*Jurnal Lahan Suboptimal : Journal of Suboptimal Lands*
*ISSN: 2252-6188 (Print), ISSN: 2302-3015 (Online, www.jlsuboptimal.unsri.ac.id)*
*Vol. 12, No.2: 129-138 Oktober 2023*
*DOI: 10.36706/JLSO.12.2.2023.652*

# Utilization of Jengkol (*Pithecellobium jiringa*) Peel Biochar and Chicken Manure as Organic Fertilizer on Red Chili Plants (*Capsicum annum* L) in Acidic Dry Land

*Pemanfaatan Biochar Kulit Jengkol dan Kotoran Ayam Sebagai Pupuk Organik pada Tanaman Cabai Merah* (*Capsicum annum L*) *di Lahan Kering Masam*

Rosmiah Rosmiah[1], R. Iin Siti Aminah[1*)], Dessy Tri Astuti[1], Neni Marlina[1], Dewi Meidalima[2], Beta Pratama[3]

[1]Faculty of Agriculture, Muhammadiyah University, Palembang 30263, South Sumatra, Indonesia
[2]Faculty of Agriculture Tridinanti University, Palembang 30129, South Sumatra, Indonesia
[3]Agrotechnology Study Program, Faculty of Agriculture, Muhammadiyah University, Palembang 30263, South Sumatra, Indonesia
[*)] Correponding author: iin_siti.aminah@yahoo.com

(Received: 23 June 2023, Accepted: 15 September 2023)

**Citation**: Rosmiah R, Aminah RIS, Astuti DT, Marlina N, Meidalima D, Pratama B. 2023. Utilization of jengkol (*Pithecellobium jiringa*) peel biochar and chicken manure as organic fertilizer on red chili plants (*Capsicum Annum* L) in acidic dry land. *Jurnal Lahan Suboptimal : Journal of Suboptimal Lands.* 12 (2): 129-138. DOI: 10.36706/JLSO.12.2.2023.652.

## ABSTRAK

Cabai (*Capsinum annum* L.) merupakan tanaman hortikultura yang bermanfaat sebagai bumbu dapur disamping memiliki kandungan vitamin yang baik untuk kesehatan. Penelitian ini bertujuan sebagai salah satu upaya dalam pemafataan limbah pertanian kulit jengkol dengan menambahan pupuk organic kotoran ayam dengan dosis berbeda berpotensi untuk meningkatkan pertumbuhan dan hasil pada tanaman cabai pada lahan kering masam. Percobaan lapangan dilakukan di lahan Dinas Pertanian tanaman pangan kecamatan Gandus Palembang pada bulan Maret sampai Mei 2022. Rancangan percobaan Acak Kelompok factorial dengan 2 faktor yaitu Faktor pertama : dosis pupuk Biochar Kulit Jengkol (B) terdiri dari : $B_1$ =5 ton/ha, $B_2$ =15 ton/ha, $B_3$=25 ton/ha. Faktor kedua : dosis Pupuk kandang ayam (K) terdiri dari: $K_0$= 0 (tanpa pupuk), $K_1$=10 ton/ha, $K_2$=20 ton/ha, $K_3$ = 30 ton/ha. Pengamatan pertumbuhan dan hasil dilakukan dengan mengukur peubah tinggi tanaman (cm),diameter batang (cm), jumlah cabang produktif (cabang), berat cabai per tanaman (g), berat cabai per petak (g). Percobaan terbaik diperoleh pada kombinasi perlakuan dosis pupuk Biochar kulit jengkol 15 ton/ha dan pupuk kandang ayam 30 ton/ha merupakan perlakuan terbaik terhadap pertumbuhan dan produksi cabai, dengan hasil per petak sebesar 343,5 g/tanaman atau setara 10,99 ton/ha.

Kata kunci: biochar kulit jengkol, pupuk kandang ayam, cabai merah

## ABSTRACT

Chili (*Capsinum annum*) is a horticultural plant that is useful as a spice in the kitchen, besides containing vitamins that are good for health. This study aimed as an effort to make jengkol skin agricultural waste useful by adding chicken manure organic fertilizer at different doses with the potential to increase growth and yield of chili plants on acidic dry land. The field experiment was conducted on the land of the Food Crops Agriculture

Office, Gandus District, Palembang from March to May 2022. Randomized factorial group experimental design with 2 factors, namely the first factor: the dose of Jengkol Peel Biochar fertilizer (B) consisting of: B1 = 5 tons/ha, B2 =15 tons/ha, B3=25 tons/ha. The second factor: the dose of chicken manure (K) consists of: K0 = 0 (without fertilizer chicken manure), K1 = 10 tons/ha, K2 = 20 tons/ha, K3 = 30 tons/ha. Growth and yield were observed by measuring plant height (cm), stem diameter (cm), number of productive branches (branches), chili weight per plant (g), chili weight per plot (g). The best trial was obtained in the combination treatment dose of 15 tons/ha of jengkol peel biochar fertilizer and 30 tons/ha of chicken manure, which was the best treatment for the growth and production of chilies, with a yield per plot of 343.5 g/plant or equivalent to 10.99 tons/ha.

