Improving Quality Of Hybrid Maize Seed Production By Soaking In Different Population Density Of Trichoderma Harzianum

by Muhammad Jayadi

Improving Quality Of Hybrid Maize Seed Production By Soaking In Different Population Density Of Trichoderma Harzianum

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Abstract: The using of hybrid maize seeds is still around 60% of the total planting in Indonesia. Seed production inhibit by the low productivity of F1 seeds which ranges only 1 tonnes/ha. The one alternative increasing plant development used Trichoderma harzianum, the one of famous decomposer fungi living in many ecosystem. Trichoderma spp. known as natural decomposition fungi has ability biological fertilizer material and high potential increasing plant growth and reproduction. Commonly plants grow on soil given by T. harzianum result increasing of germination, flowering and weight of yield. The purpose of the research is to analyze the impact different population density of T. harzianum spores that affect the quality of hybrid maize seeds. The research was conducted at Experimental Farm Indonesian Cereals Research Institute (ICERI) Maros district, South Sulawesi, Indonesia from March 2018 to September 2018. The result was showed treatment T_2 (population density of T. harzianum 10^8 spore/ml) resulted growth and maize production better than T_0 (control) and T_1 (population density of T. harzianum 10^4 spore/ml). Conclusion of the study, the treatment used T_2 (population density of T. harzianum 10^8 spore/ml) showed highest result in average widest of maize stem diameter (30.07 cm), the fastest female flowering time (56.94 days), the longest maize cob (19.44 cm), widest of maize cob diameter (4.79 cm), highest number of cob in maize row (0. 20 g), highest number of seeds in maize row (14.10 kg), heaviest of cob weight (13.31 g), cob weight in plot (32.11 kg) and the highest of seed yield (8.33 kg in every plot or 4.17 tonnes/ha) than treatment T_0 (control) and T_1 (population density of T. harzianum 10^4 spore/ml).

Index Terms: density, hybrid, maize, population, seed, Trichoderma harzianum

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1. INTRODUCTION

Agricultural traditional practices commonly affected by various problem mainly presence pests, diseases and decreased soil fertility. The change quality of soil fertility is a main problem in development country caused using of hazardous chemical pesticides in long period to be source of pollution in farmer land. This is a problem for government and must be create long term safety product for consumers further. The problem caused chemical compound need biocontrol agent safety environment and consumers, also may help resolve problem of soil fertility. The meaning of biological control as using beneficial microorganism against plant pathogens and pests (Datta et al., 2004; Harman et al., 2004; Singh et al. 2007; Yucel et al., 2013). The microorganism especially group of fungi and bacteria is nature friendly and spread in worldwide. The one famous fungi was controlled plant disease and solving soil fertility problem is Trichoderma harzianum (Gajera et al., 2011). Commonly Trichoderma spp. living in rhizosphere especially highly interactive in root and soil environment. They are familiar microbes in all of agriculture soil contain organic waste harvest and decaying wood (Harman, 2000; Kubicek et al., 2001; Bailey et al., 2006; Saba et al., 2012 and Brotman et al., 2013). Maize (Zea mays L.) is the one of important food crop commodity that playing important role in national scale. Recently, maize products is not only used as food but also used as cattle feed and industrial materials including source of alternative fuels (biofuels). Maize demand continues increasing by year and positive correlation to population growth, as a result of increased human food, source of energy and consumption protein from animal. The use of superior seeds is the main key efforts increasing maize productivity. Government encourages the use of superior hybrid maize seeds because they has high level of productivity. Shifting the use of maize seeds to hybrid types must be followed by the ability to produce the similar seeds. Seed production is low value because seed from F1 has productivity ranges only 1 tonnes/ha (Tokatlidis, 2001 and Ipsilandis et al., 2005). The Indonesian need for hybrid maize seeds at 2017 increased to 94.142 tonnes with 15 kg per ha of seed requirements (Indonesian Ministry of Agriculture, 2017).

