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The Effect of Rice Straw Mulch and Plus Organic Fertilizer Residue on The Growth of Glutinous Corn (*Zea mays ceratina* Kulesh)

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Abstract

This study aimed to determine the effect of rice straw mulch and plus organic fertilizer residue on the growth of glutinous corn. This study was conducted from May to July, 2022 at the Field Laboratory, Faculty of Agriculture, Halu Oleo University, Kendari, Southeast Sulawesi. This study used a randomized block design with split-plot design treatments. Main plots were residue of rice straw mulch (M): without residue of rice straw mulch (M0), 4 t ha-1 residue of rice straw mulch (M1), and 8 t ha-1 residue of rice straw mulch (M2). Main subplots were residue of plus organic fertilizer (P): without residue of plus organic fertilizer (P0), 2.5 t ha-1 residue of plus organic fertilizer (P1), 5 t ha-1 residue of plus organic fertilizer (P2), and 7.5 t ha-1 residue of plus organic fertilizer (P3). Each experimental unit was repeated three times. Measured variables were plant height, number of leaves, leaf area, , plant fresh weight, plant dry weight, and flowering age. The data were analyzed using ANOVA, if the analysis result was significant (Fhit> Ftab), then analyzed further using DMRT on α=0.05. The research results showed a single effect in 8 t ha-1 residue of rice straw mulch (M2) or 7.5 t ha-1 residue of plus organic fertilizer (P3) by producing the highest growth of glutinous corn

Keywords: growth, mulch, plus organic fertilizer, residue

A. Introduction

Corn (*Zea mays* L.) is a staple food widely used for food ingredients such as the flour and oil industries and is used for the animal feed ingredient industry. Corn as a food ingredient, can provide more excellent nutritional value compared to other types of grains. Corn generally consists of starch, protein, fat, vitamins, minerals, and organic matter. Glutinous corn is known for special character of glutinous or sticky. Glutinous corn has good taste, is more legit, fluffier and softer. The savory taste of glutinous corn is caused by high amylopectin content, ranging from 90-99% (Suarni, S., Aqil, M., Subagio, H., & Timur, B. P. T. P. J., 2019).

Soil fertility is a problem that needs to be resolved to promote the growth of corn plants, especially in dry land. Naturally, marginal dry land has low soil fertility, based on the acid soil, low nutrient reserves, exchangeable bases, and low base saturation, while having high to very high aluminum saturation (Arsyad, A.R., Junedi, H., & Farni, Y., 2012). According to Sipayung, N.Y., Gusmeizal, & Sumihar, H. (2017), low soil quality can be caused by infertile soil, such as low nutrient content and soil microorganisms. Efforts to maintain soil organic matter levels to reach ideal conditions should provide good actions, environmentally awareness, and sustainability condition. Adding organic matter to the soil has a strong effect to improve soil properties, including soil nutrients (Roidah, 2013).

Mulching is one of efforts to overcome the problem of soil fertility sustainably. Mulch is a covering material above the soil surface for cultivated plants. Mulch is important to reduce the evaporation rate of groundwater due to solar radiation and evaporation so that decreased soil temperature and maintained water humidity to optimize plant growth (Gustanti, Y., Chairul, & Zuhri, S., 2014). Using mulch can modify the microclimate so plants can grow well (Hamzah, H., Jumiati, J., & Hasriani, H., 2022). Rice straw is local raw material that can be utilized as mulch and processed into organic fertilizer. Rice straw is abundant during the harvest season and has not been used properly by farmers. According to Setiyaningrum, A., Darmawati, A., Budiyanto, S. (2019), several advantages of rice straw mulch, including retaining soil aggregates from splashing rainwater, suppressing weed growth, ensuring better plant growth because there is no competition for nutrients, and being more economical because it can be obtained free of charge (Fahmi, 2014). In addition, rice straw contains about 40% N, 30-35% P, 80-85% K, and 40-45% S. Setiyaningrum *et al.* (2019) added that rice straw also contained 4-7% Si, 1.2-1.7% K2O, and 0.07-0.12% P2O5. Through its content, the residue of decomposed straw mulch will increase soil fertility and is very beneficial for plant growth.