Keywords: jengkol peel biochar, organic fertilizer chicken manure, red chili

## INTRODUCTION

Red chili pepper (*Capsicum annum* L.) is a seasonal vegetable belonging to the eggplant family (Solanaceae) originating from the Americas which contains nutrients needed by humans such as vitamin A, vitamin C, carotene, iron, potassium, calcium, phosphorus and also contains alkaloids such as capsaicin, flavonoids, and essential oils (Wahyuni et al., 2013), making chili a commodity needed as a cooking ingredient (Rindani, 2015 in Andani et al., 2020) with a spicy taste and has good nutritional content (Sutrisni, 2016). used for the manufacture of drugs and cosmetics (Suwardana et al., 2014).

Report from the Central Bureau of Statistics (BPS Sumsel., 2022) chili production in South Sumatra has decreased compared to 2021. Several strategic commodities such as chili and shallots need attention from the government to achieve price stabilization by increasing production and improving product quality.

Problems in farming on dry land is the low level of fertility and high acidity of the soil so that improvements need to be made to increase soil fertility. Steps to increase food production, especially horticulture on sub-optimal land, include the use of acid dry land. Acid dry land in Indonesia has an area of 108.8 million hectare (Mulyani & Sarwani, 2013). As an effort to increase soil fertility, namely through the use of *in-situ* sources of organic matter, such as returning crop residues. An alternative to the use of soil amendments is the production of biochar from agricultural waste that is effective and can last a long time in the soil (Tang et al., 2013).

One of the potential organic fertilizers as organic fertilizer for agricultural waste is the use of jengkol peel. Some research results show that jengkol peel waste fertilizer or jengkol peel biochar, can be given as solid fertilizer or liquid fertilizer.

Jengkol peel (*Pithecellobium jiringa*) is classified as organic waste which is widely available in traditional markets and does not provide economic value. This skin sometimes piles up in the trash and is left just like that even though it is very disturbing to the view and causes an unpleasant and disturbing odor because of the pungent smell.

The use of jengkol as a vegetable pesticide has been experimented with by Rangkuti et al. (2019) for rice plants to suppress walang sangit attacks, Astuti (2013) suppresses the growth of mulberry snails, but it is still relatively expensive, it would be very good if jengkol peel which is considered as waste can be used as a pesticide and also organic fertilizer. Based on the results of his research it is known that at a concentration of 10% jengkol peel extract increases the growth of rice plants and reduces the viability and vigor of weeds. Jengkol peel contains nutrients: 1.82% N, 0.03% P, 2.10% K, 0.27% Ca, and 0.25% Mg. Information about jengkol skin is still very limited so further research is needed, especially how to apply it.

Through this research, the utilization of jengkol peel is expected to improve plant growth and productivity. The use of biochar from jengkol peel waste can also be used as material for fertilizer. Basically, biochar has the potential to increase C-soil in a sustainable manner, retain water and nutrients in the soil. Another benefit of biochar is that it can store carbon stably for thousands of years by immersing it in the soil. The application of jengkol peel biochar added with organic compost fertilizer to shallots has an effect on vegetative growth while generative growth has no significant effect (Hasibuan et al., 2022). Various studies that have been conducted show that the application of biochar can reduce the use of fertilizers and increase soil and plant productivity. On red chili plants, especially in Indonesia, the effect of biochar has not been widely reported, so research on the benefits of biochar on red chili needs to be done. The research results of Wijayanti et al. (2013) showed that the application of chicken manure with the addition of urea fertilizer increased fruit weight yields compared to goat and cow organic fertilizers, the application of chicken manure organic fertilizer had higher yields compared to the administration of cow manure organic fertilizer (Rizal et al., 2019)

The results of several studies on the benefits of applying jengkol peel waste with chicken fertilizer were carried out in an effort to increase the yield of chili plants (*Capsicum annum* L), so that through the application of the use of jengkol peel biochar with the addition of chicken manure at different doses the growth and yield of chili plants can be increased. The purpose of this study was to determine the aplivation og jengkolpeel biochar through the addition of chicken manure fertilizer in acidic dry land.

