Growth and Yield of Several Red Chilli (Capsicum Annuum L.) Peat-Strains on Peat Soil

by Susilawati Susilawati

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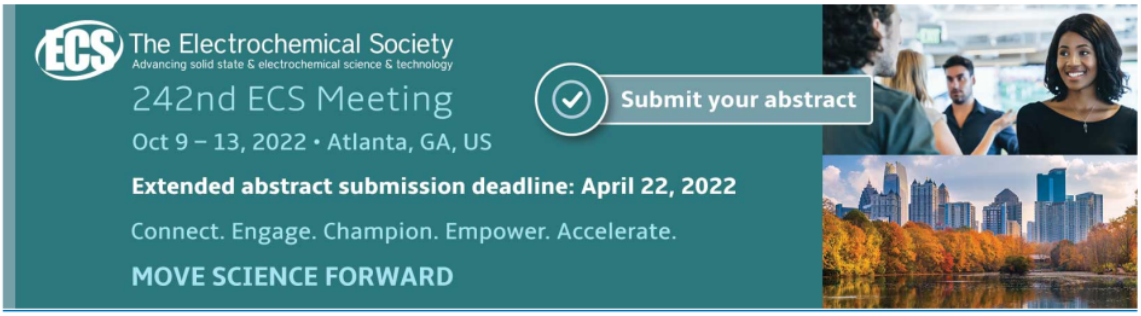

Growth and Yield of Several Red Chilli (*Capsicum Annuum* L.) Peat-Strains on Peat Soil

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Abstract. The study was aimed to evaluate agronomic characters of growth and yield of red chili peat-strains grown on peat soil with the application of chicken manure. The study was conducted in Talang Kelapa, Palembang Lat S-2°55'"Long E 104°41'". Factorial randomized block design was used with 2 factors and 3 replicates. The first factor was chili strains consisting of G1 = Strain 1 (F10120005-141-16-35-1-3); G2 = Strain 3 (F10120005-141-16-35-7-1); and G3 = Strain 4 (F10120005-241- 2-9-4-4). While the second factor was chicken manure dosage, P0 = control (without chicken manure); P1 = 10 tons/ha (250 grams/polybag); and P2 = 20 tons/ha (500 grams/polybag). Parameters observed were plant height, leaf number, root shoot ratio, plant fresh and dry weight, leaf area, flowering age, fruit weight, fruit diameter and estimated production per hectare. Results showed that the addition of chicken manure on peat soil had a good effect on growth and production of the red chili peat-strains. G3 (Strain 4= F10120005-241-2-9-4-4) showed the best response to the application of 20 tons/ha (500 grams/polybag) of chicken manure. The combination of P2G3 treatments (20 tons/hectare in G3) resulted in the highest production with an estimated yield of 2.56 tons per hectare.

1. Introduction

Beside shallot, red chili (*Capsicum annuum* L.) is one of important horticultural crops in Indonesia and influential to national economy that can even cause an inflation. Red chili plants can be cultivated commercially due to its high economic value and nutritional content. However, the productivity of chili plants in Indonesia is still relatively low due to fluctuating climatic factors and improper farming techniques including the lack of high yielding varieties. Furthermore, there's a decline in harvested area as occurred in South Sumatra, from 6,048 hectares with a production of 41,814 tons in 2018 to 5,187 hectares with a production of 40,497 tons in 2019 showing a decline in production by 3 percent [1]. In order to increase chili national production and fair distribution across Indonesia, the growth of chili production centers outside Java needs to be encouraged.

Wetlands area outside Java has been regarded as one of potential area to be developed for agricultural purposes, including tidal and non-tidal swampland and also peatland area. However regarding its complex characteristics, cultivation system in wetlands should implement water level management, ameliorant and fertilizer, and also the use of adaptive varieties. Previous research has studied the effect of inundation treatment on growth of several chili varieties resulting in Kiyo F1 variety showed better agronomic characters and a high tolerance level compared to other varieties under flooded conditions during vegetative and generative phases [2,3].