Another way to increase plant growth is nutrient addition through fertilization. Fertilization aims to increase plants' nutrients because the nutrients in the soil are not always sufficient to support optimal plant growth (Supartha, 2012). The fertilizer can be organic or inorganic fertilizers. However, imbalance chemical fertilizer without organic matter addition will bring serious consequences and damage the soil (Setiawati, M.R., Sofyan, E.T., & Nurbaity, A., 2017). An alternative solution is by using organic fertilizers to help increase soil fertility and provide unavailable to plants. Applying organic fertilizers can improve soil physical properties, fertilize the soil, add soil nutrients and humus, and affect the life of soil microorganisms (Marlina, N., Midranisah, M., Syafrullah, S., & Harapin, H., 2022). Plus organic fertilizer is a modified fertilizer added with certain microbes (Plant Growth Promoting Rhizobacteria) to enhance and maximize the role of the fertilizer (Sutariati and Wahid, 2012).

Using organic materials, such as mulch and organic fertilizers leaves a residual effect on the soil. Organic matter residue is material left in the soil after certain treatments. The decomposition of straw mulch and organic fertilizer takes a long time because most of the organic matter will be stored as residue that can be reused in the next growing season (Yalang, A., Barus, H., & Rauf, A., 2016). Straw mulch residue in the cultivated area will protect the soil from rain, maintain soil moisture, and increase soil nutrient content. The residue produced by organic fertilizers can increase soil fertility. The residual effect of organic fertilizers can improve the quality and properties of the soil for several years after application. It also increases the N content and other nutrients derived from plant materials (Murwindra, R., Astegi, A., Dwi, P.M., Edi, K., Jumriana, R.N., & Nofri. Y., 2021). Using residue from rice straw mulch and plus organic fertilizer is one of the strategic efforts to overcome soil fertility problems and increase crop growth.

Based on the description of the background above, it is necessary to determine the residual effect from using plus organic fertilizer and rice straw mulch on the growth of glutinous corn.

B. Methodology

This study was carried out at the Experimental Garden II and the Agronomy Laboratory of the Faculty of Agriculture, University of Halu Oleo, from May to July, 2022. The materials used included glutinous corn variety Kumala F1, marker labels, raffia rope, tarpaulin, waring net, paper envelopes, plastic, and zipper packs. The equipment were hoes, machetes, a watering can, tape measure, calipers, analytical scales, cameras, ovens, and stationery.

1. Research Design

The environmental design used a randomized block design with split-plot design treatment. The main plots were rice straw mulch residue (M) which consisted of 3 levels, namely without rice straw mulch residue (M0), 4 t ha-1 residue of rice straw mulch (M1), and 8 t ha-1 residue of rice straw mulch (M2). Subplots were plus organic fertilizer residue (P) which consisted of 4 levels, namely without plus organic fertilizer residue (P0), 2.5 t ha-1 residue of plus organic fertilizer (P1), 5 t ha-1 residue of plus organic fertilizer (P2), and 7.5 t ha-1 residue of plus organic fertilizer (P3). There were 12 treatment combinations, and each treatment was repeated three times to obtain 36 experimental units.

2. Prosedure

Before carrying out the experiment, the first step was preparing the materials and equipment for land and beds, planting the glutinous corn variety of Kumala F1, and maintaining the plant. The land had previously been planted with soybeans treated with rice straw mulch and organic fertilizer. Land processing was carried out after the harvest of the first crop without any land renewal. Machete was used to clear weeds and crop residues, followed by loosening the beds using a hoe without changing the shape and position of the plots from the previous experiment. The trial plot was 200 cm x 150 cm, and the ditch spacing between treatment plots was 30 cm. Re-sorted glutinous corn variety Kumala F1 seed with the characteristics of large seeds were used to minimize growth.

