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Performance The Red Onion (*Allium ascalonicum* L.) by Husk Charcoal and Fertilizer K Application

Rakhmiati, Etik Puji Handayani*, Jamaludin, and Raffel Jubili Sitompul

Sekolah Tinggi Ilmu Pertanian Dharma Wacana, Jurusan Agroteknologi
Jl. Kenanga No. 3, Mulyojati, Kota Metro, Lampung, e-mail: etikpuji68@gmail.com

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ABSTRACT

The cultivation of Red Onions (*Allium ascalonicum*, L.) in paddy fields needs to be investigated further because paddy fields have constraints on the soil physical and chemical properties, such as soil structure, drainage, pH, and nutrient availability. The application of husk charcoal and K fertilizer is expected to increase the productivity of Red Onions, so it is necessary to study the appropriate dose. The research aimed to determine the effect of the interaction between the application of husk charcoal and KCl fertilizer and the influence of each factor on the growth and yield of Red Onions. The results showed that rice husk charcoal treatment at a dose of 20 Mg ha^{-1} was effective in increasing the growth and yield of Red Onions compared to rice husk charcoal at a dose of 10 Mg ha^{-1} and 0 Mg ha^{-1} (control), as evidenced by the variable shallot plant height, number of leaves, number of tubers per clump, wet tuber weight per clump, and tuber dry weight per clump. KCl fertilizer treatments at doses of 100 kg ha^{-1}, 200 kg ha^{-1}, and 300 kg ha^{-1} did not significantly affect to growth and yield of Red Onions. There was not interaction between the rice husk charcoal and KCl fertilizer treatments.

Keywords: Ameliorant, fertilizer, husk charcoal, red onions

INTRODUCTION

Red Onions (*Allium ascalonicum* L.) are a horticultural plant in the form of tubers that has many benefits for household consumption as flavoring dishes in the pharmaceutical and cosmetic industries. The cultivation of this plant in paddy fields needs to be investigated further because paddy fields have different characteristics from dry land, so that it can increase the productivity of Red Onions in paddy fields by more than 7.64 Mg ha^{-1} (BPS, 2019). More is needed to meet the demand for Red Onions, which always increases along with the increasing population and the development of the business and industrial world.

The characteristics of paddy fields classified as acidic soils, low N-total, and P-total vary from low to very high and high K-total (Handayani, 2014). High K and P nutrient status were essential for the development of Red Onion bulbs; however, the soil's acidity and low availability of N negatively impact the growth of Red Onion plants. Therefore, improving the planting media with amelioration efforts in Red Onion cultivation in paddy fields is essential.

A suitable planting medium for Red Onions was loose soil with good aeration and porous. Adding husk charcoal as an ameliorant can create the physical properties of the soil. Now, the application of husk charcoal in Red Onion cultivation has yet to be optimally utilized. In contrast, the availability of rice husk, which is the main ingredient in the manufacture of husk charcoal, is very abundant, and agricultural waste must be utilized. About 20-30% of the weight of rice is rice husks, and the content of rice husk charcoal is about 13-29% of the composition of rice husks which is always produced every time the husks are burned. Based on this calculation, if 1,000 kg of rice husks are burned, 130-290 kg of husk charcoal will be produced with a water content of 0.895% or 1,452-3,240 kg with a moisture content of 10%. According to Saiyidatul et al., (2010), the water content of rice husk charcoal from burning for 4 hours will produce husk charcoal with a moisture content of 0.895 %.

Red Onion is a plant that requires much silica. Silica is essential in plant metabolism, which is related to several parameters that determine the nutritional quality of vegetable crops. Husk charcoal is an organic material that contains high silica, and it can improve soil physical properties such as soil structure (Riadi, 2010); this affects the number and distribution of macro and micropores in the soil, increasing the water available to plants. Excess water in the soil was adsorbed by husk charcoal so that the available water in the soil increased, as indicated by a decrease in the pF curve from 0 to 2 to 4 (Manickam et al., 2010), increasing plant growth and yield (Carter et al., 2013), and bulb development, number and size of Red Onion bulbs (Tarigan et al., 2015).

