THE EFFECT OF PLANT DISTANCE IN INTERCROPPING PATTERN AND FERTILIZATION ON THE PRODUCTION OF CASAVA (Manihot esculenta Crantz) VARIETY OF ELEPHANT IN SIKKA DISTRICT

Yovita Yasintha Bolly

Universitas Nusa Nipa Indonesia, Jl Kesehatan No.3 Kabupaten Sikka
Corresponding email: vytayovieeta@gmail.com

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ABSTRACT

Cassava (Manihot esculenta Crantz) is a local food that has long been cultivated and consumed by almost all people in Sikka Regency. In cultivating cassava, farmers generally still use traditional techniques so that it has not had an impact on increasing cassava production. Cassava production can be improved through several efforts, namely using superior varieties, setting planting distance, and fertilizing activities according to plant needs. This study aimed to determine the effect of planting distance and types of inorganic fertilizers on cassava production in the Sikka Regency. This research was designed using a factorial randomized block design, namely planting distance (T) and type of fertilizer (P). Each factor consists of several levels that combine six treatments, including T2P0, T2P1, T2P2, T3P0, T3P1, and T3P2. Each treatment was repeated three times to obtain 18 experimental units. Observation variables include the number of tubers per plant and tuber wet weight per plant. Observation data were analyzed using analysis of variance (ANOVA). The results showed that the addition of Urea, SP36, and NPK Phonska (complete) fertilizers could increase the wet weight of cassava at a planting distance of 2x1 m. and the planting distance of 2x1 m had a significant effect on the number of tubers/plant, and at the planting distance of 1x1 m supported by fertilization was able to increase the wet weight of tubers/plants.

Keywords: Cassava, planting distance, kind of fertilizer, Sikka Regency

INTRODUCTION

The planting area for cassava in 2015 was 4,767 ha with a production of 45,406 tonnes/ha, in 2016 the planting area increased to 9,123 ha but was followed by a decrease in production, namely 41,017 tonnes/ha, and in 2017 the planting area for cassava decreased to become 7,338 ha with an increase in production to 49,672 tonnes/ha. The production of cassava that has fluctuated occurs because, in addition to the fluctuating planting area, it is also due to poor quality planting material, cultivation techniques that are partially carried out traditionally, uncertain climatic conditions, and soil fertility level not been maintained. Farmers can carry out increased cassava production as producers by applying recommended cultivation techniques, such as good soil cultivation, use of superior varieties, choosing the suitable planting material, setting the correct spacing, fertilizing, and weeding and seasoning (Makruf dan Iswadi, 2015).

Many efforts to increase cassava production at the farm level have been carried out, especially by the Research Institute, by creating new high-yielding varieties. One of the superior varieties of cassava is the elephant variety. Elephant cassava, a local plant in East Kalimantan, has a special feature: it can be directly consumed, and the plant productivity is relatively high, reaching more than 100 tonnes/ha (Amarullah, 2015). In addition, from an economic point of view, the research results of Mardika et al. (2016) show that the Revenue Cost Ratio of elephant variety cassava farming in the Kerti Winangun Farmers Group, Evidence Village, Kubutambahan is 3.00, which means that the elephant variety cassava farming is feasible to be continued.

During growth and production, cassava requires sufficient nutrients, especially nitrogen (N), phosphorus (P), and potassium (K). The N nutrient functions to stimulate the growth of stems, branches, and leaves and form green leaf substances useful in photosynthesis. The P nutrient plays a role in increasing the number of tubers and the formation of plant roots. In contrast, the K nutrient plays a role in the formation and translocation of carbohydrates for plants (Soepardi, 1983, quoted from Roja, 2009). The results showed that the nutrients lost to the harvest for each ton of fresh tubers were 6.54 kg N; 2.24 kg P2O5; and 9.32 K2O / ha/season, where 25% N, 30% P2O5, and 26% K2O are found in tubers (Wichmann, 1992 quoted from Roja, 2009).