## MATERIALS AND METHODS

### Implementation of Research

The research was carried out on land owned by the Palembang City Agriculture and Food Security Office, RPH Complex, TPH, JL. Sofian Kenawas, Gandus, Gandus sub-district, Palembang City, South Sumatra, research time from March 2022 to May 2022. The materials used were red chili seeds of the Laris Variety and chicken manure.

While the materials used in the process of making biochar were dried peel waste, kerosene, and dry wood branches. The tools used were shovels, hoes, sample boards, label paper, scissors, paddles, meters, and scales. or the manufacture of biochar, tools were needed, namely, a pyrolysis tube (modified biochar-making place), matches, a sieve, and mortar. Biochar was made in a simple 60 liters used drum with 20 kg of jengkol peel waste material which was heated for approximately 5 hours at a temperature of around 300 – 500$^{o}$ C (Herlambang et al., 2017).

### How to Make Biochar

Making biochar through carbonation was the process of decomposing cellulose into carbon elements and removing non-carbon elements. *Jiringa peel* waste of as much as 20 kg was put into a burning iron drum and then put into a charring furnace from a modified used drum.

Burning was done by lighting coconut fiber that has been dipped in kerosene and added with firewood so that the fire was more durable, after the fire was lit perfectly, the jiringa skin was put into the drum slowly so that the fire does not go out until the drum was full. Furthermore, during the charring process, the drum was closed so that the oxygen in the charring room was as low as possible so that good charcoal results were obtained and left for 8 hours.

### Land Preparation:

The research area of 10 m x 30 m was cleared of grass vegetation, then the land was processed twice with an interval of 7 days, and then made plots with a size of 2 m x 2 m as many as 36 plots with a spacing of 50 cm x 50 cm.

**Nursery**

Seeding of chili seeds was carried out in polybags, the seedling media used in this study consisted of 10 kg soil and 5 kg chicken manure (2 : 1). Chili seeds were first soaked with clean water for 12 hours to accelerate the seed germination process. After the seeds germinate, they are transferred to baby polybags that have been filled with soil and chicken manure media, each polybag contains 1 seed. While in the nursery, care was taken such as watering morning and evening.

**Planting**

Planting was done in the afternoon when the seedlings have 4-6 leaves or are 30 days after sowing. The seedling polybags were opened, then planted in the planting holes that had been provided according to the treatment.

**Fertilization**

Biochar jiringa peel and chicken manure fertilizers were applied a week before planting with doses according to the treatment, for the calculation of giving based on recommendations, namely 5 tons per Hectare so that in a plot area of 2x 2 m, then convert in m2, namely (5000 kg : 10000 m2) multiplied by the plot area of 4 $m^2$, so that 2 kg per plot was obtained. Treatment with the notation as follows: Biochar jiringa peel: B1 5 tons/ha, B2 15 tons/ha (3 kg/plot) and B3 25 tons/ha (4 kg/plot). Application of chicken manure, namely: K0= 0 ton/ha (control) K1=10 ton/ha (4 kg/plot) K2=20 ton/ha (6 kg/plot), and K3=30 ton/ha (8 kg/plot). Biochar was given 1 week before planting, while chicken manure organic fertilizer was given 2 weeks before planting so that it was more decomposed so it could provide nutrients for plants. Liquid compound NPK fertilizer at a dose of 250 ml/plant was applied after planting as an additional base fertilizer.

**Maintenance**

Plant maintenance includes watering, weeding, pruning, installing stakes, and controlling pests and diseases. Watering was done in the afternoon using a hand sprayer if it does not rain or the soil was too dry. Weeding was done in the afternoon by pulling weeds around the chili plants.

**Research Methods**

This study used a Factorial Randomized Group Design with 12 treatment combinations that were repeated three times, so there were 36 treatment units were obtained. The treatment factors were as followed:

Factor 1: Dosage of jiringa peel biochar fertilizer (B) Consists of B1: 5 tons/Ha; B2: 15 tons/Ha B3: 25 tons/hectare.

Factor 2: Dose of Chicken Manure Organic Fertilizer (K). Consist ok K0: 0 ton per hectare (control), K1 10 ton per Hectare, K2 20 ton per Hectare, K3 30 ton per hectare. Plant variables were plant height (cm) plant diameter (cm), number of productive branches, weight chili of plant (gram), weight of chili per plot which was converted to weight per Hectare.