Peatland area in Indonesia is estimated around 18,586 million hectares, spread over the island of Sumatra, Kalimantan, Sulawesi, Maluku and Papua. South Sumatra has the second largest peatland area on Sumatra after Riau, with 1,484 million hectares or about 20.60 percent [4]. In South Sumatra, the largest peatland is in Ogan Komering Ilir (OKI) Regency, covering an area of 769 thousand hectares. The area of swampland including peat and lakes in OKI Regency reaches about 75 percent of the total area. In addition to its distribution in Ogan Komering Ilir Regency, peatlands are also spread in several other regencies in South Sumatra such as Musi Banyuasin (593,311 Ha), Muara Enim (24,104 Ha) and Musi Rawas (34,126 Ha) [5].

Cultivation of red chili plants with planting media using peat soil often lacks the required nutrients and high soil acidity. Efforts to improve the condition of peat soils are through fertilization. Thus, this study was aimed to evaluate agronomic characters of the growth and production of red chili peat strains on peat soil with the application of organic chicken manure.

2. Materials and Method

The study was conducted in Talang Kelapa, Alang-Alang Lebar, Palembang Lat S-2°55'"Long E 104°41'" for three months in 2021. The study used red chili from IPB strains, while chicken manure and peat soil from Tanjung Banyan Village in Tanjung Lubuk District, Ogan Komering Ilir. The study used a factorial randomized block design with 2 factors. The first factor was chili strains, G1 = Strain 1 (F10120005-141-16-35-1-3, G2 = Strain 3 (F10120005-141-16-35-7-1), G3 = Strain 4 (F10120005-241- 2-9-4-4). The second factor was chicken manure treatment, P0 = control (without chicken manure); P1 = 10 tons/ha (250 grams/polybag) of chicken manure; P2 = 20 tons/ha (500 grams/polybag) of chicken manure. The total combination consisted of 9 treatments and 3 replicates resulting in 27 treatment units with 2 plants per unit. The parameters observed were plant height, leaf number, total leaf area, plant fresh weight, plant dry weight, root shoot ratio, flowering age (DAP = days after planting), fruit weight, fruit diameter and fruit length. Data then were analyzed using analysis of variance and 5% of Least Significance Difference (LSD) test.

The seeds were first soaked in water for ± 24 hours then sown in seedling trays of 34 cm x 25.5 cm x 7 cm. After 1 week, the seedlings were transferred and maintained in polybags (14.5 cm x 6 cm) for 3 weeks. Planting media used peat soil originated from Tanjung Beringin Village in Tanjung Lubuk District, Ogan Komering Ilir, mixed with chicken manure according to the treatment. The addition of chicken manure was carried out one week before planting. The media mixture was put into a polybag (35 cm x 35 cm) with a total media of 5 kg and a media height of ± 23 cm. SP-36 fertilization was given to the media one week before planting at a dose of 150 kg ha^{-1}. Other fertilizers were applied with doses (kg ha^{-1}) of urea 50, ZA 300 and KCl 150. Fertilization was carried out three times, first 1/3 dose at planting time, second 1/3 dose at 1 month after planting and the third 1/3 dose at 2 months after planting.

3. Results and Discussion

3.1. Results

Agronomic Characters The addition of organic chicken manure on peat soil planting media showed an effect on growth and production of red chili peat strains. Plant height and leaf number in the first week and eighth week showed similar response pattern. In the first week, the two variables did not show any difference among three strains used and due to the addition of organic chicken manure. However, at the eighth week there were differences among the three strains, where G1 had the lowest height and the smallest leaf number compared to G2 and G3 due to the application of chicken manure.

Plant height in the first week did not show a consistent difference between the three chili strains, where G3 had the lowest height in P0 treatment. Yet in P1 and P2 treatments, G3 had the highest height compared to G1 and G2. (Figure 1A). However, the different responses of the three strains due to the addition of organic chicken manure showed similar pattern, G1 strain had the lowest plant height which was significantly different from G2 and G3 in P0, P1 and P2 treatments (Figure 1B).