Prepared a planting hole of ± 2 cm with a distance of 40 cm x 60 cm. Put 2 seeds in the planting hole to minimize not growing, then pour soil on the top. After the plants were 2 WAP old, sorting was done by cutting one plant that did not grow well to obtain one plant in each planting hole. Plant maintenance was essential to maximize the growth of cultivated plants. Maintenance carried out were watering, weeding, hilling, and controlling pests and diseases. Observational variables were plant height, number of leaves, stem diameter, leaf area, plant fresh weight, plant dry weight, and flowering age.

3. Data analysis

The observation results were analyzed using variance (ANOVA), if Fcount > Ftable = 0.05, then it was analyzed further using Duncan's Multiple Range Test (DMRT) at the 95% confidence level.

C. Result and Discussion

The analysis results of the effect of rice straw mulch residues and plus organic fertilizer on glutinous corn growth are presented in Table 1.

Table 1. The analysis results of the effects of rice straw mulch residues and plus organic fertilizer on glutinous corn growth

No	Observational variable	Treatment		
		Straw Mulch (M)	Plus Organic Fertilizer (P)	Interaction (M X P)
1.	Plant Height (cm)			
	- 2 WAP	tn	*	tn
	- 4 WAP	tn	**	tn
	- 6 WAP	tn	**	tn
	- 8 WAP	tn	**	tn
2.	Number of Leaves (leaves)			
	- 2 WAP	tn	*	tn
	- 4 WAP	tn	**	tn
	- 6 WAP	tn	**	tn
	- 8 WAP	tn	**	tn
3.	Stem Diameter (cm)			
	- 2 WAP	tn	**	tn
	- 4 WAP	tn	**	tn
	- 6 WAP	tn	**	tn

- 8 WAP	tn	**	tn
4. Leaf Area (cm^2)			
- 2 WAP	*	**	tn
- 4 WAP	tn	**	tn
- 6 WAP	tn	*	tn
- 8 WAP	tn	tn	tn
5. Fresh Weight (g)	tn	*	tn
6. Dry Weight (g)	tn	**	tn
7. Flowering age (day)	*	**	tn

Note: tn (no significant effect), * (significant effect), ** (very significant effect)

Table 1 shows no interaction effect between rice straw mulch residue and plus organic fertilizer residue on all variables observed. Independent rice straw mulch treatment significantly affected leaf area at 2 WAP and flowering age. The independent treatment of plus organic fertilizer showed a significant effect on plant height at 2 WAP, the number of leaves at 2 WAP, leaf area at 6 WAP, and plant fresh weight, and had a very significant effect on plant height at 4, 6 and 8 WAP, the number of leaves at 4, 6 and 8 WAP, stem diameter at 2, 4, 6 and 8 WAP, leaf area at 2 and 4 WAP, plant dry weight, and flowering age.

Decomposed rice straw mulch has a lower ability to maintain soil moisture, but it can contribute to soil nutrient availability if the decomposition process occurs perfectly; its effect will be seen at the end of the vegetative or early reproductive phase. Organic matter is slowly decomposing in the soil, so nutrients are slowly available (Kuziemska, B., Wysokińsk, A., & Trębicka. J., 2020). The mulch residue used in this study is assumed to be in the decomposition process, which means not yet undergone complete decomposition. Thus, its role in independently increasing plant growth and interacting with plus organic fertilizer residues was insignificant (Table 1) except at flowering age (Tables 1 and 7). This condition was in contrast to the plus organic fertilizer residue, which significantly affected plant growth, fresh and dry weight, and flowering age. Yalang *et al.* (2016), stated that the residue of organic mulch could be a nutrient reserve used for planting in the next period and organic fertilizer had a residual effect which means the nutrients gradually become available to plants. Therefore the treatment only has independent effect, especially plus organic fertilizer residue.

