INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS

ISSN(print): 2643-9840, ISSN(online): 2643-9875

Volume 07 Issue 12 December 2024

DOI: 10.47191/ijmra/v7-i12-50, Impact Factor: 8.22

Page No. 5757-5762

Efforts to Increase the Quantity and Quality of Tejakula Tangerines and Control of Unjuicy Fruit with Different Fertilization Packages

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ABSTRACT: The results showed that the fertilization package treatment with Cow Manure Organic Fertilizer + AB MIX Kryptonium + Mycorrhizal Biofertilizer + Probiotic Liquid Organic Fertilizer gave the lowest percentage of the number and weight of unjuicy fruits and gave the highest value on the number and weight of harvested fruits per tree, edible portion, fruit pulp color, fruit water content and fruit pulp moisture content when compared to other treatments. This treatment gave the lowest number and weight of unjuicy fruits which were 1.82% and 4.09% respectively and much lower than the percentage of the number and weight of unjuicy fruits in the control which were 9.11% and 22.08% respectively. In addition, this treatment also gave the highest number and weight of harvested fruits per tree, 259.63 fruits and 32.31 kg respectively, or an increase of 69.19% and 70.97% compared to the control with the number and weight of harvested fruits per tree, 80.00 fruits and 9.38 kg respectively. Fruit moisture content and pulp moisture content in this treatment were significantly higher than the control with values of 89.22% and 91.05%, respectively.

KEYWORDS: Fertilization package, Fruit Quality, Fruit Quantity, Tejakula Tangerine, Unjuicy Fruit

INTRODUCTION

Tejakula tangerines (*Citrus reticulata* cv. Tejakula) are native to Buleleng Regency, Bali Province which has been released as a national superior tangerine. This tangerine has a distinctive flavor in the form of a blend of sweet and slightly sour flavors with an attractive fruit appearance resembling mandarin oranges with a bright orange color when ripe due to β Cryptoxanthin pigment [1]. This advantage causes high public interest in Tejakula tangerines compared to other local citrus varieties [2]. This citrus was very popular in the 1980s but the glory ended because of the endemic Citrus Vein Phloem Degeneration (CVPD) so that widespread plant eradication was carried out. Farmers' longing for the glory days encouraged farmers to re-cultivate Tejakula tangerines on a small scale with a trial and error system. Tejakula tangerine re-cultivation by farmers experienced several obstacles in addition to CPVD such as the presence of unjuicy fruit [3].

Lack of juicy and unjuicy fruit is the low water content in citrus fruits that reduces the quality of citrus fruits because the texture of the pulp is rough, hard and hollow with a bland to slightly bitter taste that is not in demand by consumers. The cause of unjuicy in Tejakula tangerines is thought to be related to the lack of nutrient availability in the soil, affecting physiological processes in the plant body.

Appropriate fertilizer application should be able to meet all the nutrient needs of plants so that they can produce optimally both in terms of quantity and quality of yield [4]. Fertilization strategy is a major factor in addition to environmental factors considering that this will affect plant productivity, size, fruit quality where fruit quality is strongly influenced by the provision and availability of nutrients, especially when the plant is in the fruit filling and enlargement phase [5]. Fertilization can be done by combining several different types of fertilizers. Fertilizers can be in the form of organic fertilizers, inorganic fertilizers, biological fertilizers, probiotic fertilizers or their combinations. Therefore, the purpose of this research is to analyze and find the best fertilization package to increase the quantity, quality and control of unjuicy fruit in Tejakula tangerines.

RESEARCH METHODS

The research was conducted in Tejakula tangerine plantation owned by farmers in Tembok Village, Tejakula Subdistrict, Buleleng Regency, Bali Province, Indonesia from December 2023 - August 2024. The study used a 1-factor Randomized Group Design (RAK) with 6 treatment levels, namely Po (10 kg of Cow Manure Organic Fertilizer), Pa (Po + 275 g Urea + 310 g SP 36, + 137.5 g KCl), Pk (Po + 20 ml AB MIX Kryptonium/10 l water), Pm (Pk + Mycorrhizal Biofertilizer), Pp (Pk + Probiotic Liquid Organic Fertilizer (POC)) and Pc (Cow Manure Organic Fertilizer + AB MIX Kryptonium + Mycorrhizal Biofertilizer + Probiotic POC Fertilizer). Each treatment was repeated four times so that there were 24 citrus trees as experimental units. Observation data were analyzed using analysis of variance (anova) followed by the least significant difference test (LSD) at the 5% level.