Cassava can be cultivated intercropping with other food crops such as corn, rice, and beans. The intercropping pattern is made by adjusting the spacing of cassava so that it can be planted with other crops (beans, corn, and others). The results of Amarullah's research (2015) show that planting elephant varieties of cassava with a spacing of 1x1m (population of 10,000 plants) produces tubers weighing 12-20 tons/ha and tuber diameters ranging from 5-7 cm. Adequate plant populations increase yields in cassava with efficient energy and soil nutrients, and sunlight (Okoli et al. 2010 quoted from Amarullah, 2015). The spacing of cassava for intercropping with peanuts, soybeans, or green beans is 2x1m (5,000 cuttings/ha), and the spacing for intercropping which is effective in controlling erosion and high productivity is 40 cm between rows and 10-15 cm in rows (Hilman, et al. 2004).

METHODOLOGY

The research was conducted in Paubekor Village, Koting District, Sikka Regency. The research period was from November 2017 to October 2018. The materials used were cassava cuttings from elephant varieties from Malang, Urea fertilizer, SP36 fertilizer, NPK Phonska fertilizer.

This study used a randomized block design (RBD) with a factorial pattern repeated three times. The first factor is spacing (T), consisting of (T): single maize spacing 1x 0.3 m, (T2): maize + cassava spacing 2 X 1 m, and (T3): corn + cassava spacing 1 X 1 m. The second factor is the type of fertilizer (P), consisting of (P0): without fertilizer (control), (P1): Urea, and (P2) Urea + SP36 + NPK Phonska. The observation variables included the number of tubers per plant (tubers) and the wet weight of cassava per plant (kg).

RESULTS AND DISCUSSION

This study indicated that the T2P1 treatment gave the highest number of tubers of 6.39 tubers. In contrast, the lowest number of tubers was produced by the T3P0 treatment of 3.00, which was not significantly different from the T2P0, T2P3, T3P1, and T3P2 treatments (Table 1).

Table 1. Number of Plant Tubbers^{-1}

No.	Perlakuan	Jumlah umbi tanaman^{-1}
1	T2P0	3,28 a (a)
2	T2P1	6,39 b (b)
3	T2P2	5,83 a (b)
4	T3P0	3,00 a (a)
5	T3P1	4,61 a (b)
6	T3P2	5,56 a (b)

Source: primary data processed (2019)
Information: The average treatment followed by unequal letters shows a significant difference according to the BNT test at the 5% level.

The number of tubers produced in this study is still far from the optimal number of tubers for elephant variety, which is 20 tubers per plant with a tuber diameter of up to 10 cm (Amarullah, 2015). According to Ispandi (2003), the adaptation process to the growing environment may be one of the factors that cause the yield of these new varieties of tubers to be far below their potential yield in addition to soil physical and chemical factors.

The spacing affects the number of cassava tubers, namely, the 2x1 m spacing gives the highest number of tubers compared to the 1x1 m spacing. It is presumably because the wide spacing provides more space for the roots of cassava to grow. In addition to that, optimal soil cultivation supports the growth of cassava roots to increase the number of cassava tubers. According to Amarullah (2015), the growing medium for elephant cassava roots that will form tubers requires deep soil solum ± 60 cm (2 hoes) because it has large tubers with distribution in all directions. In line with Lal (1985) quoted from Amarullah (2015) that soil processing activities vary with the soil and types of plants to be planted

At a 1x1 m (T3) spacing, the cassava population in the experimental plot had a narrower space for root growth. In addition, the nutrients available in the soil are not sufficient to meet the needs of each cassava plant. However, if supported by optimal fertilization, applying good cultivation technology, and maximum soil cultivation at tight spacing, cassava can produce optimally. The results of Amarullah's research (2015) show that the elephant variety of cassava harvested at the age of 9 months by applying intensive cultivation technology produces a total of 18.60 tubers.