The results of Duncan's multiple range test (DMRT) on the effect of plus organic fertilizer residue on plant height, stem diameter, number of leaves, leaf area, plant fresh and dry weight, and flowering age are presented in Tables 2, 3, 4, 5, 6, and 7.

Plant Height

The DMRT results on the independent effect of plus organic fertilizer residue treatment on the plant height are presented in Table 2.

Table 2. The independent effect of plus organic fertilizer residue treatment on the plant height at the age of 2, 4, 6, and 8 WAP

Plus Organic Fertilizer Residue	Plant Height (cm)			
	2 WAP	4 WAP	6 WAP	8 WAP
0 t ha^{-1} (P0)	37.74^{b}	81.82^{b}	112.70^{c}	139.44^{c}
2.5 t ha^{-1} (P1)	38.15^{b}	90.07^{a}	118.85^{b}	148.18^{b}
5 t ha^{-1} (P2)	41.54^{ab}	92.06^{a}	123.30^{ab}	153.74^{ab}
7.5 t ha^{-1} (P3)	44.51^{a}	95.77^{a}	126.82^{a}	159.71^{a}
DMRT α = 0.05	2 = 4.60 3 = 4.83 4 = 4.97	2 = 5.59 3 = 5.87 4 = 6.05	2 = 5.93 3 = 6.22 4 = 6.41	2 = 8.68 3 = 9.11 4 = 9.39

Note: Numbers followed by different letters in the same column are significantly different based on 95% confidence level of DMRT test

Table 2 shows the effect of plus organic fertilizer residue on plant height. The highest plant height at 2 WAP obtained by P3 was significantly different from P0 and P1, but not significantly different from P2. The P0 obtained the lowest plant height, significantly different from P3, but not significantly different from P1 and P2. The highest plant height at 4 WAP obtained by P3 was significantly different from P0, but not significantly different from P1 and P2. The lowest plant height obtained by P0 was significantly different from the other treatments. The highest plant height at 6 WAP obtained by P3 was significantly different from the P1 and P0, but not significantly different from the P2. The P0 obtained the lowest height and was significantly different from the other treatments. The highest plant height at 8 WAP obtained by P3 was significantly different from the P1 and P0, but not significantly different from the P2. The P0 obtained the lowest height and significantly differed from the other treatments.

Application of a higher dose of plus organic fertilizer residue results in higher growth of plant height. It is suspected that plus organic fertilizer residue from the previous application at a higher dose (7.5 tons per hectare) can still provide nutrients for plant growth. According to Zamrodah (2016), the residual effect of organic fertilizers can become nutrient reserves that can be used for the next planting period. Subowo (2010) stated that more organic matter caused a longer period for soil microorganism to decompose, so the organic matter residues could be utilized for subsequent planting. Haumein (2020) stated that the higher the organic fertilizers applied to the soil, the higher residue released. According to Armiyarsih, Sasli, I., & Haris, T. (2020), amino acids produced due to the decomposition of organic matter in the soil will break down into ammonium ($NH4+$) or nitrate ($NO3-$) that can contribute to the availability of nitrogen for plant height growth. Plant height is largely driven by the availability of nitrogen and phosphate nutrients (Rhezali and Lahlali, 2017). According to Hartanti, I., Hapsoh, & Yoseva, S. (2014), N nutrients trigger plant growth during the vegetative phase. It supports by Sinuraya and Melati (2019), that the N element plays a role in cell division and elongation, thereby affecting plant height growth.

Stem Diameter

The DMRT results on the independent effect of plus organic fertilizer residue treatment on the stem diameter of glutinous corn are presented in Table 3.

Table 3. The independent effect of plus organic fertilizer residue treatment on the stem diameter of glutinous corn at the age of 2, 4, 6, and 8 WAP.

