, 21, and 35 DAP.

Observation and Data Analysis

The variables observed in the effect of biological agents on the generative growth of cherry tomato plants include the flowering period, the number of flowers per plant, the number of fruits, and the weight of fruits per plant. The data were analyzed using ANOVA (software, type, year) and followed by an HSD test at 5% ([Rochiman, 2008](#)).

RESULTS AND DISCUSSION

Number of Flowers, Number of Fruits, and Weight of Fruits per Plant Period 1

Based on the ANOVA results, there was no significant effect of the treatment of PGPM (Plants Growth Promoting Microorganism) *Streptomyces* sp. and *Trichoderma* sp. on the number of flowers, the number of fruits per plant, the number of fruits per plant, and the weight of the total fruits per plant. However, the final observation on the number of flowers and fruit weight in cherry tomato plants treated with PGPM *Streptomyces* sp. showed larger average values than those without the application of PGPM and with the application of other PGPM concentration formulas. (Table 1).

The highest number of flowers (40.32) was obtained in the treatment of PGPM *Streptomyces* sp., while the lowest number of flowers (38.24) was in the treatment without PGPM. The highest number fruits per plant (5.37) was observed in the combination treatment of PGPM *Streptomyces* sp. and *Trichoderma* sp. (3: 1), while the lowest number

Table 1. The average flowering period and weight of fruits per plant at period 2

Concentration of PGPM <i>Streptomyces</i> : <i>Trichoderma</i>	Flowering period (35 days after planting)	Parameter Weight of fruits per plant (gram)
Without PGPM	35.16ab	43.08a
ST (1:0)	33.99a	54.93ab
ST (0:1)	37.58b	69.82b
ST (2:2)	37.53b	65.88b
ST (3:1)	34.31a	60.31 ab
BNJ 5%	2.88	17.55

Remarks: Means followed by the same letters are not significantly different based on HSD test at 5%, S = *Streptomyces* sp., T = *Trichoderma* sp.

(4.41) was in the treatment without PGPM. The highest total number of fruits (34.08) was obtained in the treatment of PGPM *Streptomyces* sp., while the lowest total number of fruits (31.74) was in the treatment without PGPM. Meanwhile, the average total weight of fruits was the highest (447.96) in the treatment of PGPM *Streptomyces* sp. and the lowest (388.92) in the treatment without PGPM.

The administration of PGPM (Plants Growth Promoting Microorganism) *Streptomyces* sp. and *Trichoderma* sp. at several different concentrations with a dose of 200 mL/plant by casting and 100 mL/plant by spraying has not been able to increase the number of flowers, the number of fruits per plant, the total number of fruits, and the weight of fruits. This can be because the dose and concentration of PGPM is less than optimal and less effective in increasing plant growth and production. This follows the opinion of [Ardiyanto et al., \(2017\)](#), stating that the frequency of administration and the concentration used are related to the process of plant growth and production. The results of the study that have been registered as a simple patent IPR Application Number: S00202005990 claim that the application of multi-antagonist *Streptomyces narbonensis* and *Trichoderma harzianum* (3:1) on tomato, melon, and chili plants is effective with application dose of 200 mL/plant and 300 mL/plant in vertisol ([Suryaminarsih et al., 2019](#)).

Flowering Period and Weight of Fruits per Plant Period 2

Based on the results of ANOVA, there was a significant effect of biological agents *Streptomyces* sp. and *Trichoderma* sp. on the flowering period and weight of fruits period 2. The average values of flowering period and weight of fruits due to biological agent treatment (PGPM) is presented in Table 2.

