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THE COMBINATION EFFECT OF PLANT STANDING AND DOSAGE OF MANURE ON GROWTH AND YEARS OF CORN (*Zea mays L.*) CULTIVAR SWEET LADY

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ABSTRACT

This study aims to determine: (1) the effect of the combination treatment spacing and manure dosage on the growth and yield of sweet corn, (2) the best combination of spacing treatment and manure dosage on the growth and yield of sweet corn, and (3) correlation between growth components and yield of sweet corn plants. The experiment was carried out in Bakung Kidul Village, Jamblang District, Cirebon Regency from November 2022 to February 2023. The experimental method used was an experimental method using a Randomized Block Design (RBD) with a further test of the Scott Knott Cluster Test at a 5 percent significance level. It consisted of a combination of spacing and manure treatment, and was repeated three times. The treatment combinations were as follows: A (40 cm x 40 cm and 15 tons of manure/ha), B (40 cm x 40 cm and 20 tons of manure/ha), C (40 cm x 40 cm and 25 tons of fertilizer manure/ha), D (50 cm x 40 cm and 15 tons of manure/ha), E (50 cm x 40 cm and 20 tons of manure/ha), F (50 cm x 40 cm and 25 tons of manure/ ha), G (60 cm x 40 cm and 15 tons of manure/ha), H (60 cm x 40 cm and 20 tons of manure/ha) and I (60 cm x 40 cm and 25 tons of manure/ha). The results showed that: (1) the combination of spacing and manure treatment had a significant effect on the growth and yield of sweet corn, (2) a spacing of 50 cm x 40 cm combined with 20 tons of manure per hectare had the best effect on plant height, number of leaves, cob length, weight of cobs with and without husks per plot. Spacing of 50 cm x 40 cm combined with 20 and 25 tons of manure per hectare gave the best effect on cob diameter, cob weight with and without husks per plant, and (3) there was a significant positive relationship between plant height at 42 days old after planting, the number of leaves aged 28 days and 42 days after planting with cob weight without husk per plot.

INTRODUCTION

Corn is one of the food ingredients other than rice which has long been cultivated in Indonesia, and is the most important food ingredient after rice. In order to be self-sufficient in carbohydrates as much as 2,100 calories/capita/day, corn is a commodity that must be considered in its development after rice and wheat (Suprapto, 2019). One type of corn that has not been commercially cultivated by farmers is sweet corn. Sweet corn besides containing carbohydrates and protein which is quite high, also contains several essential amino acids that are needed by the human body. The nutritional content in 100 g of sweet corn kernels is as follows: Protein 3.5 g, Fat 1.0 g, Carbohydrates 22.8 g, Calcium 3.0 mg, Phosphorus 111.0 mg, Iron 0.7 mg, Vitamin A 400 SI, Vitamin B 0.15 mg, Vitamin C 12 mg and Water 27.3 g (Koswara, 2016).

The productivity of the corn he cultivates is still relatively low, at around three tonnes of fresh cobs per hectare (Sukoco, 2015). The yield of sweet corn in Indonesia per hectare is still

low, an average of 2.89 tonnes of wet cobs per hectare (Rukmana, 1997), while the yield of sweet corn in Australia can reach 7 - 10 tonnes of wet cobs per hectare (Mayadewi, 2007).

One effort to increase the yield of sweet corn is through intensification efforts. In intensification efforts are made to increase the production of sweet corn per unit harvested area. This effort is carried out, among others, by setting the spacing of plants and using manure. According to Efendi (2017) setting the correct spacing can minimize competition between plants in terms of returning nutrients, water, sunlight and space for plant growth. In addition, proper spacing can also suppress sugar growth, so competition between plants and weeds can be avoided.

In addition to setting the right spacing, during its growth, sweet corn requires sufficient nutrients. To overcome congested soil conditions due to the use of artificial fertilizers which are carried out continuously and at high doses, it is necessary to apply natural fertilizers, including manure (Hardjowigeno, 2013). The use of manure will change soil properties in a better direction, both physical, chemical and biological properties.

Based on the description above, it is necessary to conduct research on how the response to growth and yield of sweet corn plants in various treatment combinations of spacing and manure dosage. The aims of this study were to determine (1) the effect of the combined treatment spacing and manure dosage on the growth and yield of sweet corn and (2) the relationship between growth components and yield of sweet corn.