Plus Organic Fertilizer Residue	Stem Diameter (cm)			
	2 WAP	4 WAP	6 WAP	8 WAP
0 t ha^{-1} (P0)	0.41^{c}	0.95^{d}	1.22^{c}	1.31^{c}
2.5 t ha^{-1} (P1)	0.43^{bc}	1.10^{cd}	1.32^{b}	1.41^{b}
5 t ha^{-1} (P2)	0.45^{b}	1.14^{bc}	1.34^{b}	1.45^{ab}
7.5 t ha^{-1} (P3)	0.48^{a}	1.20^{a}	1.44^{a}	1.53^{a}
	2 = 0.029	2 = 0.037	2 = 0.090	2 = 0.080
DMRT α = 0.05	3 = 0.031	3 = 0.039	3 = 0.094	3 = 0.084
	4 = 0.032	4 = 0.040	4 = 0.097	4 = 0.086

Note: Numbers followed by different letters in the same column are significantly different based on 95% confidence level of DMRT test

Table 3 shows the highest impact of the independent effect of plus organic fertilizer residue on stem diameter at 2 WAP obtained by P3 was significantly different from the other treatments. The P0 obtained the smallest stem diameter, significantly different from P2 and P3, but not significantly different from P1. P3 obtained the biggest stem diameter at 4 WAP. It was significantly different from the other treatments. The smallest stem diameter obtained by P0 was significantly different from P2 and P3, but not significantly different from P1. The P3 obtained the biggest stem diameter at 6 WAP and significantly differed from the other treatments. The smallest stem diameter was obtained by the P0, which was significantly different from the other treatments. P3 obtained the biggest stem diameter at 8 WAP and was significantly different from the P1 and P0, but not significantly different from the P1. The smallest stem diameter obtained by P0 significantly differed from the other treatments.

The residue is thought to provide nitrogen, phosphorus, and potassium nutrients affecting soil chemical properties. Applying organic matter as a soil conditioner can increase N, P, and K uptake in the soil Maftu'ah, E., Maas, A., Syukur, A., & Purwanto, B.H. (2013). Plus organic fertilizer contains macronutrients such as N, P, and K to nourish plants and ensure optimal plant growth. The presence of N, P, and elements in the planting medium will increase cell division and enlargement, so young leaves can reach perfect shape faster (Leonardo, A., Yulia, E., & Indra, S., 2016). Puspadewi, S., Sutari, W., & Kusumiyati (2016) stated that N, P, and K are macronutrients absorbed by plants, especially during the vegetative phase. The availability of N, P, and K is especially needed in stimulating plant height growth, stem diameter enlargement, and leaf formation.

Number of Leaves

The DMRT results on the independent effect of plus organic fertilizer residue treatment on the number of leaves of glutinous corn are presented in Table 4.

Table 4. The independent effect of plus organic fertilizer residue treatment on the number of leaves of glutinous corn at the age of 2, 4, 6, and 8 WAP

Plus Organic Fertilizer Residue	Number of Leaves (strands)			
	2 WAP	4 WAP	6 WAP	8 WAP
0 t ha^{-1} (P0)	3.39^{c}	5.17^{c}	8.14^{c}	8.67^{b}
2.5 t ha^{-1} (P1)	3.61^{b}	5.47^{b}	8.78^{b}	8.72^{b}
5 t ha^{-1} (P2)	3.69^{ab}	5.64^{b}	9.03^{b}	8.78^{b}
7.5 t ha^{-1} (P3)	3.86^{a}	6.03^{a}	9.44^{a}	9.42^{a}
DMRT α = 0.05	2 = 0.20 3 = 0.21 4 = 0.22	2 = 0.23 3 = 0.24 4 = 0.25	2 = 0.40 3 = 0.42 4 = 0.43	2 = 0.25 3 = 0.26 4 = 0.27

Note: Numbers followed by different letters in the same column are significantly different based on 95% confidence level of DMRT test

Table 4 shows the effect biggest impact of plus organic fertilizer residue on the number of leaves at 2 WAP obtained by P3 and was significantly different from the P0 and P1, but not significantly different from P2. The least number of leaves obtained by P0 treatment and was significantly different from the other treatments. The P3 obtained the highest number of leaves at 4 WAP, significantly different from the other treatments. A least number of leaves was obtained by P0 and significantly differed from the other treatments. The P3 also obtained the highest number of leaves at WAP, significantly different from the other treatments. The P0 obtained the lowest number of leaves, significantly different from the other treatments. P3 obtained the highest number of leaves at 8 WAP and significantly differed from the other treatments. The lowest number of leaves was obtained by P0, which was significantly different from P3, but not significantly different from P1 and P2.

