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GROWTH RESPONSE OF BANJAR SIAM ORANGE (*CITRUS NOBILIS* LOUR VAR. *MICROCARPA* HASSK) SEEDS TO FERTILIZER OF GOAT MANURE AND NPK IN RED YELLOW PODSOLIC SOIL

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ABSTRACT

Siam Banjar oranges are a type of fruit that is widely cultivated in Kalimantan. Limited quality seeds are one of the obstacles in its cultivation. The purpose of this study was to study the effect of applying goat manure and NPK fertilizer on the growth of Siam Banjar orange grafting seedlings on PMK soil. The research design used a factorial Completely Randomized Design (CRD) repeated 3 times. The first factor was the administration of goat manure (control; 100; 200 and 300 g/polybag). Meanwhile the second factor was NPK fertilization (control; 2.5 and 5 g/L). The results showed that there was an interaction between the addition of 100 g/polybag goat manure and 2.5 g/L NPK on stem diameter (7.1 mm). The addition of 100 g/polybag goat manure was able to increase shoot length (29.22 cm), number of leaves (21.11 strands), leaf area (258.61 cm²). NPK administration at a dose of 5 g/L increased shoot length (37.33 cm), number of leaves (26.66), and leaf area (353.19 cm²). A combination of 100 g/polybag goat manure and NPK dose of 5 g/L can be applied to increase the growth of Siam Banjar orange grafting seedlings.

KEY WORDS

Siam Banjar oranges, grafting, manure, NPK.

Citrus fruits control 60% of the national and regional citrus market and play an important role in increasing the country's foreign exchange (Astiari et al., 2019). Siamese orange (*Citrus nobilis* Lour var. *microcorva*) is one of the superior crop commodities that has good benefits because it is needed by people throughout the world (Department of Horticulture, 2006). Siamese oranges have many advantages, such as a slightly sour sweet taste, rather thick skin and bright orange colour, resistant to pests and diseases, contains lots of vitamin C, tastes good and refreshing, various skin colours, easy to consume, and can be cultivated in various places in the highlands and lowlands (Hidayati, 2015).

National Siamese orange production in 2018 reached 2,408,029 tons, an increase of 11.02% from 2,165,184 tons in the previous year (Dirjen Horticulture, 2014). Siam Banjar orange production in Central Kalimantan from 2015 to 2019 showed the lowest production of 5.479 tons in 2015, but then increased by 10.30 tons in 2017. Overall, the trend of Siamese orange production in Central Kalimantan has decreased, although in 2019 production reached 7,203 tonnes (BPS Kalimantan Tengah, 2019).

At this time, the main problem in cultivating Siamese oranges is getting seeds. High quality Siamese oranges are produced from seed propagation by grafting or attachment. Besides being simpler to use, this method is more effective in using materials taken from scions. The joining of two different plant parts into one plant that continues to grow and develop is called vegetative propagation. According to Hartman and Kester (1979), the purpose of grafting/attaching plants is to increase the quality and quantity of crop yields, produce a combination of plants that are superior in rooting and production, speed up flowering and fruiting time, and produce tillers that have the same fruiting quality as their parents (Samsul, 2010).

After grafting, seedling growth is strongly influenced by the growing medium. Red Yellow Podzolic Soil (PMK) is a type of dry, acid soil found in many places in Indonesia. This soil has a bright colour, ranging from yellow to yellowish red, compact with little organic



matter. According to Aditya's research findings (2016), the chemical properties of PMK soil in Central Kalimantan with a pH ranging from 5.02 to 5.13, has a low macronutrient content of NPK, Ca and Mg, and has a very low CEC value.

One way to increase PMK soil productivity while increasing plant growth is to add organic matter or through fertilization. Organic fertilization can be done by adding goat manure; this fertilizer has a higher potassium content and lower water content compared to other manures (Hartatik et al., 200). According to Selwina and Sutejo's research (2017), goat manure treatment of 15 g/polybag provided the most effective growth rate for rubber seedlings at the age of 2, 3 and 4 months after grafting. Goat manure, according to Subhan and Rizwan (2008), has the property of increasing soil aeration, increasing soil capacity to hold water, increasing soil buffering capacity, and functioning as an energy source for soil microorganisms as well as a source of nutrients. Goat manure contains N elements which can increase the growth of organs, including leaves, which are involved in photosynthesis.