RESEARCH METHOD

Place and Time of Experiment

The research was conducted in Bakung Kidul Village, Jamblang District, Cirebon Regency from November 2022 to February 2023.

Experiment Materials and Tools

The materials used in this experiment were Sweet Lady cultivar sweet corn seeds, chicken manure at the dose according to the treatment, NPK compound fertilizer (15-15-15) at a dose of 300 kg/ha, and pesticides.

The tools used include: earthmoving tools, scales, calipers, tape measure, treatment name plates, hymns or embrat, stationery, raffia rope, and others.

Experimental design

The research method used is the experimental method with a randomized block design (RBD). This study consisted of 9 treatment combinations of spacing and manure dosage, each of which was repeated 3 times, so there would be 27 experimental units.

The treatment combinations of spacing and manure tested at the experimental site are as follows:

A = Spacing of 40 x 40 cm, 15 tons/ha
B = Spacing of 40 x 40 cm, 20 tons/ha
C = Spacing of 40 x 40 cm, 25 tons/ha
D = Planting distance of 50 x 40 cm, 15 tons/ha
E = Planting distance of 50 x 40 cm, 20 tons/ha
F = Planting distance of 50 x 40 cm, 25 tons/ha
G = Spacing of 60 x 40 cm, 15 tons/ha
H = Planting distance of 60 x 40 cm, 20 tons/ha
I = Spacing of 60 x 40 cm, 25 tons/ha

Experimental Implementation

The experiment that will be carried out in the field includes the stages of land preparation, planting, maintenance, and harvesting.

Observation

Supporting observations were used to support the main observations, while the components of the observations included: soil analysis before the experiment, rainfall during the experiment, seed germination, pests and diseases, weeds, flowering age and harvest age.

Primary observations are observations whose data are used to test hypotheses. The main observations were made on the components of plant growth and yield, namely plant height (cm), number of leaves per plant (strands), number of cobs per plant and per plot (fruit), cob diameter without cob (cm), cob length without cob (cm).), weight of fresh cobs with and without husk per plant (g) and weight of fresh cobs with and without husk per plot (kg).

Analysis of Research Results

To determine the effect of the treatment tested on the growth and yield of sweet corn, an analysis of variance (F test) was carried out using the linear model proposed by Vincent (1994) as follows :

$Yij = \mu + ri + ti + \varepsilon ij$

If the results of the test of variance show that there is a significant effect, data analysis is continued by using the Scott Knott Cluster Test at the 5 percent significance level. To determine the relationship between growth variables and sweet corn crop production, a product moment correlation test was done (Sugiyono, 2017).

RESULTS AND DISCUSSION

Supporting Observations

From the results of soil analysis prior to the experiment, the soil in the experimental location had a loamy loam texture, with a content of 32.00% sand, 45.80% silt and 22.20% clay. Based on the content of these elements, the soil in the experimental location is classified as low fertility. Rainfall conditions during the experiment averaged 38.06 mm per month, with an average rainy day of 6 days per month. This condition of rainfall does not meet the needs of corn plant growth, however, because the experimental area is a technically irrigated rice field, so that the water demand for corn plants can be overcome by irrigation water. The average rainfall is 1,875 mm with an average rainy day of 91 days. The average monthly rainfall is 156.26 mm, with an average monthly rainy day of 7.6 days.

Pests that attacked the corn plants during the experiment were seed flies and leaf caterpillars. During the experiment, there were no disease attacks. The weeds that grew around the planting area during and before and during the experiment were the grass, sedge and broad leaf groups. To reduce competition with corn plants, weeding is carried out at the age of 2 and 4 weeks after planting.

Plant growth during the experiment was relatively good, this was shown by the ability to grow corn plants in the experimental plots reaching 94%, and replanting was carried out using the same reserve seeds to fill the void in the dead corn plants. Flowering corn plants aged 45 days after planting. Corn plants were harvested at the age of 65 days after planting.

Main Observations

Plant height

The combination of plant spacing and manure dosage had a significant effect on plant height in each observation period, except at the beginning of growth (14 days after planting, which was not significantly different (see Table 1).