The initial quality of the seeds to be used is greatly influenced by the condition of the plant during the process of growth and reproduction stage. Fertilizer is one of the important factors that determine the quality of the seeds production. Beside anorganic fertilizers, organic fertilizers or biological fertilizers can increase growth and production in plants. Commonly Trichoderma spp. as natural decomposition fungi is a type of biological fertilizer material has potential increasing plant growth and reproduction. T. harzianum is one of famous decomposer fungi living in many ecosystem (Mujebuur et al., 2004; Sharma et al., 2008; Mishra, 2010; Sharma et al., 2014; Srivastava et al., 2015). According to Chet (2001), plants that grow on soil given by T. harzianum have increased growth that showed increasing of germination, flowering and weight of cucumber plants. According to Gveroska and Ziberoski (2011) and Sharma et al. (2012) reported that the growth response of the plant especially tobacco and groundnut given T. harzianum increasing the number of lateral roots, chlorophyll content and the dry weight of the plant. The purpose of the research is to analyze the impact different population density of T. harzianum spores that affect the quality of hybrid maize seeds.

2 METHODOLOGY

2.1 Site of Research

The research was conducted at Experimental Farm

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Indonesian Cereals Research Institute (ICERI) Maros district, South Sulawesi Indonesia from March 2018 to September 2018.

2.2 Soil Preparation

Soil analysis was conducted to determine soil quality before and after planting. Soil treatment used a tractor, then made an experimental plot. The research used hybrid maize seeds from ICERI collection. Before planting, hybrid maize seeds are soaked for 12 hours using T. harzianum with different population density according to treatment. The seeds are planted at plot with distance 20 cm x 70 cm with one seed per planting hole. Maintenance was conducted during the trial based good agricultural practices (GAP). The next activities in maize field is Roguing I (7-15 days after planting), Roguing II (32-35 days after planting) and Roguing III (45-52 days after planting). Roguing in harvest time such as cob selection was conducted when the maize cob was ripe physiologically.

2.3 Population Density of Trichoderma harzianum

The study was used a Randomized Block Design with three treatments soaking maize seed in different population density of T. harzianum (T) divided in three levels i.e: T_0 = without T. harzianum (control), T_1 = population density of T. harzianum 10^4 spore/ml and T_2 = population density of T. harzianum 10^8 spore/ml. Each treatment was replicated three times in observation plot with measurement 5 m x 4 m, a total of nine plots in the research unit. The research used Randomized Block Design with three treatments population density of T. harzianum in soaking seeds (T) divided into three levels i.e: T_0 = without T. harzianum (soaked with distilled water), T_1 = population density of T. harzianum 10^4 spore/ml and T_2 = population density of T. harzianum 10^8 spore/ml. Each treatment was replicated three times in observation plot with measurement 5 m x 4 m. The total plot used in the research unit is nine plots. The observation was started on the growth components and maize production including: plant height, number of maize leaves, female flowering time, cob holder height, stem diameter, number of cob in maize rows, cob lenght, cob diameter, cob weight, cob weight in plot, number of seeds in maize row, weight of 100 g maize seed and seed yield. The data were tabulated and analyzed of variance (ANOVA) used STAR (Statistical Tool for Agricultural Research) program followed by Least Significant Difference with α = 5%.

3 RESULT AND DISCUSSION

Maize plant generate seeds as source of carbohydrate and easy plant growth in lowland and highland because their ability adapted quickly in habitat. The treatment with different population density of T. harzianum spores result a higher concentration contain more spores gives a better plant performance than population density with lower T. harzianum (T_1 = 10^4 spore/ml) and control. Findings of research was showed treatment used different population density of T. harzianum not significantly different from maize plant morphological parameters such as : plant height, number of leaves and cob holder height but significantly different from maize stem diameter. Table 1 was showed the treatment used population density of T. harzianum 10^8 spore/ml showed highest result in average widest of maize stem diameter (30.07 cm) and the fastest female flowering time (56.94 days) than treatment T_0 and T_1.

Table 1. The Average of Stem Diameter (cm) and Female Flowering Time (days) in Different Population Density of *T. harzianum*

Population Density of *T. harzianum*	Stem diameter (mm)	Female flowering time (days)
Control (T_0)	27.43^c	58.53^a
10^4 spore/ml (T_1)	28.79^b	57.47^b
10^8 spore/ml (T_2)	30.07^a	56.94^c

Numbers in same column followed by same letters are not significantly different (LSD α=0.05).