However, setting a wide spacing alone is not enough to increase the number of tubers. Fertilization activities need to be carried out. It can be seen that the cassava plants planted at a spacing of 2x1 m without fertilizers (P0) produced a smaller number of tubers compared to cassava plants planted at the same spacing but added with urea fertilizer. The addition of urea, SP-36, and NPK Phonska (T3) fertilizers gave an effect that was not significantly different from plants that were only given urea fertilizer. This indicates that K and P nutrients are less available for cassava in increasing the number of tubers. One of the factors that cause K and P elements to be less available is the lack of daily rainfall at the research location during the study period, especially coinciding with the time of fertilization so that At that time, the soil was dry, which would hamper the absorption of nutrients from the soil by the plant roots, this is in line with Hardjowigeno (2007) which states that the nutrients dissolved in water are then absorbed by the plant roots from the fertilization solution. According to Soepardi (1983), Tumewu et al. (2015) stated that P fertilizer plays a very important role in increasing the number of tubers because P nutrient is needed to form roots. The national average cassava production is 17.0 tonnes/ha, the nutrients required by cassava plants are 68.0 kg/ha N, 22.7 kg/ha P, and 105.4 kg/ha K (Subandi, 2009). It can be seen that P nutrients are needed in lower amounts than the K and N elements. P nutrients are given to the soil come from SP36 fertilizer as much as 36% of the dose of 250 g/plot and from NPK Phonska fertilizer as much as 15% of the dose of 250 g/plot.

Table 2**.** The wet weight of tubers per plant

No	**Perlakuan**	**Bobot Basah umbi tanaman^{-1}**
1	T2P0	1,83 a(a)
2	T2P1	4,02 a(b)
3	T2P2	4,90 a(b)
4	T3P0	1,72 a(a)
5	T3P1	4,153 a(b)
6	T3P2	4,753 a(b)

Source: primary data processed (2019)

Analysis of tuber wet weight data per plant presented in Table 2 shows that the interaction between spacing (T) and all levels of fertilizer types (P) is not significantly different at the 0.05 level with the LSD test. However, the highest wet weight is found in the interaction between plant spacing at the T2 level with the type of fertilizer at the P2 level. It shows that the type of fertilizer added to the cassava plant is not affected by the spacing in increasing the wet tuber weight per plant.

The wet weight of tubers per plant in this study was low compared to the results of Amarullah's (2009) study, namely the wet weight of tubers per elephant variety of cassava harvested nine months after planting using optimal cultivation technology reaching 20.01 kg/plant. The spacing used in this study was 1x1m, the same as the treatment in this study. Therefore, it can be concluded that the wet weight of tubers per plant is not influenced by spacing but by other factors such as cultivation technology, soil fertility, and environmental factors such as rainfall, humidity, etc. Fitriani, et al. (2015) stated that the diversity in environmental factors affects the response of plants at various growth stages, which in turn affects crop yields and low crop productivity due to the dominance of environmental factors that are stronger than plant genetic factors. The high production of elephant variety cassava in Amarullah's research (2009) is also influenced by organic fertilizers and root stimulant (atonic) solutions and monoculture cropping patterns.

The interaction between the types of fertilizers at the T2 and T3 spacing levels showed the highest wet weight in the T2P2 treatment. Still, it was not significantly different from the T3P2 treatment and the interaction between P1 and T2 and T3. The lowest wet weight was shown by the T2P0 treatment, which was not significantly different from the T1P0 treatment. It shows that fertilization is necessary to increase the wet weight of cassava, both at tight spacing and wide spacing. Cassava that was not given fertilizer received the lowest tuber wet weight because it was suspected that the cassava plant in this study had a nutrient deficiency. It is in line with Tumewu (2015) opinion, which states that one of the limiting factors for cassava production is nutrients, so to obtain high production, nutrients must be available according to plant needs.

The wet weight of tubers per plant is low compared to the results of Amarullah's (2009) study, namely 20.01 kg/plant with the same spacing. Therefore, it can be concluded that the wet weight of tubers per plant is not influenced by spacing but by other factors such as cultivation technology, soil fertility, and environmental factors such as rainfall and humidity.

CONCLUSION

Based on the research, it can be concluded that the addition of Urea, SP36, and NPK Phonska (complete) fertilizers can increase the wet weight of cassava at a spacing of 2x1 m. In addition, the 2x1 m spacing has a significant effect on the number of tubers of plant-1, and the planting distance of 1x1 m supported by fertilization can increase the wet weight of plant-1 tubers.

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