Husk charcoal contains N 0.32%, P_2O_5 0.15%, K_2O 0.31%, Ca 0.95%, Fe 180 ppm, Mn 80 ppm, Zn 14.1 ppm (Wuryaningsih et al., 1997). With the content of these elements, the improvement of planting media with husk charcoal can be used to convert lime doses to increase soil pH. Alling et al., (2014) stated that applying biochar from organic waste to the soil can also help in the availability of nutrients and increase plants' uptake of K, P, Ca, and Mg. The results of Bahri's research (2010) showed that the addition of husk charcoal had a significant effect on tuber size, and the husk charcoal dose as much as 20 Mg ha^{-1} had the best effect on Red Onion bulb size.

In addition to the problem of improving the planting media, potassium (K) fertilization in Red Onion plants is an important thing that must be done to improve the quality and quantity of Red Onion bulbs. Although the K-element reserves in paddy fields are quite large, only a small part of K-available in the soil can be utilized by plants. This is due to the characteristics of the K ion, which is mobile, so it is easily leached. In addition, K ions can be strongly bound by hexagonal holes on the colloidal surface of the paddy soil, which are dominated by the 2:1 clay mineral type (Lopulisa and Husni, 2008). Therefore, studying the appropriate K dose in Red Onion cultivation is necessary.

On the other hand, KCl fertilization had a significant effect on the production of Red Onions, namely the weight of the bulbs and the brightness of the bulb color (Tarigan and Sembiring, 2017), increasing resistance to pests and diseases, tuber yield, quality and shelf life of tubers (Gunadi, 2009).

KCl fertilizer is the source of potassium. Red Onions require potassium of 120 kg K_2O ha^{-1} (Wibowo, 2009). Rukmana (1994) recommended potassium fertilization dose of Red Onion plants was 200 kg KCl ha^{-1} in order to grow and yields optimally. The provision of potassium nutrients will affect the growth of Red Onion plants, so the right dose of KCl fertilizer will optimize plant growth and yields.

Potassium deficiency affects the root system, shoots, starch formation, and sugar translocation (Wibowo, 2009). Red Onion plants that lack K elements are usually easy to fall into, sensitive to disease, have low yield and quality, and can cause symptoms of ammonium poisoning. In contrast, excess K causes plants to lack Mg and Ca nutrients (Sumarni et al., 2012). According to Lakitan (2011), potassium acts as an activator of various enzymes in photosynthesis and respiration reactions and an activator of enzymes involved in protein and starch synthesis. Potassium plays a role in the transportation of photosynthetic products (assimilate) from the leaves through the phloem to the reproductive organ tissues (fruits, seeds, tubers) to improve the size, color, taste, and skin of the fruit, which are essential for storage and transportation (Munawar, 2011). Potassium also plays a role in regulating the osmotic pressure of cells. Thus, it will play a role in regulating cell turgor pressure.

This study aimed to determine the effect of the interaction between the application of husk charcoal and KCl fertilizer and the influence of each factor on the growth and yield of Red Onions.

MATERIALS AND METHODS

The experiment was conducted in the rice field Batanghari Agricultural Extension Center, East Lampung Regency, from June to September 2020. The experiment consisted of 9 treatments combination and three replications and was laid out on factorial in a randomized block design. The first factor was husk charcoal dose: without husk charcoal (a_0), husk charcoal 10 Mg ha^{-1} (a_1), husk charcoal 20 Mg ha^{-1} (a_2). The second factor was the dose of KCl fertilizer: 100 kg ha^{-1} (k_1), 200 kg ha^{-1} (k_2) and 300 kg ha^{-1} (k_3).

The first step was to take a composited soil sample from 10 points of paddy fields in Batanghari District, East Lampung Regency. Then soil pH, Nitrogen, Phosphore, dan Kalium were analyzed by Field Soil Test Equipment (Table 1).

The Bima Brebes variety of Red Onion bulbs has been stored for 75 days after harvesting. It was Selected with a tuber size medium, with a diameter of 1.5 – 1.8 cm, not deformed, with roots and pithy. The dormant period of the tubers breaks down by cutting one-third of the tubers using a sharp knife. Then the tubers were coating treatment using a fungicide with the active ingredient Propineb

Table 1. Soil pH, N, P, and K cotents in paddy fields in Batanghari District, East Lampung Regency.

Variable	Value/ Content
pH	5-6 (slightly acidic)
N	Very high
P	Medium
K	High

(Antracol 70 WP) 5 g kg^{-1} tubers for 12 hours before planting.