The latest flowering period (37.58 DAP) was obtained in the treatment of PGPM *Trichoderma* sp., while the earliest (33.99 DAP) was in the treatment of PGPM *Streptomyces* sp. The application of biological agents *Streptomyces* sp. and *Trichoderma* sp. significantly affected the weight of fruits for period 2, which was the highest (69.82 grams) in the treatment of *Trichoderma* sp. and the lowest (43.08 grams) in the control treatment. This follows [Putri et al., \(2018\)](#), stating that the use of 20 ml of PGPM influences the weight of fruits. *Trichoderma* sp. is a fungus that has a role as a biological agent that can increase the growth of shallot plants due to the application carried out directly to the planting media ([Yanti et al., 2019](#)). According to [Kumar et al., \(2017\)](#), the filtrate / soluble substance from *Trichoderma viridae* VKF3 derived from mangrove soils can produce a fairly high IAA and can suppress the development of pathogens.

The cherry tomato plants in this study were not attacked by *Fusarium* sp. because at the begin-

Table 2. The average plant height, number of leaves, number of flowers, number of fruits/plant, total fruits/plant, and weight of fruits/plant

Concentration of PGPM <i>Streptomyces</i> : <i>Trichoderma</i>	Parameters					
	Plant height	Number of leaves	Number of flowers	Number of fruits/plant	Total fruits/plant	Weight of fruits/plant
Without PGPM	116,33	15,66	38,24	4,41	31,74	388,92
ST (1:0)	126,91	17,24	40,32	4,58	34,08	447,96
ST (0:1)	120,24	15,58	39,58	4,74	32,2	435,03
ST (2:2)	123,45	15,87	39,49	4,95	32,7	417,55
ST (3:1)	188,62	15,24	39,33	5,37	32,45	424,87
SD	6,44	1,14	1,76	0,78	1,46	22,19

Remarks: SD = Standard deviation S = *Streptomyces* sp., T = *Trichoderma* sp.

ning of planting, biological agents of *Streptomyces* sp. and *Trichoderma* sp. were added to the soil in polybags. *Trichoderma* sp. is also a fungus that can degrade organic matter. *Streptomyces* sp. is a gram-positive bacterium functioning as a bio-fertilizer, bioremediation, and biological control agents that effectively controls plant disease pests. *Streptomyces* sp. and *Trichoderma* sp. are biological agents combined to be used as Plants Growth Promoting Microorganism (PGPM) to determine the increase in plant growth when the Plants Growth Promoting Microorganism (PGPM) has been given to cherry tomato plants. This follows [Sutarman \(2016\)](#), stating that *Trichoderma* sp. is a parasite fungus taking nutrients from other fungi. [Widodo \(2016\)](#) states that using PGPM can protect plants from pathogen infections. According to [Keliat & Iftari \(2017\)](#), the fungus *Trichoderma* sp. is a fungus found in all types of soil. *Trichoderma* sp. can be used as biological agents because of their ability to control pathogens that attack plants to reduce the presence of pests and plant diseases. According to [Dendang \(2015\)](#), *Trichoderma* sp. produces the enzyme β - (1-3) glucanase and chitinase, which can cause exolysis able destroy the cell walls of the fungus *Fusarium*. *Trichoderma* sp. use can increase shallot plants' growth and control diseases that attack plants ([Yanti et al., 2019](#)). [Suryaminarsih et al., \(2015\)](#) found that multi antagonist *Trichoderma*

sp. can be applied to horticultural crops because it can help increase crop production. *Trichoderma* sp. can function as a fertilizer that is usually packaged in the form of compost as P and K solvents, increasing plant root growth and height. The *Streptomyces* sp. application at a dose of 30 ml, 20 ml, and 10 ml showed that the height, number of productive branches, root volume, diameter, and weight of fruits harvested in chili peppers tended to be better than control plants or without treatment. Plant height, the number of productive branches and the volume of roots increased by 27.3%, 24.3%, and 20.7%, respectively, with the application of *Streptomyces* sp. ([Putri et al., 2018](#)). The biological agent *Streptomyces* sp. is an actinobacterium that can produce bioactive compounds containing antibiotics, antiparasitics, and antifungals ([Ekundayo et al., 2014](#)). According to [Purnomo et al., \(2017\)](#), *Streptomyces* sp. can interfere with cell membrane function and synthesis of proteins and nucleic acids so that it can inhibit the growth of pathogenic fungi.