According to Pane, M.A., Damanik, M.M.B. & Sitorus B. (2014), applying organic matter to soil can increase cation exchange capacity and soil pH. Sari, V.I., Sudradjat, & Sugiyanta (2015) added that increased soil pH indicates improving soil chemical properties, namely providing nutrients. According to Fauzi and Puspita (2017), N is a nutrient that compiles protein and chlorophyll to support leaf formation. Therefore, sufficient nitrogen availability accelerates plant growth, especially stems and leaves. The 7.5 ton per ha residue of plus organic fertilizer increases the number of leaves. Leaves are the main terminal for photosynthesis to produce and assimilate plant growth and development.

Leaf Area

The DMRT results on the independent effect of straw mulch residue and plus organic fertilizer residue treatment on the leaf area of glutinous corn are presented in Table 5.

Table 5. The DMRT results on the independent effect of straw mulch residue and plus organic fertilizer residue treatment on the leaf area of glutinous corn at 2, 4 and 6 WAP

Rice Straw Mulch Residue	Leaf Area (cm^2)					
	2 WAP	DMRT α = 0,05	4 WAP	DMRT α = 0,05	6 WAP	DMRT α = 0.05
0 t ha^{-1} (M0)	73.30^{b}		tn		tn	
4 t ha^{-1} (M1)	87.88^{a}	2 = 8.00				
8 t ha^{-1} (M2)	78.88^{b}	3 = 8.18				
Plus Organic Fertilizer Residue						
0 t ha^{-1} (P0)	67.26^{b}		102.14^{c}		1320.50^{b}	
2.5 t ha^{-1}(P1)	77.87^{ab}	2 = 11.13	114.57^{bc}	2 = 19.50	1401.62^{b}	2 = 263.87
5 t ha^{-1}(P2)	86.37^{a}	3 = 11.68	128.22^{ab}	3 = 20.47	1534.56^{ab}	3 = 277.09
7.5 t ha^{-1} (P3)	87.89^{a}	4 = 12.04	141.64^{a}	4 = 21.09	1696.73^{a}	4 = 285.46

Note: Numbers followed by different letters in the same column are significantly different based on 95% confidence level of DMRT test

Table 5 shows the biggest impact of the independent effect of straw mulch residue on the leaf area at 2 WAP was obtained by M1, which was significantly different from the other treatments. The smallest leaf area was obtained by M0 and was not significantly different from the M2, but significantly different from the M1. Meanwhile, the independent effect of plus organic fertilizer residue on leaf area at 2 WAP showed P3 obtained the widest leaf area, which was significantly different from P0, but not significantly different P1 and P2. The narrowest leaf area was obtained by P0 and was significantly different from P2 and P3, but not significantly different from P1.

The independent effect of plus organic fertilizer residue leaf area at 4 WAP showed that P3 obtained the widest leaf area, which was significantly different from P1 and P0, but not significantly different from the P2. The narrowest leaf area was obtained by P0 was significantly different from P2 and P3, but not significantly different from P1. Widest leaf area at 6 WAP was obtained by P3, significantly differed from P1 and P0, but not significantly different from P2. The narrowest leaf area was obtained by P0 and significantly differed from P2 and P3, but not significantly different from P1.