The implementation of the research includes making probiotic POC, making mycorrhizal biofertilizer, making AB MIX Kryptonium stock solution, fertilization, plant maintenance, fruit sampling and data collection. Probiotic POC was made by combining the necessary ingredients, namely 1 kg of kepok banana peel, 1 kg of goat manure, 2.5 ℓ of green young coconut water, 2.5 ℓ of rice washing water, 0.5 kg of brown sugar, 0.1 ℓ of EM4 starter and distilled water. The preparation of mycorrhizal biofertilizer is carried out by combining the type/genus of mycorrhizal spores with spore carrier media with a composition of 100 g of volcanic sand carrier media sown with 50 spore consortia from the genus glomus, acaulospora and scutellospora obtained from spore propagation from exploration results on citrus plantations in Tejakula District. Preparation of AB MIX Kryptonium stock solution is done by dissolving each nutrient A and nutrient B solids into 5 ℓ of distilled water. The implementation of fertilization begins with cleaning the rhizosphere area and making a run around the tree. Fertilizers were sprinkled and shaken into the furrows around the sample plants according to the treatment level with a fertilizer application interval of 2 times, namely at the beginning of the study and 2 months after the first fertilization. Especially for mycorrhizal biofertilizer, it was sprinkled at the base of the plant and given only once during the first fertilization. Plant maintenance was carried out in the form of weeding, maintenance pruning, and pest and disease control. Fruit harvesting was carried out by picking fruit at three different maturity levels at each fertilization level. After harvesting, fruit samples were brought to the laboratory to be observed and measured for observation variables consisting of the number of harvested fruits per tree, weight of harvested fruits per tree, percentage of the number of unjuicy fruits, percentage of the weight of unjuicy fruits, edible portion, fruit flesh color, fruit moisture content and fruit pulp moisture content.

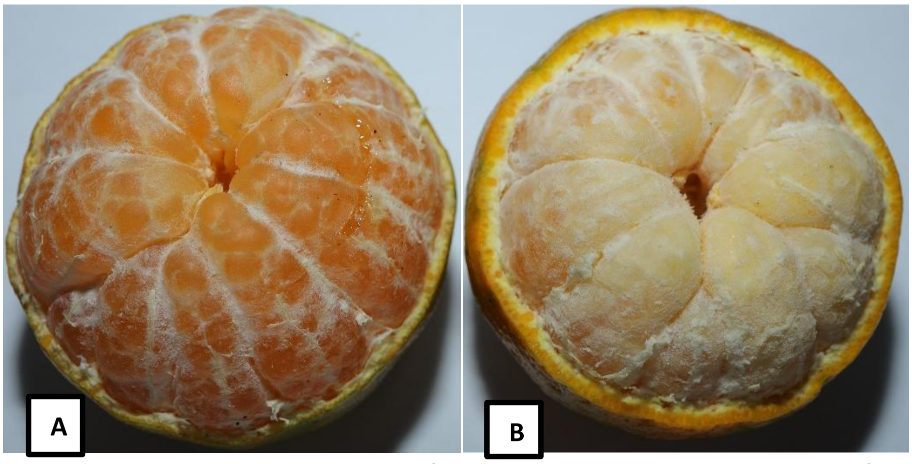

Figure 1. Citrus Fruit Curves that are not unjuicy/ Juicy (A), Fruit Curves that are unjuicy/ Unjuicy (B)

RESULTS

Number of harvested fruits per tree and harvested weight of fruits per tree

The highest number of harvested fruits per tree and weight of harvested fruit per tree were obtained at the Pc level and significantly different from other levels such as Po, Pa, Pk and Pm, but not significantly different from Pp. The number of harvested fruits per tree was Pc (259.63), Pp (193.50), Pm (167.38), Pa (143.88), Pk (138.50) and Po (80.00), respectively. While the weight of harvested fruit per tree is Pc (32.31), Pp (23.65), Pm (18.71), Pa (17.92), Pk (15.57) and Po (9.38), respectively. Application of fertilizer at the Pc level gave 69.19% more fruit harvest per tree compared to the control (Po) while the weight of fruit harvest per tree gave 70.97% higher results compared to the control (Table 1).

Table 1. Effect of treatments on number of harvested fruits per tree and weight of harvested fruits per tree

Treatment	Number of Harvested Fruits per Tree (fruit)	Weight of Harvested Fruit per Tree (kg)
Po	80,00 (8,83) c	9,38 (3,09) c
Pa	143,88 (11,81) b	17,92 (4,22) b
Pk	138.50 (11.43) bc	15.57 (3.90) bc
Pm	167,38 (12,60) b	18,71 (4,29) b
Pp	193.50 (13.41) ab	23.65 (4.72) ab
Pc	259,63 (15,70) a	32,31 (5,56) a
BNT 5%	2,75	0,90

Note: The means followed by the same letter at the same column are not significantly different according to LSD (Least Significant Different) test at alpha 5%. The numbers outside the brackets are the original data while the numbers inside the brackets are the data transformed to the normal distribution. $\sqrt{X + 0{,}5}$ Because the original data does not spread normally

Percentage of the number of unjuicy fruits, percentage of the weight of unjuicy fruits and edible portion

The fertilizer package treatment showed that the highest percentage of the number of unjuicy fruit was in the Po treatment (9.11%) followed by Pp (8.51%), Pm (6.77%), Pk (5.99%), Pa (5.47%) and the lowest in Pc (1.82%) and Pc was significantly different from all other treatments. The level of Pc was able to reduce and overcome the breathlessness lower by 80.03% compared to Po (Table 2).