CONCLUSION

The application of *Streptomyces* sp. and *Trichoderma* sp. at a dose of 200 mL/plant by casting and 100 mL/plant by spraying with several different concentrations has not been able to promote the generative growth of cherry tomato plants. The application of *Trichoderma* sp. resulted in the latest

flowering period (37.58 DAP), while the application of *Streptomyces* sp. produced the lowest one (33.99 DAP). The administration of PGPM has an influence on the weight of fruits which has the highest weight of fruits (69.82 grams) was obtained in the treatment of *Trichoderma* sp., while the lowest (43.08 grams) was in the control treatment.

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REFERENCES

- Ardiyanto, F. M., A.S. Karyawati, & S. M. Sitompul. (2017). Pengaruh Frekuensi Pemberian dan Konsentrasi Rizobacteria Pemacu Pertumbuhan Tanaman Terhadap Pertumbuhan dan Hasil Kedelai Sayur (*Glycine max* L. Merr.). *Jurnal Produksi Tanaman*. 5(11):1762-1767.
- Dendang, B. (2015). Uji Antagonisme *Trichoderma* spp. terhadap *Ganoderma* sp. yang Menyerang Tanaman Sengon Secara in-vitro. *Jurnal Penelitian Kehutanan Wallace*.4(2): 147 - 156. <http://dx.doi.org/10.18330/jwallacea.2015.vol4iss2pp147-156>
- Direktorat Jenderal Hortikultura. (2015). Statistik Produksi Hortikultura Tahun 2014. Kementerian Pertanian Indonesia. www.hortikultura.pertanian.go.id.
- Ekundayo, F. O., K.A. Oyeniran & A. D. Adedokum. (2014). Antimicrobial Activities Of Some *Streptomyces* Isolated From Garden Soil Samples And Fish Pond Water In Futa. *Journal Bio-sci*, 22(1):21-29. <http://www.banglajol.info/index.php/JBS/index>
- Keliat, J & Iftari W. (2017). Uji Antagonis *Fusarium* sp. pada Kangkung Belerang terhadap Isolat Kitinolitik LT4 dari Limbah Cair Tahu. *Jurnal Biosains*. 3(3): 140- 143. <https://doi.org/10.24114/jbio.v3i3.7899>
- Kementerian Pertanian, (2017). Statistik Konsumsi Pangan 2017. Pusat Penelitian dan Pengembangan Tanaman Pangan. Jakarta.
- Kumar, N. V., Rajam, K. S., & Rani, M. E. (2017). Plant growth promotion efficacy of indole acetic acid (IAA) produced by a mangrove associated fungi-*Trichoderma viride* VKF3. *International Journal of Current Microbiology and Applied Sciences*, 6(11), 2692-2701. <https://doi.org/10.20546/ijcmas.2017.6.11.317>
- Purnomo, E., Mukarlina & Rahmawati. (2017). Uji Antagonis Bakteri *Streptomyces* spp. Terhadap Jamur *Phytophthora palmivora* BBK01 Penyebab Busuk Buah Pada Tanaman Kakao. *Probiot*, 6(3): 1-7. <http://dx.doi.org/10.26418/protobiont.v6i2.20795>
- Pusat Data dan Sistem Informasi Pertanian. (2014). Outlook Komoditi Tomat. Kementerian PPN Bappenas Indonesia. <https://perpustakaan.bappenas.go.id/e-library/>
- Putri, A. R, Sri Sulandari & Triwidodo A. (2018). Kefektifan Bakteri Rizosfer *Streptomyces* sp. untuk Menekan Pepper Yellow Leaf Curl Virus Pada Tanaman Cabai Besar di Lapangan. *Jurnal Fitopatologi Indonesia*. Vol. 14 (5): 183-188. <https://doi.org/10.14692/jfi.14.5.183>