## RESULTS

**Early Soil Characteristics of the Gandus City Agriculture Land**

The results of the analysis of soil fertility in the research area of the Office of Agriculture and Resilience of the City of Gandus (Analysis of the Bina Sawit Laboratory, 2022) pH H2O 4.45 (classified as very acidic), cation exchange capacity 13.61 cmo1+/kg (classified as low), C-Organic 2.72% (classified as moderate), N-total 0.24% (classified as medium), P Bray II 4.08 ppm (classified as low), Ca-dd 0.84 cmo1+/kg (classified as moderate), Mg-dd 0, 20 cmo1+/kg (moderate) K-dd 0.20 cmo1+/kg (moderate), Na-dd 0.07 cmo1+/kg (moderate), soil texture 21.79% (sand), 50.61% (dust), 27.60% (clay) classified as clay. This means that the soil in the research area has moderately fertile soil fertility as indicated by a base saturation value of 9.63% (base cation (Ca+Mg+Na+K-dd)/CEC x 100% =

0.84+0.20+0 .07+0.20/13.61 x 100% = 9.63% (Soil Research Institute, 2005).

**Effect of application of peel biochar and organic chicken manure fertilizer on the growth of jengkol plants**

The results of the study in Table 1 show that the application of jengkol peel biochar fertilizer had a very significant effect on the variables of plant height, stem diameter and chili weight per plot, as well as the treatment of the application of organic chicken manure had a significant to very significant effect on the variables of plant height, stem diameter, chili weight per plant and chili weight per plot. Meanwhile, the treatment interaction had no significant effect on all observed variables except for the stem diameter variable which had a very significant effect.

Table 2 summarizes the results of the treatment effect at several different doses of jengkol peel application on several variables. Table 3 showed the results of the recapitulation of the treatment of manure application with different doses of plant variables. Figure 1, 2, and 3 showed the combination treatment on the variables number of productive chili branches, chili weight per plant and chili weight per plot. Table 4. Recapitulation of the combination of doses of jengkol peel and chicken manure organic fertilizer differed in several treatment variables. Figure 2. Graph of the effect of the combined treatment dose of jengkol skin biochar and chicken manure organic fertilizer on chili weight variable per plot (g).

Table 1. Results of the analysis of the variation effect of doses of jengkol peel biochar fertilizer and chicken manure on the observed variables

| Observed Variables | Treatment | | | Coefficient of Diversity (%) (KK) |
|---|---|---|---|---|
| | B | K | Interaction | |
| Plant Height (cm) | ** | * | ns | 9.88 |
| Stem Diameter (cm) | ** | ** | ** | 12.24 |
| Number of Productive Branches (branches) | | | | |
| Chili Weight per Plant (g) | ns | ns | ns | 19.52 |
| Chili Weight per Plot (g) | ns | * | ns | 15.69 |
| | ** | ** | ns | 14.36 |

Note: Not Significant effect, * = significant effect, ** = very significant effect, B = dose of Jengkol Peel Biochar Fertilizer, K = Dosage of Chicken Manure Fertilizer

Table 2. Recapitulation of the effect of skin biochar fertilizer dosage treatmen jengkol on the observed variables

| Biochar Fertilizer Dosage | Plant Height (cm) | Plant Diameters (cm) | Number of Productive Branches (Branches) | Chili Weight per Plant (g) | Chili Weight per Plot (g) |
|---|---|---|---|---|---|
| $B_1$ | 50.81 [a] | 2.03 [a] | 1.69 | 59.33 | 502.00 [a] |
| $B_2$ | 58.13 [b] | 2.68 [b] | 1.92 | 69.08 | 612.58 [b] |
| $B_3$ | 53.05 [ab] | 2.52 [b] | 1.87 | 64.67 | 570.42 [ab] |
| BNJ 0.05= | 5.47 | 0.30 | ns | ns | 82.73 |

Note: Numbers followed by the same letter and column are significant not real different, B1: 5 tons per hectare; B2 : 15 tons per hectare B3 : 25 tons per hectare