Table 1. Effect of Combination of Planting Spacing and Manure on Plant Height at 14, 28 and 42 HST

No	Treatment	Plant Height (cm)		
		14 HST	28 HST	42 HST
1	A (Planting distance of 40 cm x 40 cm ; 15 tons/ha of Manure	48.33 a	117.00 b	201.67 a
2	B (Planting spacing 40 cm x 40 cm ; 20 tons/ha Manure	51.00 a	111.67 b	212.67 a
3	C (Planting spacing 40 cm x 40 cm ; 25 tons/ha Manure	49.00 a	112.67 b	208.00 a
4	D (Planting spacing 50 cm x 40 cm ; 15 tons/ha Manure	51.33 a	106.67 a	199.33 a
5	E (Planting distance of 50 cm x 40 cm ; 20 tons/ha of Manure	49.67 a	103.67 a	229.67b
6	F (Planting spacing 50 cm x 40 cm ; 25 tons/ha Manure	46.00 a	102.67 a	204.67 a
7	G (Planting spacing 60 cm x 40 cm ; 15 tons/ha Manure	52.33 a	103.67 a	200.67 a
8	H (Planting spacing 60 cm x 40 cm ; 20 tons/ha Manure	51.67 a	104.00 a	204.67 a
9	I (Planting spacing 60 cm x 40 cm ; 25 tons/ha Manure	50.33 a	101.00 a	205.00 a

Information : The mean number accompanied by the same letter in the same column is not significantly different based on the Scott-Knott Cluster test at 5% significance level.

At 42 days after planting, it was shown that treatment E (50 cm x 40 cm and 20 tons/ha of manure) gave the highest plant height and was significantly different from other treatments. This shows that a spacing of 50 cm x 40 cm is the optimum spacing for corn so that it can increase plant height.

Plant density is a factor affecting plant growth, due to the absorption of solar energy by the leaf surface. If the plant conditions are too dense, it can affect vegetative development and crop yields due to decreased photosynthetic rates and decreased leaf area development (Novizan, 2002).

Number of Leaves

The combination of spacing and manure had a significant effect on the number of leaves in each observation period (see Table 2).

Table 2. Effect of Combination of Planting Spacing and Manure on Number of Leaves per Plant at 14, 28 and 42 DAP.

No	Treatment	Number of Leaves (strands)		
		14 HST	28 HST	42 HST
1	A (Planting distance of 40 cm x 40 cm ; 15 tons/ha of Manure	6,67 b	11.33 b	13.00 a
2	B (Planting spacing 40 cm x 40 cm ; 20 tons/ha Manure	7.33 b	10.67 a	12.33 a
3	C (Planting spacing 40 cm x 40 cm ; 25 tons/ha Manure	5.33 a	10.00 a	12.33 a
4	D (Planting spacing 50 cm x 40 cm ; 15 tons/ha Manure	5.33 a	10.00 a	12.00 a
5	E (Planting distance of 50 cm x 40 cm ; 20 tons/ha of Manure	5.33 a	13.33 b	15.67 b
6	F (Planting spacing 50 cm x 40 cm ; 25 tons/ha Manure	5,67 a	11.67 b	13.67 a
7	G (Planting spacing 60 cm x 40 cm ; 15 tons/ha Manure	5.33 a	10.00 a	12.00 a

No	Treatment	Number of Leaves (strands)		
		14 HST	28 HST	42 HST
8	H (Planting spacing 60 cm x 40 cm ; 20 tons/ha Manure	5,67 a	10.33 a	12.00 a
9	I (Planting spacing 60 cm x 40 cm ; 25 tons/ha Manure	5.00 a	9.33 a	11.67 a

Information : The mean number accompanied by the same letter in the same column is not significantly different based on the Scott-Knott Cluster test at 5% significance level.

At 42 days after planting, the combined treatment with a spacing of 50 cm x 40 cm and a dose of manure of 20 tons/ha (E) gave the highest number of leaves per clump and was significantly different from the other treatments.

Plant density affects the appearance of plant growth, mainly due to the coefficient of use of light. The plant responds by reducing the size of both the whole plant and certain parts (Effendi, 2008). The number of plant populations per unit area is an important factor to get maximum results. Maximum production is achieved when using the appropriate spacing. The higher the level of density of a crop, the higher the level of competition between plants in terms of getting nutrients and light.