The highest percentage of the weight of unjuicy fruit was obtained in Po (22.08%) followed by Pk (16.65%), Pp (14.73%), Pa (13.82), Pm (12.91%) and the lowest in Pc (4.09%) and Pc was significantly different from all other treatments. The level of Pc was able to reduce and overcome moths lower by 81.48% compared to Po (Table 2).

The highest percentage of edible portion was obtained at the Pc level (70.74%) and the lowest at Pk (50.65%). Between Pc and Pk had a difference of 28.40% and when compared with other treatments, the Pc level was significantly different from Po, Pk, Pm and Pp but not significantly different from Pa (Table 2).

Table 2. Effect of treatment on percentage of the number of unjuicy fruit (%), percentage of the weight of unjuicy fruit weight (%) and edible portion (%)

Treatment	Percentage of the number of unjuicy fruits (%)	Percentage of the weight of unjuicy fruit (%)	Edible Portion (%)
Po	9,11 (76,86) a	22,08 (84,80) a	59.64 bc
Pa	5,47 (74,45) b	13,82 (79,76) b	64.32 ab
Pk	5.99 (74.82) ab	16.65 (81.42) ab	50,65 c
Pm	6.77 (75.30) ab	12,91 (79,13) b	57.00 bc
Pp	8.51 (76.44) ab	14.73 (80.30) ab	59.29 bc
Pc	1,82 (71,98) c	4,09 (73,50) c	70,74 a
BNT 5%	2,23	5,00	10,83

Note: The means followed by the same letter at the same column are not significantly different according to LSD (Least Significant Different) test at alpha 5%. The numbers outside the brackets are the original data while the numbers inside the brackets are the transformed data. $\sqrt{X + 0{,}5}$ Because the original data does not spread normally

Fruit flesh color, fruit moisture content, and fruit pulp moisture content

The Pc treatment (4.35) had the highest fruit flesh color value and the lowest in Po (3.27) and Pc was significantly different from Po, Pk, Pm, and Pp but not significantly different from Pa. Fruit flesh color value in Pc was 24.83% higher than Po as the control (Table 3).

Fruit moisture content showed the highest value at the Pc level (89.22%) and the lowest at Po (87.32%) and Pc was significantly different from Po, Pa, Pk, and Pm but not significantly different from Pp. Fruit moisture content in Pc was 2.13% higher than Po as the control (Table 3).

Fruit pulp moisture content in the Pc treatment tends to give the highest value compared to other treatments at 91.05% followed by Pm (90.20%), Pk (90.00%), Pp (89.58%), Pa (89.48%) and the lowest in Po (87.61%) and Pc is significantly different from Po and Pa but not significantly different from Pk, Pm and Pp. Fruit flesh moisture content in Pc tended to be 3.78% higher than Po as the control (Table 3).

Table 3. Effect of treatment on fruit flesh color, fruit moisture content (%) and fruit flesh moisture content (%)

Treatment	Fruit flesh color	Fruit moisture content (%)	Fruit pulp moisture content (%)
Po	3,27 c	87,32 c	87,61 c
Pa	3.96 ab	88.00 bc	89,48 b
Pk	3.67 bc	88.12 bc	90.00 ab
Pm	3,86 b	87.69 bc	90.20 ab
Pp	3.49 bc	88.51 ab	89.58 ab
Pc	4,35 a	89,22 a	91,05 a
BNT 5%	0,47	1,02	1,51

Note: The means followed by the same letter at the same column are not significantly different according to LSD (Least Significant Different) test at alpha 5%.