Table 3. Recapitulation of the effect of treatment of chicken manure dosage on observed variables

| Chicken Manure Organic Fertilizer Dosage | Plant height (cm) | Plant Diameters (cm) | Number of Productive Branches (Branches) | Chili Weight per Plant (g) | Chili Weight per Plot (g) |
|---|---|---|---|---|---|
| $K_0$ | 50.86 [a] | 1.90 [a] | 1.69 | 55.56 [a] | 5475.67 [a] |
| $K_1$ | 51.81 [a] | 2.42 [b] | 1.79 | 63.56 [ab] | 557.78 [ab] |
| $K_2$ | 53.99 [ab] | 2.57 [b] | 1.89 | 67.56 [ab] | 588.67 [b] |
| $K_3$ | 59.32 [b] | 2.74 [b] | 1.93 | 70.78 [b] | 624.56 [b] |
| BNJ 0.05= | 6.98 | 0.38 | tn | 13.22 | 105.59 |

Note: Numbers followed by the same letter and column not significant different, K0: 0 ton/Ha: (Control), K1: 10 tons/Ha; K2: 20 tons/Ha; K3: 30 tons/Ha

Table 4. Recapitulation of the effect of interaction treatment of skin biochar fertilizer doses jengkol and chicken manure on the observed variables

| Interaction Combination of treatments | Plant Height (cm) | Plant Diameters (cm) | Number of Productive Branches (Branches) | Chili Weight per Plant (g) | Chili Weight per Plot (g) |
|---|---|---|---|---|---|
| $B_1K_0$ | 48.57 | 0.89 [a] | 1.56 | 41.67 | 329.67 |
| $B_1K_1$ | 50.27 | 2.14 [b] | 1.63 | 62.00 | 536.67 |
| $B_1K_2$ | 51.46 | 2.45 [b] | 1.78 | 66.67 | 560.00 |
| $B_1K_3$ | 52.93 | 2.63 [b] | 1.79 | 67.00 | 581.67 |
| $B_2K_0$ | 53.47 | 2.56 [b] | 1.78 | 63.00 | 556.67 |
| $B_2K_1$ | 54.23 | 2.62 [b] | 1.89 | 65.33 | 578.33 |
| $B_2K_2$ | 56.63 | 2.64 [b] | 2.00 | 71.33 | 628.33 |
| $B_2K_3$ | 68.20 | 2.89 [b] | 2.00 | 76.67 | 687.00 |
| $B_3K_0$ | 50.53 | 2.26 [b] | 1.74 | 62.00 | 540.67 |
| $B_3K_1$ | 50.93 | 2.50 [b] | 1.86 | 63.33 | 558.33 |
| $B_3K_2$ | 53.90 | 2.63 [b] | 1.89 | 64.40 | 577.67 |
| $B_3K_3$ | 56.87 | 2.69 [b] | 1.99 | 68.67 | 605.00 |
| BNJ 0.05= | ns | 0.79 | ns | ns | ns |

Note: Numbers followed by the same letter and column are not significantly different

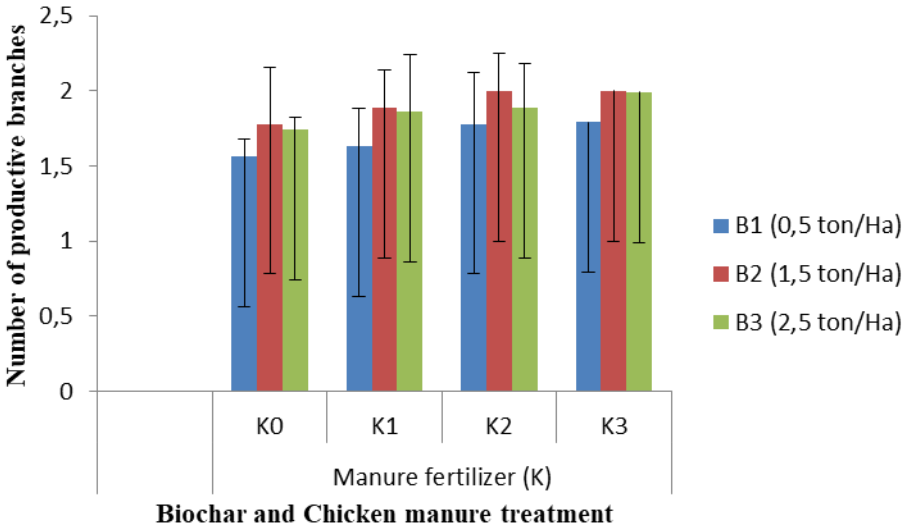


Figure 1. Graph of the effect of the treatment combination of doses of jengkol peel biochar and chicken manure organic fertilizer on the number of productive branches of chili plants