Planting medium used 8 kg paddy soil in polybag mixture husk charcoal according to treatment 0 g polybag^{-1} (a_0), 10 Mg ha^{-1} ∞ 41.7 g polybag^{-1} (a_1), and 20 Mg ha^{-1} 83.3 g polybag^{-1} (a_2). One tuber is planted in the polybag with a hole punch tool soil; the planting hole is made as deep as the average height of tubers. Onion bulbs are put in the hole with movements such as turning the screw so that the tip of the bulbs appears flush with the soil surface. Then sprinkle around the tubers with the active ingredient Karbofuran insecticide (Furadan 3GR) amount ± 0.5 g polybag^{-1}.

The fertilizer application was carried out three times. The first as basic fertilizer at 7 days before planting: Dolomite 2.0 Mg ha^{-1} (8.33 g polybag^{-1}); ZA 100 kg ha^{-1} (0.417 g polybag^{-1}); SP-36 250 kg ha^{-1} (1.042 g polybag^{-1}). While KCl 2/3 part according to the treatment dose. The second fertilization at the age of 12 days after planting: ZA 100 kg ha^{-1} (0.417 g polybag^{-1}). The third fertilizer application 30 days after planting: KCl 1/3 part according to the treatment dose and ZA 100 kg ha^{-1}.

The parameters observed were plant height, number of leaves, Number of Bulbs, Bulb diameter, Average Wet Weight Per Bulb, Wet weight of bulbs per clump, and dry weight of bulbs per clump.

The data from the observations were tested for homogeneity with the Barlett test, and the non-additiveness of the data ware tested with the Tuckey test, then analyzed with the Least Significant Difference test. All tests were carried out at the 5% level.

RESULTS AND DISCUSSION

Plant height and number of leaves

Plant height and number of leaves of Red Onion plants due to adding husk charcoal and KC fertilizer at various doses carried out 10 days after planting (DAP) to 50 DAP are presented in Figure 1. Based on Figure 1 it is known that Red Onion plants reach