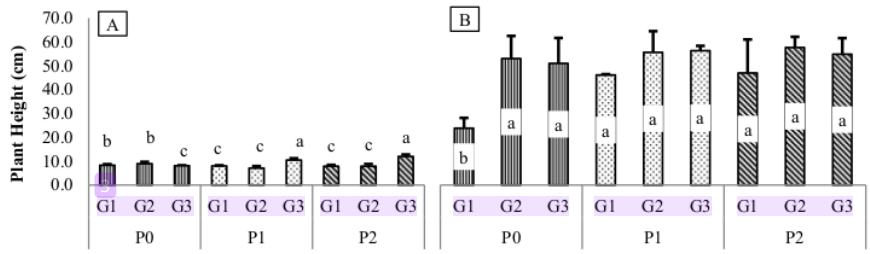

Figure 1. Plant height in the first week (A) and the eighth week (B) P0 = control, P1= 10 tons/ha (250 grams/polybag), P2= 20 tons/ha (500 grams/polybag). G1=Strain 1 (F10120005-141-16-35-1-3, G2=Strain 3 (F10120005-141-16-35-7-1), G3=Strain 4 (F10120005-241-2-9-4- 4)

The addition of organic chicken manure had caused similar response to the variables of leaf number and plant height, where in the first week of P0 treatment, the lowest leaf number was G2 strain which was not different with G3. In P1 treatment, there was no significant difference on leaf number for all chili strains.

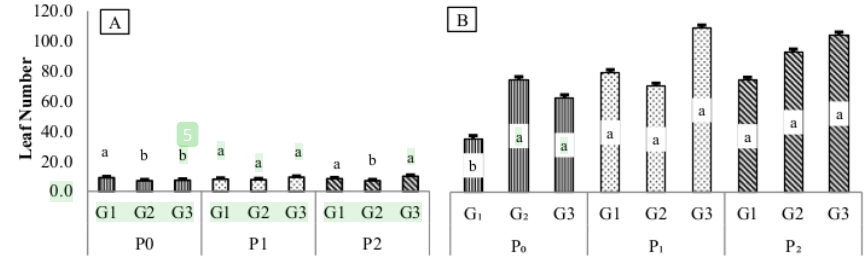

Figure 2. Leaf number in the first week (A) and the eighth week (B) P0 = control, P1= 10 tons/ha (250 grams/polybag), P2= 20 tons/ha (500 grams/polybag). G1=Strain 1 (F10120005-141-16-35-1-3, G2=Strain 3 (F10120005-141-16-35-7-1), G3=Strain 4 (F10120005-241-2-9-4- 4)

Total Leaf Area (cm^2) Total leaf area of three chili strains lines used was significantly different one another due to the difference on chicken manure treatments. P0 (control) treatment showed a smaller total leaf area which was significantly different from P2 and P2. All three strains had similar response in treatment P0, P1 and P2, except that G1 strain in P2 compared to G2 and G3 strains (Fig 3A).

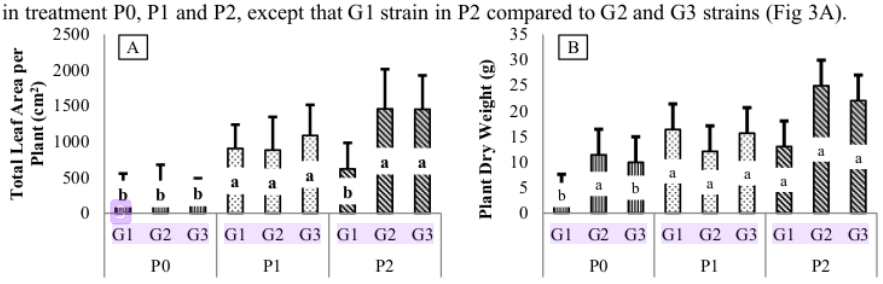

Figure 3. Total leaf area at harvest time (A) and plant dry weight (B). P0 = control, P1= 10 tons/ha (250 grams/polybag), P2= 20 tons/ha (500 grams/polybag). G1=Strain 1 (F10120005-141-16-35-1-3, G2=Strain 3 (F10120005-141-16-35-7-1), G3=Strain 4 (F10120005-241-2-9-4- 4)