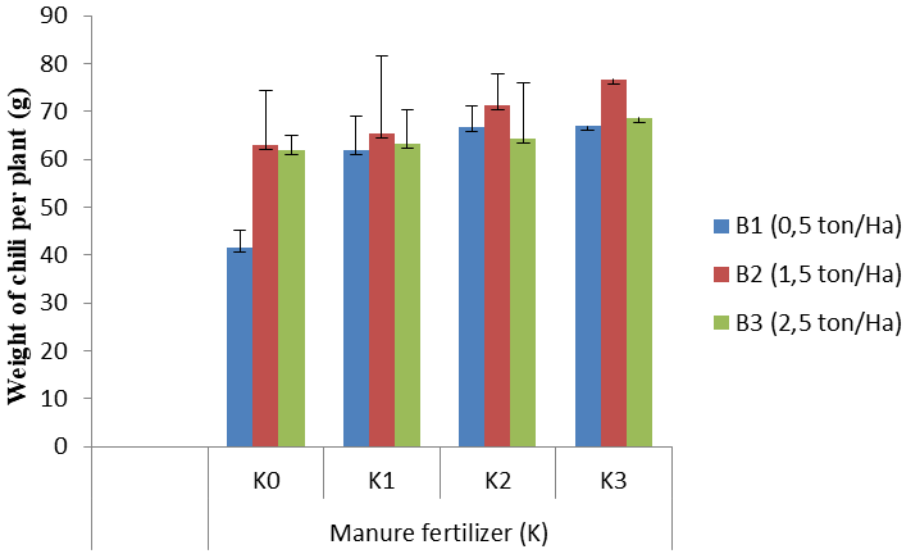


Figure 2. Graph of the effect of the combined treatment dose of jengkol skin biochar and chicken manure organic fertilizer on chili weight variable per plot (g)

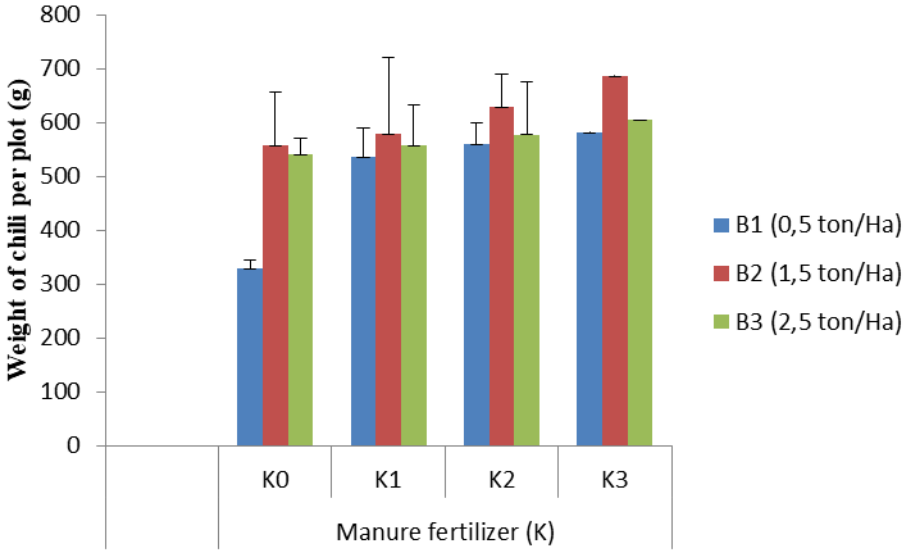


Figure 3. Graph of the effect of the treatment combination of doses of jengkol skin biochar and doses of organic chicken manure on the weight of chilies per plot

## DISCUSSION

The treatment of jengkol peel biochar fertilizer at a dose of 15 tons/ha in this study was the best in increasing the growth and production of red chili when compared to the dose of 5 tons/ha biochar fertilizer. Physically, it can be seen from the crumbly soil structure so that the roots of chili plants grow well and can freely absorb nutrients in the soil and can increase the ability to hold water so that water that carries nutrients such as N, Ca, K, Mg is also available for plants. This causes an increase in plant height, stem diameter and the highest number of fruit branches (Table 2 & 3). Application of Biochar can also significantly reduce N leaching so that N is available to plants, can increase soil CEC thereby reducing the risk of nutrient leaching, especially K and retaining P which cannot be retained by ordinary organic matter (Lehmann, 2007). The availability of sufficient N, P and K nutrients for plants to increase chili production can be seen from the results of the research on the number of productive branches and the highest fruit weight of

chilies in the Biochar fertilizer treatment of 15 tons/ha, namely the number of productive branches, the weight of chilies per plant and the weight of chilies per plant. plot. Long-term gains to nutrient availability are associated with higher stabilization of organic carbon along with slower release of nutrients than commonly used organic matter.