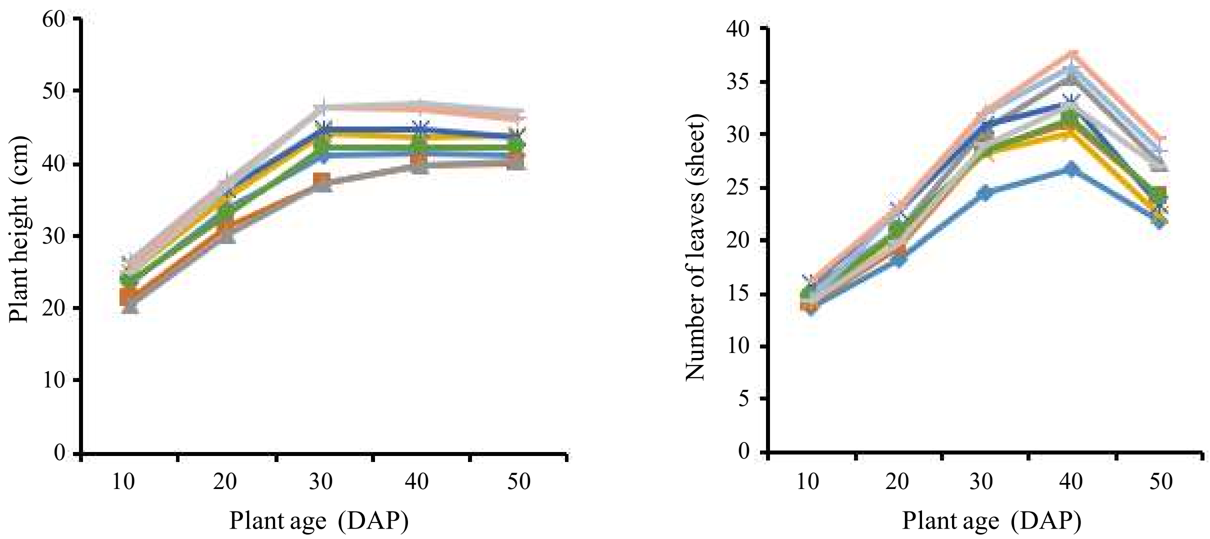

Figure 1. The effect of husk charcoal and KCl fertilizer at various doses on plant height and number of leaves of Red Onion. Notes: : a_0k_1 (without husk charcoal + KCl 100 kg ha^{-1}), : a_0k_2 (without husk charcoal +KCl 200 kg ha^{-1}), : a_0k_3 (without husk charcoal +KCl 300 kg ha^{-1}), : a_1k_1 (charcoal husk 10 Mg ha^{-1} + KCl 100 kg ha^{-1}), : a_1k_2 (husk charcoal 10 Mg ha^{-1} + KCl 200 kg ha^{-1}), : a_1k_3 (husk charcoal 10 Mg ha^{-1} + KCl 300 Mg ha^{-1}), : a_2k_1 (husk charcoal 20 Mg ha^{-1} + KCl 100 kg ha^{-1}), : a_2k_2 (husk charcoal 20 Mg ha^{-1} + KCl 200 kg ha^{-1}), : a_2k_3 (charcoal husk 20 Mg ha^{-1} + KCl 300 Mg ha^{-1}).

their highest at 30 DAP and then almost stagnant until 50 DAP. While on the number of leaves, the highest growth in the number of leaves occurred 40 DAP and then decreased. The decrease in the height of the Red Onion was caused by the disease, which was characterized by dry shoots. Meanwhile, the decrease in the number of leaves is thought to have entered the generative period, marked by the appearance of flowers so that new leaves do not grow anymore. In contrast, some of the old leaves began to dry up.

The addition of husk charcoal with a dose of 20 Mg ha^{-1} on the growing media resulted in the best plant height and number of Red Onions compared to that without husk charcoal (control) and a dose of 10 Mg ha^{-1} husk charcoal, with a plant height of 46.59 cm and the number of leaves reached 28.29 strands. The treatments of KCl fertilizer doses of 100 kg ha^{-1}, 200 kg ha^{-1}, and 300 kg ha^{-1} resulted in plant height and some Red Onions that were not significantly different. There was no interaction between husk charcoal dose and fertilizer dose KCl treatment on plant height and the number of Red Onions (Table 2).

Number of Bulbs, Bulb diameter, and Average Wet Weight Per Bulb

Treatment of husk charcoal at a dose of 20 Mg ha^{-1} was the best dose for the observation variable for the number of bulbs, with an average number of bulbs reaching 8.82. The number of tubers was 31.8% higher than without husk charcoal (control) and 18.4% compared to 10 Mg ha^{-1} husk charcoal. While on the variables of bulb diameter and wet weight per bulb, husk charcoal treatment with doses of 0 Mg ha^{-1}, 10 Mg ha^{-1}, and 20 Mg ha^{-1} had no significant effect with the resulting diameter of the bulb between 2.42 cm to 2.52 cm and the average wet weight per bulb produced was between 7.97 g to 8.75 g (Table 3).

Table 3 shows that the all KCl fertilizer treatments did not significantly affect the variables of bulb number, bulb diameter, and average wet weight of bulb. The number of bulbs produced from treatment with various doses of KCl fertilizer was between 7.49 bulbs to 7.87 bulbs, with an average bulb diameter of 2.46 cm to 2.53 cm. Meanwhile, the average weight variable per bulb of Red Onions produced due to applying KCl fertilizer in various doses was between 8.12 g to 8.68 g.

Table 3 shows that the interaction between husk charcoal treatment and KCl fertilizer had no significant effect on bulb number, bulb diameter, and average wet weight per bulb. For the variable number of bulbs, the effect of infection resulted in the number of bulbs of Red Onions ranging from 6.47 to 9.0 of the bulb and for the variable diameter of bulbs produced from 2.4 cm to 2.6 cm. While the interaction

Table 2. Plant height of Red Onion with different Husk Charcoal and KCl Fertilizer Doses.