Number of Cobs per Plant and per Plot (fruit)

The combination of spacing and manure had a significant effect on the number of cobs per plant and per plot (see Table 3).

Table 3. The Effect of Combination of Planting Spacing and Manure on the Number of Cobs per Plant and per Plot

No	Treatment	Number of cobs (fruit)	
		per Plant	per Plot
1	A (Planting distance of 40 cm x 40 cm ; 15 tons/ha of Manure	1.00 a	40.67 b
2	B (Planting spacing 40 cm x 40 cm ; 20 tons/ha Manure	1.67 b	41.33 b
3	C (Planting spacing 40 cm x 40 cm ; 25 tons/ha Manure	2.00 b	40.67 b
4	D (Planting spacing 50 cm x 40 cm ; 15 tons/ha Manure	1.67 b	40.00 b
5	E (Planting distance of 50 cm x 40 cm ; 20 tons/ha of Manure	1.33 a	36,67 a
6	F (Planting spacing 50 cm x 40 cm ; 25 tons/ha Manure	2.00 b	40.67 b
7	G (Planting spacing 60 cm x 40 cm ; 15 tons/ha Manure	1.33 a	28.00 a
8	H (Planting spacing 60 cm x 40 cm ; 20 tons/ha Manure	1.00 a	33.67 a
9	I (Planting spacing 60 cm x 40 cm ; 25 tons/ha Manure	1.00 a	34,67 a

Information :The mean number accompanied by the same letter in the same column is not significantly different based on the Scott-Knott Cluster test at 5% significance level.

In observing the number of cobs per plant and per plot, it was shown that the treatment spacing was 40 x cm 40 cm at the manure rate of 15 tons/ha, 20 tons/ha and 25 tons/ha (A, B and C), the spacing treatment Planting 50 cm x 40 cm at a rate of 15 tons and 25 tons/ha of manure (D and F) was not significantly different, but the five treatments were significantly different from the treatment of 50 cm x 40 cm plant spacing at a dose of 15 tons of manure/ha (E), and spacing of 60 cm x 40 cm at the rate of manure 15 tons/ha, 20 tons/ha and 25 tons/ha (G, H and I). This shows that the spacing of 40 cm x 40 cm and 50 x 40 cm is the optimum spacing. With proper spacing, competition between plants can be avoided so that the number

of cobs produced is greater than the treatment with spacing that is tighter or more spaced apart.(2014), the use of proper spacing can increase crop yields such as the number of cobs per plant and per plot.

Manure has an important role in plant growth. Manure affects soil chemical properties, including its ability to supply nutrients, increase cation exchange capacity, supply acids such as humic acid and sulfuric acid.

Cob Diameter and Length without Husband

The combination of planting distance and manure has a significant effect on the diameter and length of cobs without cobs, as shown in Table 4.

Table 4. Effect of Combination of Planting Spacing and Manure on Diameter and Length of Cob Without Husband.

No	Treatment	Cob Diameter (cm)	Cob Length (cm)
1	A (Planting distance of 40 cm x 40 cm ; 15 tons/ha of Manure	2.94 a	16.03 a
2	B (Planting spacing 40 cm x 40 cm ; 20 tons/ha Manure	3.51 a	16,47 a
3	C (Planting spacing 40 cm x 40 cm ; 25 tons/ha Manure	3.66 a	17.08 a
4	D (Planting spacing 50 cm x 40 cm ; 15 tons/ha Manure	3,14 a	17.55 a
5	E (Planting distance of 50 cm x 40 cm ; 20 tons/ha of Manure	4.95 b	22,28 b
6	F (Planting spacing 50 cm x 40 cm ; 25 tons/ha Manure	4.89 b	18.89 a
7	G (Planting spacing 60 cm x 40 cm ; 15 tons/ha Manure	3.94 a	17.50 a
8	H (Planting spacing 60 cm x 40 cm ; 20 tons/ha Manure	3,16 a	17.00 a
9	I (Planting spacing 60 cm x 40 cm ; 25 tons/ha Manure	3.75 a	19,18 a

Information :The mean number accompanied by the same letter in the same column is not significantly different based on the Scott-Knott Cluster test at 5% significance level.