Meanwhile, the use of biochar fertilizer at a dose of 25 tons/ha is good enough to support the growth and production of chili plants, and the lowest dose is 5 tons/ha. This shows that the dose of 5 tons/ha of jengkol peel biochar fertilizer is a dose of organic fertilizer that is not sufficient to improve soil fertility. In the soil there are many nutrients needed by plants, but not all of the nutrients in the soil can be absorbed by plants because the nutrients in the soil are not available. One of the nutrients in the soil that is not always available is nitrogen (N). Nitrogen is one of the essential nutrients for plants so it is very important for plant growth and development. If nitrogen in the soil cannot meet the needs of plant nutrients, input is needed that can supply nitrogen availability because if it is not met, plant growth and development can be disrupted (Tando, 2018).

Chicken manure organic fertilizer in the soil can increase the ability of the soil to store water for mineralization of organic matter into nutrients that can be used directly by plants during their growth period, can also support microorganisms and be able to improve soil structure (Mayadewi, 2007). The treatment of organic chicken manure at 10 tons/ha has not seen a significant effect on plant growth and production, but with increasing use of chicken manure up to 20 tons/ha, plant growth and production also increase, as a result of increased soil microorganism activity in the presence of organic matter. which comes from chicken manure can increase the availability of soil nutrients, besides that organic matter can also reduce soil acidity and increase pH (Sismiyanti et al., 2018; Nurida, 2014). The combination treatment of chicken manure with a dose of 30 tons/ha showed the best treatment, so it was able to increase soil pH even though the increase was still in the acid category. The level of soil acidity resulting from the application of organic matter depends on the maturity level of the organic matter provided, the expiration date of the organic matter and the type of soil. According to Gusnidar et al. (2019) if the addition of organic matter that is still immature will cause a slow increase process that has not decomposed properly and still releases organic acids, an increase in C-organic in composted soil and the more organic fertilizer added to the soil, mthe more a large increase in the C-organic content in the soil.

This increase in total N-total soil comes from the mineralization of organic matter provided (Darmawati, 2015) explains that the process of loss of N in the soil can be caused by being absorbed by plants, used by microorganisms, N is still in the form of NH4+ which is bound by illite clay minerals so it is not can be used by plants, N is also still in the form of $NO_3$- which is easily washed away by rainwater, and land conditions that are still stagnant with poor drainage and poor air fertility can also occur denitrification and also volatilization in the form of $NH_3$ (ammonia). Some of the research results of providing biochar can increase the ability to hold ground water (Yu et al., 2013). In addition, it is also able to increase soil pH in acid dry land in Lampung, retain N and P so that it can be more available for plants (Nurida, 2014). Applications Biochar with the addition of organic manure can increase soil fertility in the cultivation of shallots (Pakpahan et al., 2020) and corn (Abel et al., 2021).

## CONCLUSION

The application of 15 tons per hectare of jengkol peel biochar with addition of 30 tons per hectare of chicken manure organic fertilizer showed higher red chili production potential than other treatments with a

production of 343 grams per plant or equivalent to 10.99 tons per hectare.

## ACKNOWLEDGEMENTS

Thanks to the dean of the Faculty of Agriculture, University of Muhammadiyah Palembang, who has made it easy to complete the writing of this article through financial assistance in the implementation of reseach**.**

## REFERENCES

Abel G, Suntari R, Citraresmini A. 2021. Effect of rice husk biochar and compost on C-organic, N-total, soil C/N, N absorption, and growth of corn in ultisols. *Jurnal Tanah dan Sumberdaya Lahan*. 8 (2): 451–460. DOI: 10.21776/ub.jtsl.2021.008.2.16.

Astuti P. 2013. Effectiveness test of Jengkol (*Pithecellobium jiringa*) fruit peel on mulberry snail mortality. *Ziraa'ah Majalah Ilmiah Pertanian*. 37 (2): 40–45. DOI: 10.31602/zmip.v37i2.40.

Andani R, Rahmawati M, Hayati M. 2020. Growth and yield of chili pepper plants due to type of growing medium and variety in hydroponic substrate. *JIM Agroteknologi.* 5 (2): 1–10. DOI :10.17969/jimfp.v5i2.14764.

Central Bureau of Statistics. 2022. Badan Pusat Statistik (BPS) Sumatera Selatan Province. South Sumatera in Horticulture.