Treatment	Plant Height (cm)	Number of Leaves (sheet)
Dosage of Rice Husk Charcoal (A)		
0 Mg ha^{-1} (a_0)	40.55a	24.38a
10 Mg ha^{-1} (a_1)	43.33b	23.31a
20 Mg ha^{-1} (a_2)	46.59c	28.29b
BNT	0.5	1.12
Dosage of KCl Fertilizer (K)		
100 kg ha^{-1} (k_1)	43.85	24.20
200 kg ha^{-1} (k_2)	43.23	25.69
100 kg ha^{-1} (k_3)	43.28	26.09
Interaction of K x A		
k_1a_0	41.22	21.87
k_1a_1	40.15	24.07
k_1a_2	40.28	27.20
k_2a_0	43.84	22.40
k_2a_1	43.49	23.40
k_2a_2	42.33	24.13
k_3a_0	46.50	28.33
k_3a_1	46.05	29.60
k_3a_2	47.23	26.93

Table 3. Number of Bulbs. Bulb diameter. and Average Wet Weight Per Bulb of Red Onion due to differences in Doses of Husk Charcoal and KCl Fertilizer.

Treatment	Number of Bulb	Diameter of Bulb (cm)	Wet Weight Per Bulb (g)
Dosage of Rice Husk Charcoal (A)			
0 Mg ha^{-1} (a_0)	6.69a	2.422	7.97
10 Mg ha^{-1} (a_1)	7.45b	2.525	8.75
20 Mg ha^{-1} (a_2)	8.82c	2.525	8.42
BNT	0.39		
Dosage of KCl Fertilizer (K)			
100 kg ha^{-1} (k_1)	7.49	2.533	8.68
200 kg ha^{-1} (k_2)	7.87	2.460	8.38
100 kg ha^{-1} (k_3)	7.60	2.498	8.12
Interaction of K x A			
k_1a_0	6.47	2.428	7.90
k_1a_1	6.60	2.432	8.33
k_1a_2	7.00	2.405	7.70
k_2a_0	7.27	2.597	9.14
k_2a_1	8.00	2.471	8.56
k_2a_2	7.07	2.568	8.54
k_3a_0	8.73	2.576	9.02
k_3a_1	9.00	2.477	8.24
k_3a_2	8.73	2.522	8.14

effect for the variable average wet weight per tuber produced was between 7.7 g to 9.14 g.

Wet weight of bulbs per clump and dry weight of bulbs per clump

The treatment of husk charcoal 20 Mg ha^{-1} was consistently the best treatment on the variable wet weight of bulbs per clump and dry weight of bulb per clump compared to the other husk charcoal treatments (Table 4). Table 3 shows that the husk charcoal treatment of 20 Mg ha^{-1} resulted in the wet weight of bulbs per clump reaching 71.49 g, 40.7% higher than the treatment without husk charcoal (control) and 17.28% higher than husk charcoal treatment 10 Mg ha^{-1}. Meanwhile, the dry weight of bulbs per clump produced by the treatment of husk charcoal 20 Mg ha^{-1} was 62.6 g, 38.49% higher than the treatment without husk charcoal (control) and 16.64% compared to the husk charcoal treatment 10 Mg ha^{-1}.

Based on Table 4, it is known that the all KCl fertilizer doses did not significantly affect the wet weight of bulbs per clump and dry weight of bulbs per clump. The wet weight of bulbs per clump produced by adding KCl fertilizer ranged from 59.76 g to 61.87 g. Meanwhile, the dry weight per clump produced was between 52.22 g to 54.91 g. Based on Table 3, it can also be seen that there was no interaction between the treatment of giving husk charcoal and KCl fertilizer to the variables of the wet weight of bulbs per clump and dry weight of bulbs per clump. The wet weight of bulbs produced from these treatments was between 49.93 g to 734 g, and the dry bulbs per clump was between 44.33 g to 65.13 g.

Husk charcoal with a dose of 20 Mg ha^{-1} was the best dose on the variables of plant height, number of leaves, number of bulbs, wet weight of bulbs per clump, and dry weight of bulbs per clump of Red Onions compared to other husk charcoal doses. Providing husk charcoal in the planting media can improve the physical and chemical properties of the soil. By adding husk charcoal to the planting media, the soil becomes looser, soil porosity increases, and the planting media has a pretty good water-holding water-holding capacity (Asadi et al., 2021), so the roots of Red Onions grow more actively to absorb water and nutrients which makes the growth of Red Onion more better.