The element phosphorus (P) plays a role important in energy transfer within plant cells, promotes root development and earlier fruiting, and increases N uptake during early growth. NPK fertilizer as a compound fertilizer contains more than two types of main nutrients, namely N (15%) in the form of NH_3 , P (15%) in the form of P_2O_5 , and K (15%) in the form of K_2O . Juanita et al. (2013) found that NPK Compaction fertilizer given to *Gyrinops versteegii* seedlings at a dose of 1 gram per plant increased the diameter of the plant stems.

According to the description above, it is expected that goat manure and NPK can increase the nutrient content in PMK soil while helping plant growth. Goat manure and NPK fertilizer can be used as an alternative to increase the growth of Siam Banjar orange grafting seedlings. Goat manure has the ability to improve soil structure and support physiological processes for plant growth, while NPK fertilizer provides macro-nutrient content to increase PMK soil fertility.

MATERIALS AND METHODS OF RESEARCH

The research was conducted from April to July 2022 at the Horticulture Seed Propagation Installation (IPBH), which is managed by the Agriculture, Horticulture and Livestock Services Office of Central Kalimantan Province in Pelaranan Village, East Kotawaringin Regency.

For this study, the materials used were: Japanche Citroen (JC) variety for rootstock, Siam Banjar variety as scion and intris, goat manure, NPK Mutiara 16-16-16 fertilizer, and polybags (30 x 30).

The study was conducted using a completely randomized design (CRD) Factorial consisting of two treatment factors and three replications: The first factor was the application of goat manure, which consisted of 4 (four) levels:

- K0 = No Fertilizer (Control) (0 tons/ha);
- K1 = Goat manure 25 tons/ha (100 g/polybag);
- K2 = Goat manure 50 tons/ha (200 g/polybag);
- K3 = Goat manure 75 tons/ha (300 g/polybag).

The second factor is the provision of NPK concentration consisting of 3 (three) levels:

- N0 = Without NPK (Control);
- N1 = NPK concentration of 2.5 g/L water;
- N2 = NPK concentration of 5 g/L water.

There are twelve treatment combinations for each treatment factor. There were 36 experimental units because each treatment combination was repeated three times.

The research began with seed preparation, planting media preparation, planting, grafting, fertilizer application, and maintenance.

Percentage of viable entries, shoot length, number of leaves, stem diameter, and leaf area were all variables observed.

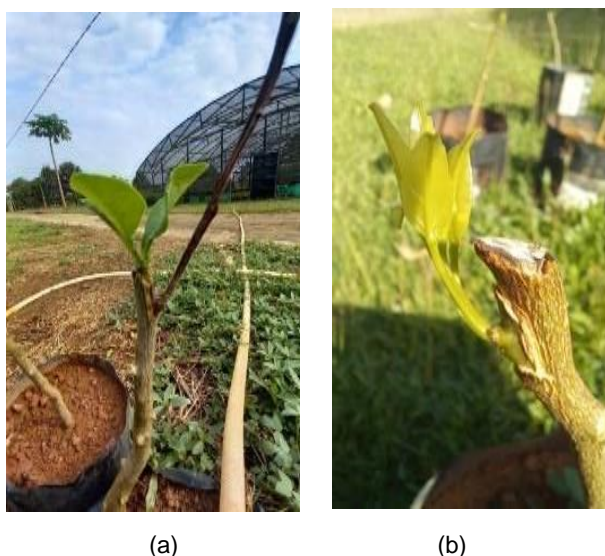


Analysis of variance (ANOVA) was used to analyse the data obtained by the F test at 5% and 1%. If there is a significant difference, the Honestly Significant Difference (HSD) is used at level $\alpha = 5\%$ to determine differences between treatments.

RESULTS AND DISCUSSION

Data from observations of the percentage of living entries in the main sample is 100%. The living entries are marked by the visual appearance of the fresh green entries (stem patches) and the buds can be seen protruding on the patch.

Figure 1(a) dead grafting shows that grafting of citrus plants failed during the growth period due to estrangement between the upper and lower stems. Figure 1 (b) live grafting shows the light green patch and grafted shoots.



Picture 1 – (a) Dead grafting, (b) Live grafting

The results of the analysis of shoot length variance of Siam Banjar citrus plants showed that there was no relationship between the treatment of goat manure and NPK fertilizer. Only one treatment factor was goat manure and NPK fertilizer which had a significant effect at the age of 8 and was very significant at the age of 10 and 12 weeks after grafting.