- Ramdani, H., Arifah R., & Haris, S. (2018). Increasing of Production and Quality of Cherry Tomato (*Solanum lycopersicum* var. cerasiforme) through Used of Various Growth Medium Compositions and SP-36 Fertilizer Dosages. *JURNAL AGRONIDA*, 4(1): 9-17. <https://doi.org/10.30997/jag.v4i1.1524>
- Rochiman, K. S. (2008). Perancangan Percobaan. Surabaya: Airlangga University Press. 274 hal.
- Suryaminarsih, P., Kusningrum, Ni'matuzaroh & Surtiningsih, T. (2015). Antagonistic compatibility of *Streptomyces griseorubens*, *Gliocladium virens*, and *Trichoderma harzianum* Against *Fusarium oxysporum* cause of tomato wilt diseases. *International Journal of Plant & Soil Science*, Vol 5 (2) 82-89. DOI: [10.9734/IJPSS/2015/11026](https://doi.org/10.9734/IJPSS/2015/11026)
- Suryaminarsih, P., Wiwik S. H., Elly, S., Noni, R., & Ramdan, H. (2019). Aplikasi (*Streptomyces* sp.) Sebagai Agen Hayati Pengendali Lalat Buah (*Bactrocera* sp.) dan Plant Growth Promoting Bacteria (PGPB) Pada Tanaman Tomat dan Cabai. *J. Ilmu Pertanian*. Vol. 22 (1): 62-69. <https://doi.org/10.30596/agrium.v21i3.2456>
- Sutarman. (2016). Penerapan *Trichoderma harzianum* Sebagai Perlakuan Tanah dan Pengobatan Tambahan Untuk Mengendalikan Gangguan Tanaman Kentang (*Solanum Tuberosum* L.). Fakultas Pertanian. Universitas Muhammadiyah Sidoarjo.
- Tamreihao, K., Ningthoujam, D. S., Nimaichand, S., Singh, E. S. Reena, P., Singh, S. H. & Ningthomba, U. (2016). Biocontrol and Plant Growth Promoting Activities of A *Streptomyces corchorusii* strain UCR3-16 and Preparation of Powder Formulation for Application As Biofertilizer Agents For Rice Plant. *Microbiological research*, 192, 260-270. <http://dx.doi.org/10.1016/j.micres.2016.08.0050944-5013/2016>
- Verma, P. P., Shelake, R. M., Das, S., Sharma, P., & Kim, J. Y. (2019). Plant growth-promoting rhizobacteria (PGPR) and fungi (PGPF): potential biological control agents of diseases and pests. In *Microbial Interventions in Agriculture and Environment* (pp. 281-311). Springer, Singapore. https://doi.org/10.1007/978-981-13-8391-5_11
- Widodo. (2016). Peranan Plants Growth Promoting Rizhobacteria (PGPR) dalam Pengendalian Terpadu Hama dan Penyakit Tumbuhan (PHT). Artikel Online <http://cybex.ipb.ac.id/index.php/artikel/detail/Komoditas/381> [Diakses Pada 08 April 2021].
- Yanti, Y. A., Indrawati, & Refilda. (2013). Penentuan Kandungan Unsur Hara Mikro (Zn, Cu, dan Pb) di dalam kompos Yang Dibuat dari Sampah Tanaman Pekarangan Dan Aplikasinya Pada Tanaman Tomat (*Solanum lycopersicum* Mill). *Jurnal Kimia Unand*. 2(1): 2303-3401.
- Yanti, Y., Hamid, H., Nurbailis., Habazar, H., Nurbailis., Yahewardi., Reflin., Nilisma, M., & Diandinny, A. (2019). Peningkatan Produksi Bawang Merah melalui Aplikasi Yuyaost dan *Trichoderma* di Kelompok Tani Ngungun Jorong Gantiang Utara. *Jurnal Hilirisasi IPTEKS*, 2 (4a), 333-342. <http://hilirisasi.lppm.unand.ac.id>