Plant Dry Weight (g) All strains from control treatment (P0) had comparatively lower dry weight compared to all strains from chicken manure treatments. However, G2 strain showed insignificant difference with all chili strains from P1 and P2 treatments. Increasing the dosage of organic fertilizer was assumed could increase the dry weight of plant (Fig 3B).

Yield Parameters

Flowering Age (DAP) The application of chicken manure resulted in the difference of flowering age among the chili strains. Strains that were grown in control treatment relatively had a longer flowering age, ranging from 25 to 31 days after planting (DAP). While both P1 and P2 treatment resulted a faster flowering age which was about 25 to 26 DAP (Fig 4A).

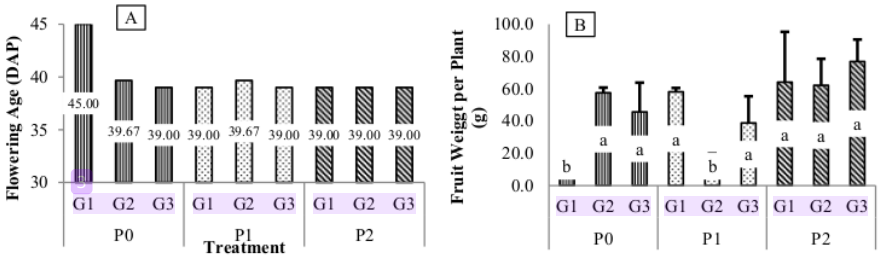

Figure 4. Flowering age (DAP) (A) and fruit weight per plant (B). P0 = control, P1= 10 tons/ha (250 grams/polybag), P2= 20 tons/ha (500 grams/polybag). G1=Strain 1 (F10120005-141-16-35-1-3, G2=Strain 3 (F10120005-141-16-35-7-1), G3=Strain 4 (F10120005-241-2-9-4- 4)

Fruit Weight per Plant (g) The increasing dosage of chicken manure application in P2 treatment significantly increased fruit weight per plant but the difference was insignificant among all three strains. There was an increase in G1 strain from P0 to P1 treatment, while G2 and G3 had a decreasing tendency though it was still not significantly different statistically (Fig 4B).

Fruit Diameter (mm) All chicken manure treatments (P0, P1 and P2) did not show any significant differences in fruit diameter for all strains, except for G1 in P0 treatment. The biggest fruit diameter was even obtained from P0 treatment, which was from G2 strain with 8.02 mm. While the smallest diameter was also in P0 treatment, from G1 strain with 2.20 mm (Fig 5A).

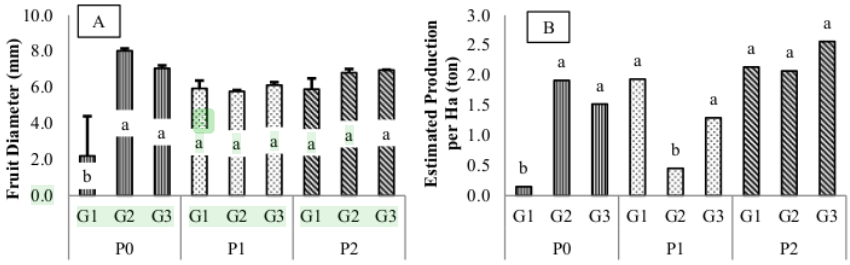

Figure 5. Fruit diameter (mm) (A) and estimated production per ha (B). P0 = control, P1= 10 tons/ha (250 grams/polybag), P2= 20 tons/ha (500 grams/polybag). G1=Strain 1 (F10120005-141-16-35-1-3, G2=Strain 3 (F10120005-141-16-35-7-1), G3=Strain 4 (F10120005-241-2-9-4- 4)

Estimated Production per Ha (ton) The production of all three chili strains were increased following the increase of chicken manure application dosage. The highest dosage of 20 tons per hectare showed a better result compared to other treatments, where all strains produced a higher yield.