According to the results of the analysis of 100 g/polybag goat manure (K1) used in this study, macro nutrients, especially nitrogen nutrients at 3.03%, phosphorus at 1.33%, and potassium at 1.69%, are very influential on plant vegetative growth, one of which is shoot length, so that plants have produced the best results on shoot length variables (Figure 2).

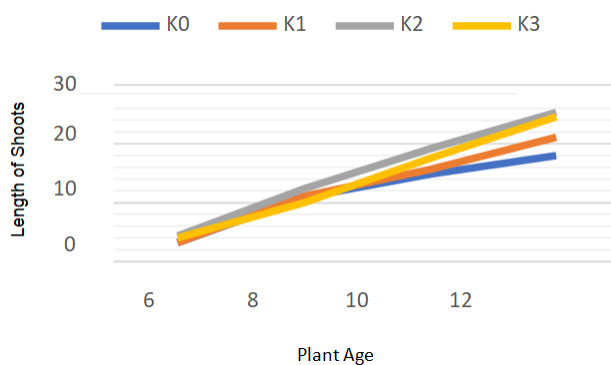


Figure 2 – Shoot Length Growth of Siam Banjar Orange Grafting Seedlings (cm) aged 6, 8, 10 and 12 weeks after grafting due to application of goat manure



The results of the analysis of variance in the number of leaf blade grafting of Siam Banjar oranges showed that only one factor influenced the variable number of leaf blades, namely the treatment of goat manure and NPK fertilizer, and that both had no effect on the variable number of leaf blades.

Goat manure 100 g/polybag (K1) generally gives the best results on the variable number of leaves (Figure 3). The results of the analysis of the goat manure used in this study showed that it contained macronutrients, particularly 3.03% nitrogen, 1.33% phosphorus and potassium 1,69%.

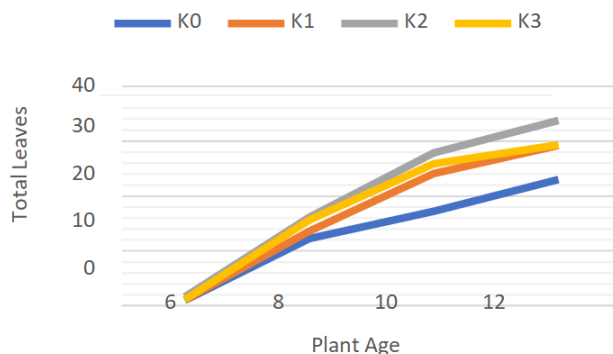


Figure 3 – Increase in number of leaves (strands) on plants aged 6, 8, 10 and 12 weeks after grafting due to application of goat manure

The nutrients N, P, and K in the soil affect the number of leaves (Fahrudin, 2009). Young leaves reach their perfect shape more quickly because element N helps the process of cell division and enlargement. As a manufacture of phosphate sugars needed by plants during photosynthesis, element P plays an important role in plant metabolism. Successful photosynthesis produces photosynthate, which can be used for plant growth and development. Element K can help increase the number of plant leaves because it plays a role in regulating the movement of stomata.

According to research conducted by Aditya et al. (2019), the availability of nitrogen at the beginning of growth will affect the number and area of leaves formed, so that the chlorophyll content produced is also higher, so that plants can produce sufficient amounts of carbohydrates/assimilates for vegetative growth.

The results of the analysis of the variance of the stem diameter of Siam Banjar orange grafting showed that there was an interaction between the goat manure and NPK fertilizer treatments at the age of 12 mso (Table 1). The results of the analysis of variance also showed that the single factor treatment of goat manure and NPK fertilizer had a very significant effect at 8, 10 and 12 weeks after grafting.

The results showed that the concentration of goat manure of 100 grams per polybag (K1) and the concentration of NPK fertilizer of 2.5 grams per L (N1) affected the stem diameter of Siam Banjar orange grafting. This shows that the nutrients in goat manure and NPK fertilizer affect the diameter of grafting stems. Element N is very important for plants, especially during the vegetative phase to build leaves and stems (Atikah et al., 2023). More chlorophyll is formed so that plants can absorb sunlight better (Damanik, 2009). Nutrient K is responsible for water distribution in plants, translocation of carbohydrates, and increasing plant resistance to disease, and increasing plant absorption of nutrients contained in the soil. This is consistent with the findings of Khadijah's research (2021), which shows that the application of NPK 16:16:16 fertilizer really affects the diameter of the shoots of the Kasturi citrus plant. In this study, the addition of compound fertilizer increased the availability of plant nutrients, including the elements N, P, and K. Plants absorb and use nitrogen, especially during vegetative growth. In addition, nitrogen plays a role in the formation of chlorophyll, which is needed for the process of photosynthesis, which produces the energy needed by cells for cell division, enlargement, and elongation activities (Khaliriu and Sabli, 2020).