DISCUSSION

The provision of fertilization packages at the Pc level (Cow manure + AB MIX Kryptonium + Mycorrhizal Biofertilizer + POC Probiotics) tends to be able to control unjuicy in Tejakula tangerines compared to other treatments. This can be seen in the observation variables, especially in the percentage of the number of unjuicy fruits and the percentage of the weight of the lowest unjuicy fruit at the Pc level which is also supported by the variable number of harvested fruit per tree, weight of harvested fruit per tree, edible portion, fruit flesh color, fruit moisture content and the highest fruit flesh moisture content in Pc. This is thought to be because the fertilizer used is more complex and diverse in the form of collaboration between organic and inorganic fertilizers so that it can meet and provide the nutrients needed by plants [6]. Different things can be seen in other fertilization levels which tend not to be able to overcome the unjuicy fruit, especially at the Po fertilizer level. At Po, the percentage of the number and weight of unjuicy fruits showed high results so that the fruit produced was of low quality. The high rate of fruit dropping in Po is thought to be related to the provision of nutrients that are less than optimal due to only using cow manure organic fertilizer whose nutrients are slowly available so that the absorption of nutrients by plants tends not to be optimal [7].

The use of organic fertilizers given to all sample plants besides having disadvantages also has advantages. According to [8] organic fertilizers can effectively improve chemical, biological and improve some soil physical properties such as soil permeability, soil pore space and help form soil granular structure. Appropriate application of organic fertilizers is also able to provide nutrients that can increase plant growth so that it has implications for increasing the quantity and quality of yields [9,10]. The content of organic matter in cow dung organic fertilizer is also considered to be able to increase available organic matter in the soil, nitrogen and phosphorus content although it takes longer when compared to chemical fertilizers [11].

The use of AB MIX Kryptonium at the Pc level is done to fulfill the macro and micro elements needed by citrus plants so as to provide optimum quantity and quality of citrus fruits. This fertilizer contains 17 different nutrients consisting of 6 types of macro elements and 11 types of micro elements. The macro elements contained are nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg) and sulfur (S) while the micro nutrients are iron Fe), copper (Cu), zinc (Zn), boron (B), molybdenum (Mo), chloride (Cl), nickel (Ni), sodium (Na), cobalt (Co) and iodine (I). According to [12] the nutrient solution in the form of AB mix containing complete nutrients if applied at the optimum concentration will show better results than fertilizers containing incomplete nutrients even though they are applied according to plant needs.

The use of mycorrhizal biofertilizer also had a significant impact on the sample plants. Biofertilizers in principle do not contain nutrients directly but contain microorganisms that are able to provide the nutrients needed by plants [13]. According to [14], the association of plants with mycorrhiza through root infection and the formation of intensive external hyphae can facilitate the absorption of water along with other nutrients that have been provided by other fertilizers. In addition, mycorrhiza is also able to help plants access nutrients sourced from organic matter, especially facilitating the absorption of phosphorus in the soil solution [15].

Probiotic POC in synergy with other fertilizers also has a positive impact on plants. Research [16] reported that probiotic microbes have a beneficial impact on plant growth such as absorbing and fixing nitrogen from the rhizosphere, facilitating the absorption of nutrients from the soil solution, producing growth regulator hormones such as auxins and cytokinins, producing antibiotics that function to increase immunity so that the roots are protected from pathogens, dissolving phosphate in the soil which involves acidification, chelation and cation exchange reactions and can increase plant yields by up to 25%. Research by [17] suggests that probiotic microbes have 3 roles, namely biofertilizer (nutrient provider), bioprotectant (control and protection against pathogens) and biostimulant (growth stimulator). According to [18] kepok banana peel can increase plant growth and productivity because it contains nutrients such as magnesium, calcium, zinc and sodium. Goat manure has a higher nutrient content compared to other livestock manure such as cows, especially in nitrogen and potassium elements. According to [19], the application of goat manure fertilizer at a dose of 15 tons/ha can have a significant effect on plant height, stem diameter, number of branches, number of flowers and fruit weight of tomatoes. The addition of young green coconut water is done because coconut water contains nutrients such as potassium, calcium, magnesium, sulfur, iron, copper and sodium and contains sugar and protein molecules [20]. According to [21] coconut water also contains growth regulating hormones such as auxin, cytokinin and gibberellin which function to stimulate plant growth. Rice washing water in probiotic fertilizer functions to increase nutrients because it contains nitrogen, phosphorus, magnesium and sulfur and there are also ZPTs that function to regulate root growth and suppress apical dominance [22].

CONCLUSIONS

The fertilization package at the Pc level in accordance with the research data shows its effectiveness in controlling unjuicy in Tejakula tangerines. The collaboration between cow manure organic fertilizer, AB MIX Kryptonium fertilizer, Mycorrhizal Biofertilizer and Probiotic Fertilizer makes nutrients for plants available while being able to be absorbed directly or indirectly due to the association between plants and mycorrhizal and probiotic microbes. Future research with a more robust methodology can develop these findings to find other alternative technologies in overcoming unjuicy fruit in Tejakula tangerines.

ACKNOWLEDGEMENTS

The authors would like to thank the Regional Research and Innovation Agency of Bali Province for funding this research through research collaboration with the Institute for Research and Community Service of Udayana University.

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