Winarti (2021) stated that organic fertilizer residues could decompose and release nutrients, including N. The N availability in the soil determines the amount of N that can be absorbed. Adequate N availability will form broader leaves and higher chlorophyll content, so plants can produce sufficient assimilations to support vegetative growth. The sufficient N will ensure that leaves grow and become broader. Leaf size determines the effectiveness of the photosynthesis process. Broad leaves allow high sunlight absorption so that more chemical energy is collected to support the photosynthesis process to produce higher photosynthates or assimilates. In this situation, the plant will grow and develop plant organs such as roots, stems and leaves to the fullest. Photosynthesis results are broken down through respiration to produce energy causing the leaves to be longer and broader. The N element determines leaf chlorophyll, which captures sunlight for maximum photosynthesis and assists plants in spurring vegetative growth, such as the number of leaves and leaf area (Asra, G., Simanungkalit, T., & Rahmawati, N., 2015). Rahmah, A., Izzati, M., Parman, S. (2014) stated that nitrogen was used to support plant vegetative growth, including leaf development. According to Hardian, M., Basuni., & Sahwan, M. (2021), the growth of plant leaves and stems can be hampered due to N deficiency.

Plant Fresh Weight and Dry Weight

The DMRT results on the independent effect of plus organic fertilizer residue treatment on the fresh weight and dry weight of glutinous corn are presented in Table 6.

Table 6. The independent effect of plus organic fertilizer residue treatment on the fresh weight and dry weight of glutinous corn

Plus Organic Fertilizer Residue	Fresh Weight (g)	DMRT α = 0.05	Dry Weight (g)	DMRT α = 0.05
0 t ha^{-1} (P0)	63.28^{b}		18.72^{c}	
2.5 t ha^{-1}(P1)	70.01^{b}	2 = 10.31	21.02^{bc}	2 = 2.97
5 t ha^{-1}(P2)	75.32^{ab}	3 = 10.83	22.88^{ab}	3 = 3.12
7.5 t ha^{-1} (P3)	81.27^{a}	4 = 11.16	25.05^{a}	4 = 3.21

Note: Numbers followed by different letters in the same column are significantly different based on 95% confidence level of DMRT test

Table 6 shows that the biggest impact of the independent effect of plus organic fertilizer residue on obtained by P3 with the heaviest fresh weight, which was significantly different from the P1 and P0, but not significantly different from P2. The smallest fresh weight obtained by P0 and was significantly different from P3, but not significantly different from P1 and P2.

The P3 obtained the heaviest dry weight, which was significantly different from the P1 and P0, but not significantly different from the P2 treatment. Smallest dry weight obtained by P0 which was significantly different from P2 and P3, but not significantly different from P1.

Plus organic fertilizer residue at a dose of 7.5 t ha^{-1} is thought to create good soil structure and texture conditions along with providing macro and micro elements to encourage optimal growth. Biologically, organic matter can affect the activities of macroflora and microfauna organisms and can physically improve soil structure (Jenira, H., Sumarjan, & Armiani, S., 2016). A better root system supports optimal growth to optimize using groundwater, implicating increasing glutinous corn's fresh and dry weight. Roidah (2013) and Armiyarsih *et al.* (2020) stated that optimal plant growth was followed by increased fresh and dry weight due to improved soil conditions. Applying organic matter as a soil conditioner can increase N, P, and K uptake in the soil (Maftua'ah *et al.*, 2013). This will maximize photosynthesis to produce and accumulate assimilate. The large accumulation of photosynthate implicates high plant dry weight. Suryati, Dhiya, Sampurno, Anom, & Edison. (2014), stated that plant dry weight reflected on plant nutritional status as dry weight depends on cell number and size; generally, plants consist of 70% water. Dry matter (organic substances) can be obtained by drying water. Using organic matter such as compost increases plant dry weight (Gusta, A.R., Kusumastuti, A. , & Parapasan, Y., 2015; Armiyarsih *et al*., 2020). The highest fresh and dry weight of glutinous corn was obtained by residues of plus organic fertilizer at a dose of 7.5 ton per hectare (Table 6). Haumein (2020) stated that higher amount of organic fertilizers applied to the soil could withdraw residue, as organic fertilizers require a longer decomposition process used for plant growth in the second planting period.