Table 1 – The effect of the interaction of 100 g/polybag goat manure and 2.5 g/L NPK on the growth of plant stem diameter 12 weeks after grafting

	0 (N ₀)	2,3 a	4,06 b	4,73 bc	5,2 bc	4,07
12	2,5 (N ₁)	4,26 b	7,1 c	6,6 c	4,1 b	5,51
	5 (N ₂)	4,66 b	4,66 b	4,26 b	6,5 c	5,02
	Rata-rata K	3,74	5,27	5,19	5,26	
BNJ 5 % (Interaksi) : 1,39						

The results of the analysis of leaf area variance of grafting Siam Banjar oranges showed that except for a single factor that really affected the leaf area variable, the goat manure and NPK fertilizer treatments had no impact on the leaf area variable. Goat manure at a dose of 200 g/polybag (K2) showed the best results, with a length of 395.41 cm (Figure 4).

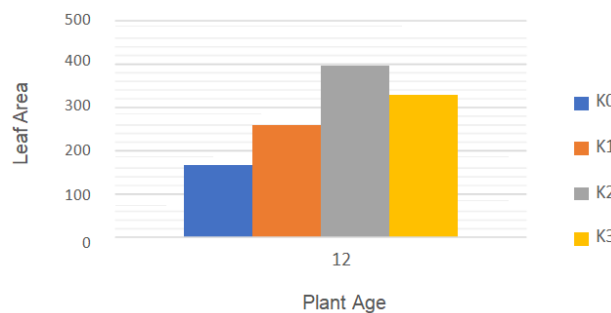


Figure 4 – Increase in leaf area of Siam Banjar Orange grafting seedlings 12 weeks after grafting due to goat manure treatment

According to the research results, goat manure can increase the leaf area of Siam Banjar orange grafting. This is because goat manure contains macro nutrients, especially 3.03% nitrogen, 1.33% phosphorus, and 1.69% potassium, which are very important for plant vegetative growth. According to Hardjowigeno (2007), N helps the vegetative growth of plants; Plants that grow in soil with the same amount of N will have greener leaves. In addition, the nutrient N is very important for the process of forming chlorophyll and increasing vegetative growth of plants, including increasing stem height, number of leaves, stem diameter, leaf area, and other aspects. Furthermore, according to research conducted by Indrasari and Gratitude (2006), applying organic matter such as goat manure up to 30 tonnes/ha can increase organic matter content, Zn content in plant tissues, and fresh and dry weight of corn roots. Furthermore, in a study conducted by Utami et al. (2019), the highest leaf area of citrus plants is 20.35 cm² on average. Goat manure is a material that contains complete nutrients in different proportions and complements each other.

CONCLUSION

Fertilization of goat manure at a dose of 25 tons/ha is the best treatment for the growth of Siam Banjar citrus grafting seedlings. This treatment was able to increase shoot length, number of leaves, stem diameter, and leaf area. NPK administration with a concentration of 5 g/L was the best treatment that was significantly able to increase shoot length, number of leaves, and leaf area of Siam Banjar citrus grafting.