The lowest production was obtained from G1 strain in P0 treatment and from G2 strain in P1 treatment (Fig 5B).

3.2. Discussion

The application of chicken manure did not give any significant effect on plant height in all strains during the first week after planting. It was due to the peat soil media used in this study containing low nutrient level so that the effect of organic fertilizer was not apparent. As reported by many studies, peat soils usually had low fertility rate, contained a lot of high organic acids and low soil pH ranging from 3 to 5[6]. The increase on plant height showed some differences eight weeks after planting, where P2 treatment with the addition of 20 tons chicken manure per hectare resulted in a higher plant height in all three chili strains (Fig 1). Similar result was reported [7] stating that the application of organic worm castings fertilizers could increase the growth of chili plants. Furthermore, [8] has also studied that chicken manure could increase the absorption and storage capacity of soil water in order to increase soil fertility. A study [9] stated that the absorbed nutrients from soil would be used to increase plant height growth. In this study, the highest average chili height from each treatment was obtained from G2 strain in all treatments. It was believed that the difference on plant height was more determined by genetic characteristics of each strain. Similar to this, report [10] stated that differences in plant height could occur due to the difference on genetics materials carried in each strain. A study [11] reported that the level of morphological diversity of chili plants was quite high, reaching 61.99%.

The application of chicken manure did not show clear differences on leaf number among the three lines. However, total leaf area was greatly influenced by chicken manure treatment. All strains from control treatment had a smaller total leaf area and were significantly different to all strains from chicken manure treatments (P1 and P2). According to [12], chicken manure contained three times more nitrogen than other manures. The high nitrogen content in chicken manure could increase growth and development of more plant leaves than other types of manure. Similar response was shown from plant dry weight where the highest weight was obtained from the highest chicken manure dosage (P2) in G2 and G3 strains. A study [13] reported that the application of organic fertilizers and the use of varieties significantly increased the vegetative growth of chili plants.

Growth in the vegetative phase would greatly affect the generative phase for yield formation. In this study, it was resulted that the application of chicken manure could accelerate the flowering process. High dosage of chicken manure at 20 tons per hectare initiated faster flowering for about 39 days after planting compared to other treatments (Fig 4A), while the flowering age of red chili plants was usually around 44 days after planting [14]. Faster flowering stage was believed strongly supported by good plant growth in the vegetative phase. It was assumed that phosphorus nutrient contained in chicken manure sufficiently supplied the needs of red chili plants. According to [15], phosphorus was needed for plants in assimilation and respiration, and also could enhance the flowering process and fruit and seed ripening. Result on this study showed that chicken manure dosage of 20 tons per hectare (P2) had better result for fruit weight parameter. The highest fruit weight was obtained from the same treatment in all three strains which was in P2. The highest weight was resulted from G3 strain with 76.89 grams per plant (Fig 4B). However, the results obtained were still very low compared to the average yield of other red chili varieties. The use of chicken manure with the right dosage then hopefully could support the growth of red chili peat strain. Research results [16] indicated that the source of organic fertilizer would greatly affect fruit weight of red chili plants. Sources of organic fertilizer derived from chicken manure resulted the heaviest fruit weight of 181.98 grams which was significantly different from other organic fertilizer sources (cow and guano). The potential for production of peat-strain chili was in line with the highest fruit weight obtained in G3 in P2 treatment with 2.56 tons per ha. This was considered still low compared to the production of red chili variety.

4. Conclusions

From results of the study, it was concluded that the use of chicken manure up to 20 tons per hectare could increase the growth and yield of red chili peat-strain on peat soil, and the G3 strain was the highest yielding strain with an estimated production of 2.56 tons per hectare.

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