Darmawati. 2015. Effectiveness of various bioactivator on compos formation from vegetable and leaf wastes. *Jurnal of Dinamika Pertanian.* XXX (2): 93–100. DOI: 10.25299/dp.2015.vol30(2).801.

Gusnidar, Fitri A, Yasin S. 2019. Titonia and Composted rice straw on Soil chemical characteristics and Maize Production in Ultisol. *Jurnal Tanah*. 16 (1): 11–18. DOI: 10.25077/jsolum.16.1.11-18.2019.

Hasibuan NM, Hutapea S, Rahman A. 2022. Utilization of jengkol skin waste as an Ingredient to Increase the Growth and Production of shallot (*Allium ascalonicum* L.). *Ilmiah Pertanian* (*JIPERTA*) *Journal*. 4 (1): 32–44. DOI: 10.31289/jiperta.v4i1.

Herlambang S, Susanti R, Purwono AZ, Sutiono HR. 2017. Technical instructions for making biochar with a rotary sleeve system. Teaching materials. Veterans National Development University, Yogyakarta. Script Media Gate Publisher. pp 1–15. ISBN 978-602-6248-28-2.

Lehmann J. 2007. A handful of Carbon. *Nature*. 447 (7141): 143–144.

Mayadewi NNA. 2007. Effect of Manure type and spacing on weed growth and yield of sweet corn. *Agritrop*. 26 (4): 153–159.

Mulyani A, Sarwani M. 2013. Characteristics and potential of suboptimal land for agricultural development in Indonesia. *Journal of Land Resources.* 7 (1): 47–58 DOI: 10.2017/jsdl.v7n1.2013.%p.

Nurida NL. 2014. Potency of Utilities Biochar for dryland rehabilitation in Indonesia. *Journal of land resources*, special edition. 57–68.

Pakpahan TE, Hidayatullah T, Mardiana E. 2020. Application of Biochar and manure to shallot cultivation in anticeptol soil at the Medan Agricultural Development Polytechnic experimental garden. *Jurnal Agrica ekstensia.* 14 (1): 49–53. DOI: 10.55127/ae.v14i1.

Rangkuti K, Ardila D, Dafni MT. 2019. Utilization of jengkolpeel waste as a vegetable pesticide on rice plants. *Journal Prodikmas*. DOI: 10.30596/jp.v4i1.5788.

Rindani M. 2015. Red chili land suitability in Jorong City Kenagarian Lubuak Batingkok, Harau Kabupaten Lima puluh District Payakumbuh Regency. *Nasional Ecopedon*. 2 (2): 28–33.

Rizal M, Subaedah S, Muchdar A. 2019. Growth and producton of two black soybean (*Glycine soja*) varietas in response to application of different types

of organic frtilizers in drylands. *Jurnal Agrotek*. 3 (2): 129–142. DOI: 10.33096/agrotek.v3i2.80.

Sismiyanti, Hermansyah, Yulnafatmawita. 2018. Classification of several sources of organic materials and optimization of utilization as biochar. *J Solum*. XV (1): 8–16. DOI: 10.25077/jsolum.15.1.8-16.2018.

Sutrisni A. 2016. Activity Test of bioactive compounds of mold against the cause of wilt (*Gliocladium* sp) in chilli peppers in-Vitro Against *Fusarium oxysporum*, Bachelor. [Thesis]. Universitas Muhammadiyah Purwokerto.

Suwardana NW, Purnomowati, Sucianto ET. 2014. Study of disease caused by fungi in red chili (*Capsicum annus* L.) in Brebes District public Garden. *Scripta Biological*. 1 (30): 223–235. DOI: 10.20884/1.sb.2014.1.3.554.

Tando E. 2018. Effort to efficiency and improve soil nitrogen avaibility and nitrogen uptake in paddy rice (*Oryza sativa* L.). *Buana Sains*. 18 (2): 171–180. DOI: 10.33366/bs.v18i2.1190.

Tang J, Zhu W, Kookana R, Katayama A. 2013. Characteristics of biochar and its application in remedian of contaminated soil. *Journal of Biosceince and Bioenginering*. 116 (6): 653–659. DOI: 10.1016/j.jbiosc.2013.05.035.

Wijayanti M, Hadi MS, Pramono E. 2013. The effect of three types of manure and urea dosage on growth and yield of chili (*Capsicum annum* L.). *Journal Agrotek Tropika*. 1 (2): 172–178. DOI: 10.23960/jat.v1i2.2028.

Yu Ok-You, Brain R, Sam S. 2013. Impact of biochar on the water holding capacity of Ioamy sand soil. 4: 4.