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REFERENCES

1. Aditya, S.I., Adji, F.F., & Kalmillah. 2016. Karakteristik Kimia and Fisika Tanah PMK (Podsolik Merah Kuning) Akibat Penggunaan Lahan Yang Berbeda. *Journal Agrienvi.* 13(1):1-7.
2. Aguslina, L. 2004. Dasar Nutrisi Tanaman. Rineka Cipta. 20 hlm. Jakarta.
3. Astiari, NKA., Sulistiawati, NPA., Mahardika, IBK., Rai, IN. 2019. Improving the quality fruit of Citrus cv. Siam out off-season through the application of fertilization and pruning. *Journal of Physics: Conference Series.* 1402. 1-6.
4. Atikah, TA., Syahid, A., Widiarti, A. 2023. Media Growing Techniques and Different Soil Types to Increase Agronomic Characteristics and Content of Flavonoid Compounds on Dayak's Onion (*Eleutherine palmifolia* Merr.). *International Journal of Design & Nature and Ecodynamics.* 18(1):91-96.
5. Badan Pusat Statistik. 2017. Data Sensus Tabel Dinamis Subjek Perkebunan. Badan Pusat Statistik Kalimantan Tengah. Palangka Raya.
6. Badan Pusat Statistik. 2019. Data Sensus Tabel Dinamis Subjek Perkebunan. Badan Pusat Statistik Kalimantan Tengah. Palangka Raya.
7. Damanik M.M.B. Hasibuan B.E. Fauzi, Sarifuddin. & Hanum H. 2009. Kesuburan Tanah and Pemupukan. USU Press. Medan.
8. Direktorat Jenderal Hortikultura. 2006. Statistik Hortikultura Tahun 2005. Departemen Pertanian.
9. Direktorat Jenderal Hortikultura. 2014. Keragaan Pembangunan Hortikultura. Rencana Strategis Direktorat Jenderal Hortikultura 2015-2019.
10. Fahrudin, F. 2009. Budidaya Caisim (*Brassica juncea* L) Menggunakan Ekstrak Teh and Pupuk Kascing. Skripsi. Fakultas Pertanian. Jurusan Studi Agronomi. Universtas Sebelas Maret. Surakarta.
11. Hardjowigeno, S. 2007. Ilmu Tanah. Akademia Pressindo Jakarta.
12. Hartmann, H.T., D.E. Kester & F.T. Davies. 1997. Plant Propagation, Principles and Practice. Sixth Edition. Prentice – Hall International, Ich. New Jersey.
13. Hartatik, W.D., Setyorini, L., R. Widodowati, S. Widati. 2005. Laporan Akhir Penelitian Teknologi Pengolahan Hara pada Budidaya Pertanian Organik. Laporan Bagian Proyek Penelitian Sumberdaya Tanah and Proyek Pengkajian Teknologi Pertanian Partisipatif.
14. Hidayati. 2015. Karakterisasi Morfologi and Pertumbuhan Vegetatif Bibit Tujuh Varietas Jeruk Keprok (*Citrus reticulata* Blanco). Fakultas Pertanian IPB, Bogor.
15. Indrasari, A & A. Syukur. 2006. Pengaruh Pemberian Pupuk Kandang and Unsur Hara Mikro Pertumbuhan Jagung pada Tanah Ultisol yang Dikapur. Lampung. Skripsi. Institut Pertanian Bogor. Bogor. Hal: 75.
16. Juanita, D. Lasut, M.T. Kalangi, I.J. & J. Singgano. 2013. Pengaruh Pemberian Pupuk Majemuk Npk Terhadap Pertumbuhan Bibit. Skripsi. Universitas Sam Ratulangi. Manado.
17. Khadijah, S. 2021. Pengaruh ZPT Dekamon and Pupuk NPK 16:16:16 Terhadap Pertumbuhan Okulasi Tanaman Jeruk Kasturi (*Citroortunella microcarpa*). Skripsi. Universitas Islam Riau. Pekanbaru.
18. Khaliriu & T.E. Sabli. 2020. Pengaruh Pupuk Organik Cair Sabut Kelapa and NPK 16:16:16 terhadap Pertumbuhan and Produksi Tanaman Bawang Merah (*Allium ascalunicum*). Skripsi. Fakultas Pertanian. Universitas Islam Riau. Pekanbaru.
19. Samsul. 2010. Perbanyak Tanaman Okulasi, Sambung, and Cangkok. Penebar Swadaya. Jakarta.
20. Selwina, A. & Sutejo, H. 2017. Pengaruh Pupuk Kandang Kambing and Pupuk NPK Phonska terhadap Pertumbuhan Bibit Karet Okulasi (*Hevea brasiliensis* Muell.Arg) Klon PB 260. *Jurnal AGRIFOR.* 16(1):17-26.
21. Subhan. & Rizwan. 2008. Pengaruh Pupuk Kandang Terhadap Produksi Mentim un (*Cucumis sativus* L). *Journal Viabel Pertanian.* 15-24.
22. Utami, R., Yulian and S. Bambang. 2019. Pertumbuhan Vegetatif Bibit Jeruk Gerga Pasca Okulasi pada Konsentrasi Pupuk Organik Cair yang Berbeda. *Jurnal Ilmu Pertanian Indonesia.* 21(1), 32-36.