Flowering Age

The DMRT results on the independent effect of straw mulch residue and plus organic fertilizer residue treatment on the flowering age of glutinous corn are presented in Table 7.

Table 7. The independent effect of straw mulch residue and plus organic fertilizer residue treatment on the flowering age of glutinous corn

Rice Straw Mulch Residue	Flowering age (day)	DMRT α = 0.05
0 t ha^{-1} (M0)	44.17^{b}	
4 t ha^{-1} (M1)	42.83^{b}	2 = 1.10
8 t ha^{-1} (M2)	42.67^{a}	3 = 1.13
Plus Organic Fertilizer Plus		
0 t ha^{-1} (P0)	44.10^{c}	
2.5 t ha^{-1} (P1)	43.33^{bc}	2 = 0.89
5 t ha^{-1} (P2)	42.78^{ab}	3 = 0.93
7.5 t ha^{-1} (P3)	42.00^{a}	4 = 0.96

Note: Numbers followed by different letters in the same column are significantly different based on 95% confidence level of DMRT test

Table 7 shows that the effect of rice straw mulch residue on flowering age was the fastest in M2, which was significantly different from M0 but not significantly different from M1. Longest flowering age was obtained by M0, which was significantly different from M2 but not significantly different from the other treatments. Meanwhile, the effect of organic fertilizer residue plus on flowering age showed that the fastest flowering age obtained by P3 was significantly different from P0 and P1, but not significantly different from P2. Longest flowering age was obtained by P0, which was significantly different from P2 and P3, but not significantly different from P1.

Dewantari, R. P., Nur, E.S., & Setyono, Y.T. (2015) stated that the treatment without mulch caused a significant change in soil water content, resulting in a water deficit. Water stress will increase leaf temperature, close stomata, and decrease photosynthesis. The soil's good physical properties due to residue from a straw mulch (Rizki, T., Hadid, A., & Mas'ud, H., 2015; Wahjunie, E.D., Sinukaban, N., & Damanik, B.S.D., 2012) and residue of plus organic fertilizer containing rhizobacteria are thought to increase nutrient availability and the activity of microorganisms producing plant growth promoting hormones to encourage plant growth rate. The plant growth rate increased along with the increasing dose of fertilizer (Zulkifli, T.B.H., Tampubolon, K., Nadhira, H., Berliana, Y., Wahyudi, D., Razali, & Musril, 2020). Plant growth rate shows the ability to produce biomass per unit of time. An increase in biomass due to water and nutrients absorbed by plants supports the development of plant organs, including reproductive organs such as plant flowers. Therefore, the residue of plus organic fertilizer at a dose of 7.5 t ha^{-1} accelerates the glutinous corn flower formation. Soil properties can be improved using ameliorant materials such as organic materials/fertilizers (Priyadi, Jamaludin, & Mangiring, W., 2020). Biologically, organic matter can affect the activities of macroflora and microfauna organisms and can physically improve soil structure (Jenira *et al*., 2016). The bacterial population increases because organic matter contains C organic and N as a source of microbial nutrition, which increases soil fertility (Tobing, S., Mubarik, N.R., & Triadiati., 2014). Therefore, increasing the dose of plus organic fertilizer and straw mulch can maximize the fertility of dry land to support glutinous corn growth.

D.Conclusion

The interaction effect of rice straw mulch residues and plus organic fertilizer residues on plant growth did not have a significant effect. Rice straw mulch residue significantly affected leaf area and flowering age. In contrast, plus organic fertilizer residue significantly affected plant height, the number of leaves, stem diameter, total leaf area, fresh weight, dry weight, stem diameter, and flowering age. The 8 t ha^{-1} residue of rice straw mulch at a dose of or 7.5 t ha^{-1} plus organic fertilizer residue by producing the best plant growth.

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