In the observation of cob diameter, the treatment of spacing of 50 cm x 40 cm at the rate of 20 tons of manure and 25 tons/ha (E and F) gave the highest cob diameter without cobs, namely 4.95 cm and 4.89 cm and significantly different from other treatment. Whereas in the observation of cob length without cob treatment spacing of 50 cm x 40 cm at a dose of 20 tons/ha (F) manure gave the highest cob length without cob, which was 22.28 cm and significantly different from other treatments. This shows that a spacing of 50 cm x 40 cm is the optimum spacing. With proper spacing, competition between plants can be avoided so that the number of cobs produced is greater than the treatment with spacing that is tighter or more spaced apart. In accordance with Sheikhfani (2013), the use of proper spacing can increase crop yields such as diameter and cob length.

Weight of Cobs per Plant and per Plot

The combination of spacing and manure had a significant effect on the weight of cobs per plant and per plot, as shown in Table 5.

Table 5. The Effect of Combination of Planting Spacing and Manure on Ribbed Cob Weight per Plant and per Plot

No	Treatment	Crusted Cob Weight	
		per Plant (g)	per Plot (kg)
1	A (Planting distance of 40 cm x 40 cm ; 15 tons/ha of Manure	276.67 a	8.72 a
2	B (Planting spacing 40 cm x 40 cm ; 20 tons/ha Manure	311.00 a	8.91 a
3	C (Planting spacing 40 cm x 40 cm ; 25 tons/ha Manure	285.00 a	8.71 a
4	D (Planting spacing 50 cm x 40 cm ; 15 tons/ha Manure	319.00 a	9,24 a
5	E (Planting distance of 50 cm x 40 cm ; 20 tons/ha of Manure	405.33 b	11.27 c
6	F (Planting spacing 50 cm x 40 cm ; 25 tons/ha Manure	392.67 a	10.93 b
7	G (Planting spacing 60 cm x 40 cm ; 15 tons/ha Manure	274.00 a	8.48 a
8	H (Planting spacing 60 cm x 40 cm ; 20 tons/ha Manure	287.33 a	9.15 a
9	I (Planting spacing 60 cm x 40 cm ; 25 tons/ha Manure	281.67 a	8.33 a

Information :The mean number accompanied by the same letter in the same column is not significantly different based on the Scott-Knott Cluster test at 5% significance level.

The combined treatment with a spacing of 50 cm x 40 cm at the rate of manure of 20 tons/ha and 25 tons/ha (E and F) gave the highest cob weight per plant, and was significantly different when compared to other treatments. In observing the weight of cobs per plot, the spacing of 50 cm x 40 cm at the rate of manure of 20 tons/ha (E) gave the highest cob weight of 11.27 kg per plot. This is because the environmental conditions for growing plants are very supportive, so that plants can freely absorb nutrients from the soil, plus the application of manure can improve the physical, chemical and biological properties of the soil.

The weight of the cobs is related to the number of cobs produced, where at a spacing of 50 cm x 40 cm at the manure rate of 20 tons/ha and 25 tons/ha produces a large number of cobs, with a large number of cobs, it will be followed by the weight Cob husky per plant or per plot will also be high.

Weight of Cobs Without Husks per Plant and per Plot

The combination of spacing and manure had a significant effect on the weight of cobs without corn per plant and per plot, as shown in Table 6.

Table 6. Effect of Combination of Planting Spacing and Manure on Cob Weight without Crinking per Plant and per Plot.

No	Treatment	No-Friction Cob Weight	
		per Plant (g)	per Plot (kg)
1	A (Planting distance of 40 cm x 40 cm ; 15 tons/ha of Manure	211.67 a	4.97 a
2	B (Planting spacing 40 cm x 40 cm ; 20 tons/ha Manure	212.67 a	4.87 a
3	C (Planting spacing 40 cm x 40 cm ; 25 tons/ha Manure	214.33 b	5,17 a
4	D (Planting spacing 50 cm x 40 cm ; 15 tons/ha Manure	219.00 b	4.67 a
5	E (Planting distance of 50 cm x 40 cm ; 20 tons/ha of Manure	237.00 c	8.90 c
6	F (Planting spacing 50 cm x 40 cm ; 25 tons/ha Manure	243.33 c	7.38 b
7	G (Planting spacing 60 cm x 40 cm ; 15 tons/ha Manure	208.33 a	4.77 a
8	H (Planting spacing 60 cm x 40 cm ; 20 tons/ha Manure	209.33 a	4.72 a

No	Treatment	No-Friction Cob Weight	
		per Plant (g)	per Plot (kg)
9	I (Planting spacing 60 cm x 40 cm ; 25 tons/ha Manure	210.33 a	5.08 a

Information : The mean number accompanied by the same letter in the same column is not significantly different based on the Scott-Knott Cluster test at 5% significance level.