Apart from being able to improve the physical properties of the soil, which makes plant growth better, the addition of husk charcoal to the growing media also affects the chemical properties of the soil, significantly increasing soil pH (Asadi et al., 2021; Mishra et al., 2017); Nurhidayati and Mariati, 2014). The increase in soil pH affects the availability

Table 4. Wet weight of bulbs per clump and dry weight of bulbs per clump of Red Onion due to differences in Doses of Husk Charcoal and KCl Fertilizer.

Treatment	Wet weight of bulbs per clump (g)	A dry weight of bulbs per clump (g)
Dosage of Rice Husk Charcoal (A)		
0 Mg ha^{-1} (a_0)	50.80a	45.20a
10 Mg ha^{-1} (a_1)	60.98b	53.67b
20 Mg ha^{-1} (a_2)	71.49c	62.60c
BNT	2.02	1.53
Dosage of KCl Fertilizer (K)		
100 kg ha^{-1} (k_1)	61.87	54.91
200 kg ha^{-1} (k_2)	61.64	54.33
100 kg ha^{-1} (k_3)	59.76	52.22
Interaction of K x A		
k_1a_0	49.93	44.33
k_1a_1	50.67	44.80
k_1a_2	51.80	46.47
k_2a_0	62.27	55.27
k_2a_1	62.87	56.20
k_2a_2	57.80	49.53
k_3a_0	73.40	65.13
k_3a_1	71.40	62.00
k_3a_2	69.67	60.67

of nutrients so plants can absorb them. It is increasing the provision of husk charcoal from 10 Mg ha^{-1} to 20 Mg ha^{-1} was proven to produce better Red Onion growth. Presumably, the increase in husk charcoal dose increases the soil pH to near neutral so that more nutrients are available in the soil (Nurhidayati and Mariati, 2014). In addition to increasing soil pH, adding husk charcoal increased plant growth due to increasing soil cation exchange capacity and increasing soil C-organic (Abrishamkesh et al., 2015). In addition to increasing pH, cation exchange capacity, and C-organic, husk charcoal is suspected of having high silica (Si) content compared to other biochars so that plant photosynthesis can increase (Koyama et al., 2016).

The results showed that Red Onion plants treated with KCl fertilizer doses of 100 Mg ha^{-1}, 200 Mg ha^{-1}, and 300 Mg ha^{-1} produced plant heights between 43.23 cm to 43.85 cm (Table 2) with an average number of bulbs from 7.49 to 7.87 (Table 3). Based on the plant height and number of leaves, it showed that the Red Onion plants grown with KCl fertilizer treatment were following the description of the plant with an average plant height of 34.5 cm and the number of tillers (number of bulbs) reaching 7-12 pieces per clump. Applying KCl fertilizer starting from a dose of 100 kg ha^{-1} is sufficient for the potassium (K) growth and yield of Red Onions. Based on the results of the initial test of the potassium content in the soil (Table 1), it was found that the potassium content in the soil was already high, so the addition of 100 kg ha^{-1} KCl fertilizer was good enough for the growth and yield of red Onion. In addition, the potassium in the soil is also thought to increase due to the addition of husk charcoal to the growing media (Altland and Locke, 2013). Indirectly, the increase in K element in the soil due to adding husk charcoal is due to an increase in soil pH. An increase in soil pH can increase potassium, including alkaline cations (Nurhidayati and Mariati, 2014). The high potassium content in the soil (Table 1) is also suspected to be the cause of the non-interaction between the treatment of husk charcoal and KCl fertilizer on the growth and yield of shallots.

CONCLUSIONS

The application of husk charcoal in paddy fields with a dose of 20 Mg ha^{-1} can increase the growth and yield of Red Onions compared to husk charcoal at a dose of 10 Mg ha^{-1} and 0 Mg ha^{-1} (control) by producing a plant height of 46.59 cm with 28.29 leaves. The average bulbs produced was 8.82, the wet weight per clump was 71.49 g, and the dry bulbs were 62.6 g. The improvement of the physical, chemical, and biological properties of the soil was due to the application of husk charcoal. In this study, KCl fertilizer doses of 100 kg ha^{-1}, 200 kg ha^{-1}, and 300 kg ha^{-1} did not significantly affect the growth and yield of Red Onions. However, plant height, number of leaves, and number of tubers produced were in accordance with the description of the variety of planted Red Onions. The interaction between the treatment of husk charcoal and KCl fertilizer at various doses did not occur.

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