Table 2 was showed the treatment used population density of T. harzianum 10^8 spore/ml showed highest result in average the longest of maize cob (19.44 cm), widest of maize cob diameter (4.79 cm), highest number of cob in maize row (0. 20 g), highest number of seeds in maize row (14.10 kg), heaviest of cob weight (13.31 g), cob weight in plot (32.11 kg) and the highest of seed yield (8.33 kg in every plot or 4.17 tonnes/ha) than treatment T_0 and T_1.

Table 2. The Average of Cob Lenght (cm), Cob Diameter (cm), Number of Cob in Maize Rows (individual), Number of Seeds in Maize Rows (seed), Cob Weight (g) and Cob Weight in Plot (kg) in Different Population Density of *T. harzianum*

Population Density of *T. harzianum*	Cob lenght (cm)	Cob diameter (cm)	Cob weight (g)	Cob weight in plot (kg)	Number of cob in maize row	Number of seeds in maize row	Seed yield (kg)
Control (T_0)	14.25^c	4.22^b	12.30^b	22.47^c	0.13^c	12.42^b	7.86^b
10^4 spore/ml (T_1)	17.05^b	4.65^a	13.18^a	28.09^b	0.17^b	12.81^b	8.29^a
10^8 spore/ml (T_2)	19.44^a	4.79^a	13.31^a	32.11^a	0.20^a	14.10^a	8.33^a

Numbers in same column followed by same letters are not significantly different (LSD α=0.05).