In the observation of cob weight without corn husks, it showed that there was an effect of the combination of spacing and manure treatment. The combined treatment with a spacing of 50 cm x 40 cm at the rate of manure of 20 tons/ha and 25 tons/h (E and F) gave the highest cob weight without cobs, namely 237 g/plant and 243.33 g/plant and significantly different from other treatments. Meanwhile, in the observation of the highest weight of cobs without cobs per plot, the combination treatment with a spacing of 50 cm x 40 cm was obtained at a rate of 20 tons/ha (E) of manure, which was 8.90 kg per plot, and significantly different from the other treatments. It is suspected that the treatment spacing of 50 cm x 40 cm is the proper spacing for corn plants,

Giving manure can increase the availability of nutrients for plants. In addition, manure also has a positive effect on the physical and chemical properties of the soil, encouraging the development of microorganisms.

Mintarsih (2019) stated spacing that was too tight would give relatively poor results, due to competition between the plants themselves. Therefore it takes an optimal spacing to obtain maximum results. This relates to plant competition for nutrients, water and efficiency in the use of sunlight (Soenarjono, 2016).

Correlation between Plant Height and Number of Leaves with Weight of Cob without Hustle per Plot

The results of the calculation of the correlation analysis showed that there was a relationship between plant height and the number of leaves with the weight of the cob without husk per plot.

Correlation coefficient values between plant height at 14, 28 and 42 days after planting with cob weight without husk per plot were -0.304, -0.251 and 0.635. For more details, it can be described as follows:

1) There was no significant negative relationship between plant height 14 days after planting and cob weight without husk per plot. The coefficient of determination (r2) was 0.092, meaning that the relationship between plant height 14 days after planting and cob weight without husks per plot was 9.20%.
2) There was no significant negative relationship between plant height 28 days after planting and cob weight without husk per plot. The coefficient of determination (r2) is 0.063, meaning that the relationship between plant height 28 days after planting and cob weight without husk per plot is 6.30%.
3) There was a significant positive relationship between plant height at 42 days after planting and cob weight without husk per plot. The coefficient of determination (r2) was 0.403, meaning that the relationship between plant height 42 days after planting and cob weight without cobs per plot was 40.30%.

The correlation coefficient values between the number of leaves aged 14, 28 and 42 days after planting with the weight of cob without husk per plot were -0.125, 0.752 and 0.825. For more details, it can be described as follows:

1) There was no significant negative relationship between the number of leaves aged 14 days and the weight of cobs without corn per plot. The coefficient of determination (r2) is 0.016, meaning that the relationship between the number of leaves 14 days after planting and the weight of cobs without cobs per plot is 1.60%.
2) There was a significant positive relationship between the number of leaves aged 28 days and the weight of cobs without corn per plot. The coefficient of determination (r2) is 0.565, meaning that the relationship between the number of leaves aged 28 days after planting and the weight of cobs without cobs per plot is 56.50%.
3) there was a significant positive relationship between the number of leaves aged 42 days after planting and the weight of cob without husk per plot. The coefficient of determination (r2) was 0.697, meaning that the relationship between the number of leaves aged 42 days after planting and the weight of cobs without cob per plot was 69.70%.

CONCLUSION

Based on the results of the study, it can be concluded as follows: (1) the combination of spacing and manure treatment had a significant effect on the growth and yield of sweet corn plants, (2) spacing of 50 cm x 40 cm combined with 20 tons of manure per hectare had the best effect on plant height, number of leaves, cob length, cob weight and without husk per plot. Planting spacing of 50 cm x 40 cm combined with 20 and 25 tons of manure per hectare gave the best effect on cob diameter, cob weight with and without husks per plant, and (3) there was a significant positive relationship between plant height at 42 days after planting, the number of leaves at 28 days and 42 days after planting, and the weight of cob without husk per plot.

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