The soaked of maize seeds used population density of T. harzianum 10^8 spores/ml (T_2) more effective in fungi enter the maize seed through imbibitions process. Based research of Sharma et al. (2003) and Kumar et al., (2013) reported that presence of T. harzianum in plant cell giving contribute against damping-off pathogen and improve success of seed germination. This process affect the growth and development of maize plant. In general, beneficial fungi T. harzianum has positive impact as a stimulator of plant growth. According to Nurahmi (2012) and Sargin et al., (2013) state that some of Trichoderma species have been reported as biological agents against pathogenic fungi in the soil. They can be isolated from rhizosphere of crops root. Ferrigo et al., (2014) reported in general, T. harzianum acts as a decomposer in nature and plays a role as a biocontrol agent and stimulator in plant growth. The soaking process of maize seed with higher population density of T. harzianum 10^8 spora/ml (T_2) more effective in fungi imbibitions process into maize seed and facilitating seed germination that affect the growth of maize plants. T. harzianum has a positive impact as a stimulator of plant growth. According to Adams et al., (2007) and Akram et al., (2012) reported that some of Trichoderma species have been reported as biological agents that fungi in the soil can isolated from plant roots. In general, T. harzianum working as a decomposer in nature and playing role as a biocontrol agent and stimulator in plant growth. Harman (2006) and Hermosa et al. (2012) reported that T. harzianum facilitate the growth of plant organs, enhancing the biological activity of beneficial soil microorganisms and accelerate the absorption of nutrients by plants. The better growth of maize organ was showed in the widest stem diameter at treatment T_2. Taiz and Zeiger (2006) state that living plants use carbohydrates for their respiration. Plant growth depend on the photosynthesis process which provides nutrients to plants. When photosynthesis exceeds respiration is vital activities in plant development. When plants are in low light conditions, the process of respiration will be the same portion as photosynthesis which causes stunted plant growth. The results of research in T_2 when the population density of T. harzianum 10^8 spore/ml resulted widest diameter of the maize stem. Furthermore, the population density of T. harzianum 10^8 spore/ml (T_2) resulted in the fastest female flowering time (56.94 days). Flower initiation is a very important stage in some plants because determine the formation of good reproductive organs and predict the yield result, especially in case the organ that responsible for the organ that form maize cob. Taiz and Zeiger (2006) and Zhang et al. (2016) state the change in apical shoots originating from the vegetative part into flower buds is the result of hormonal activity and to be important in plant development. In general, the changes occur because they are stimulated by certain environmental conditions such as temperature and day length or long exposure of sunlight. Plant sensitivity and respond to external factors continue to grow as plant age. Therefore the optimal growth occur due to the treatment of the population density of T. harzianum 10^8 spore/ml supported plant development. This is the stage of determining occurrence of a faster maize flowering process. Then, environmental factors that supporting development of maize cob are high interception of light in maize plants, especially occured in flowering period causing optimal development of cob because photosynthesis run optimally to produce assimilate and transplanted into the storage organs of food reserves that produce longer cob (19.44 cm) and the widest of maize cob diameter (4.79 cm). According to Amer and Seoud II (2008) the waste yield such as dry matter of green plants almost 90% comes from the photosynthesis process. Furthermore, according to Mastouri et al. (2010) state that the higher intensity of light, photosynthesis continues increasing along with other factors such as: carbondioxide, water and nutrition are not a limiting factor. The highest number of cob in maize row (0.20 g) will increase the number of seeds in maize row (14.10 kg). According to Fernando et al., (2000) states the environment that less supportive in the flowering period inhibit maize cob development. According to Blacutt et al. (2018) reported that maize cob growth stop during flowering if the amount of irradiation received is in a low intensity. Photosynthesis that run effectively will produce many maize seed. This result was showed in the heaviest of cob weight (13.31 rows), cob weight in plot (32.11 seeds) and the highest of seed yield (8.33 kg per plot or 4.17 tonnes/ha). Marschner (2012) state that the higher quality of photosynthesis resulted the greater accumulation of food reserves that transplanted to seeds. This is strong correlation with the assumption presence the other factor such as light, water temperature and nutrients in the optimal condition. The findings in the other research, Ferrigo et al., (2014) reported that seed treatment with T. harzianum reduces infection of roots and silk by Fusarium verticilliloides in maize under field condition. The colonies of T. harzianum living and develop in rhizosphere especially surrounding the maize roots. Blacutt et al., (2018) reported that fumonisin are mycotoxins produced by F. verticilloides the pathogenic fungi cause maize disease. Jegathambigai et al., (2004); Sharma and Dureja (2004); Shoresh et al., (2010); reported that biocontrol with fungi are biocontrol agents that against plant pathogen caused diseases in crops through seed treatment. These include the well-known Trichoderma spp. and the recently described Sebacinales spp. The fungi have the ability to control numerous foliar, root, and fruit pathogens, even presence invertebrates such as nematodes. However, this is only one benefit of their abilities. Trichoderma spp. also have the ability to ameliorate a wide range of abiotic stresses. Some Trichoderma species can also alleviate physiological stresses such as seed aging. They fungi also enhance nutrient uptake in plants and can substantially increase nitrogen use efficiency in crops. These abilities may be more important to agriculture than disease control. Some strains also have abilities to improve photosynthetic efficiency and probably respiratory activities of plants. Commonly T. harzianum living in many ecosystem in worldwide. Their potential improving soil quality of plant growth. Based Manjula et al., (2004), Amer and Seoud II (2008) and Turnip et al. (2015) reported their research that soil application with T. harzianum significantly reduced plant disease especially in tomato seedlings damping-off incited by Rhizoctonia solani. Poveda et al. (2019) reported the plant disease suppression was obtained when T. harzianum and Glomus intraradices (arbuscular mycorrhiza fungi) were applied together. Application of T. harzianum to healthy or inoculated seedlings significantly increased phosphorous supply, which resulted in higher yield, associated with the accumulation of high phosphorus levels in tissues of tomato plants.

4 CONCLUSION

Based on the findings of study the conclusion the treatment T_2 (population density of T. harzianum 10^8 spore/ml) showed highest result in average widest of maize stem diameter (30.07 cm), the fastest female flowering time (56.94 days), the longest maize cob (19.44 cm), widest of maize cob diameter (4.79 cm), highest number of cob in maize row (0. 20 g), highest number of seeds in maize row (14.10 kg), heaviest of cob weight (13.31 g), cob weight in plot (32.11 kg) and the highest of seed yield (8.33 kg in every plot or 4.17 tonnes/ha) than treatment T_0 (control) and T_1 (population density of T. harzianum 10^4 spore/ml).

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