Journal of Engineering Science and Technology
Vol. 16, No. 2 (2021) 1492 - 1505

FOLIAR APPLICATION OF BIONUTRIENT-S267 AND BIONUTRIENT-S367 ON SIAMESE CITRUS (*CITRUS NOBILIS VAR. MICRICARPA LOUR*) PLANT

HENDRAWAN HENDRAWAN*, YAYA SONJAYA,
ILHAM RAMADHAN HUSEIN, FITRI KHOERUNNISA

Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi no 299, Bandung, 40154, Indonesia
*Corresponding Author: hendrawan@upi.edu

Abstract

This research was focused to the study of the effects of two kinds of liquid fertilizers, called bionutrient-S267 and bionutrient-S367 when they were applied to citrus plant. The parameters involved were (1) content level of nitrogen, phosphorus, and potassium in leaves of citrus; (2) growth of leaves; (3) number of flower and fruit; and (4) yield. The research was conducted in a farmland in West Java, Indonesia. Bionutrient-S267 and bionutrient-S367 were applied foliarly, sprayed on the foliage of the citrus leaves. The dose and the quantity of bionutrients had been optimized beforehand. The application of the bionutrients was carried out once a week. In other hand, the control, a commercial fertilizer, was applied as usually farmers did in the region. It was found that the content level of nitrogen in the leaves tend to decrease, while that of phosphorus increased at the beginning of application then achieved maximum value at the third month and after while tend to be constant or slightly decrease for all kind of fertilizers in concern, whereas the potassium level was decreased constantly when bionutrient-S367 was applied. The length and the width of leaves on the twig decreased with the order of decrease starting from the leaf exhibit the base, the middle, and the end part of the twig for all kind of fertilizers in concern. Bionutrient-S367 and bionutrient-S267 provoked flowering earlier compared to the control, and so that for the emergence of the fruit. The diameter and mass of the fruit in the trees treated by bionutrient-S367 was superior to those resulted by both bionutrient-S267 and control. In general, in term of yield, bionutrient-S367 demonstrated its superiority against both bionutrient-S267 and positive control.

Keywords**:** Bionutrient-S267, Bionutrient-S367, Citrus, Foliar.

1. Introduction

The Siamese orange is a very important agricultural commodity both from the economic aspects and from the society nutritional function aspects. Several studies relating to the opportunities of Siamese citrus in socio-economics aspect has become the focus of very intense research [1]. There was also researcher worked on the nutritional function aspects of the citrus-based nutrients, focused not only on its nutritional content but also on the sensory aspects [2]. Regarding these two aspects in concern, the quantity of production and product quality have become a serious concern for researchers. In this context, the pre-harvest treatment, such as watering and fertilizing, has become a particular concern to researchers [3, 4].

Some practitioners have used organic fertilizer in trying to improve productivity and the quality of product. A study conducted in Valencia, Spain, showed that highly educated and technically skilled practitioners tended to practice organic citrus farming [5] and have found that the use of organic fertilizer given a beneficial result [6].

Although the use of organic fertilizer was one of the promising practices, it was not free from the risks to the environment, which has become one of the issues in terms of environmental policy retrieval [7-9]. To mitigate this risk, several research groups have tried to develop composting method and production of organic fertilizer that were able to minimize the fertilizer risk on environment [10, 11].

Excessive fertilization, which was focused only on increasing productivity, could provoke soil salinity, heavy metal accumulation, eutrophication, and nitrate accumulation, and generated other kinds of environment risk in term of air pollution due to sulphur-containing gases [12]. Besides the type of fertilizer used, the method of fertilizing also has different impact on environment. Foliar method could be considered as the potential method of fertilizing that provide good effectiveness and minimize environmental impact. In this method, liquid fertilizer was applied on the foliage of the trees in order to boost nutrient supply in corp. This kind of fertilizer application was considered to be a good choice, especially for nitrogen. It was able to reduce the loss of nitrogen due to denitrification and leaching compared with the nitrogen fertilizer applied through soil [13].

Some scientific evidence regarding the foliar effect of nutrients on crops have been published. A work using mono calcium fermented in hydrogen phosphate (FCMP) came to the conclusion that the use of FCMP by foliar was not only able to increase the quantity of sweet persimmon results but also improved its quality [14]. Other researcher revealed that the yield and quality of wheat increased when a macro-containing foliar intake and micro-nutrient added into the triazole fungicide program, with little risk of deoxynivalenol contamination [15]. It was also reported that the application of foliar micro-elemental and bio-fertilizer provided a good effect on the increase of peanut crop yield [16]. Similar result was obtained, when the organic fertilizer has been enriched and sprayed onto the tomato plant that was place in a greenhouse [17]. There was also an indication that the application of foliar liquid fertilizer given an advantage to the quality aspect of coffee [18]. The effectiveness of foliar applications depended on the nutrient ingredient used and the types of plants that were targeted for the application. Thus, the formulation of composition and appropriate dosage for each type of plant becomes an important part to be considered in the application of foliar fertilizer or nutrient.

This research was intended to test the performance of two kinds of liquid fertilizers, called bionutrient-S267 and bionutrient-S367 when they were applied foliarly to citrus plant. In addition to the micronutrient, which is usually used in fertilizer, the bionutrients have other kinds of nutrient, extracted from several sorts of biodiversity [19]. The parameters involved were (1) content level of nitrogen, phosphorus, and potassium in leaves of citrus; (2) growth of leaves; (3) number of flowers and fruits; and (4) yield. This study will be very beneficial in order to descript the performance of bionutrient-S267 and bionutrient-S367 when they were used to citrus plants.

2. Experimental Procedure

2.1. Material and main instrument

The materials used in this study include bionutrient-S267 (local), bionutrient-S367 (local). Chemicals used include sulfuric acid, potassium sulphate, copper(II) sulphate, sodium hydroxide, boric acid, BCG-MR indicator, hydrochloric acid, hydrogen peroxide, cesium chloride, ammonium molybdate, ascorbic acid, potassium antimoniltartrate (acquired from Merk, Germany). The main equipment used were UV-Vis spectrophotometer M-1240 (Shimadzu, Japan), Flame-photometer Corning 410 (CIBA-Corning, Madrid, Spain).

2.2. Procedure

The study was conducted in three phases, namely: application stage, observation of leaf growth and crop result, and laboratory test. Application was carried out in a citrus plantation in a farming area in West Java, Indonesia. The total number of citrus trees in the farm area was 125, where all the citrus trees were on the same age (around 5 years old). Of the 215 citrus trees, 9 trees were selected as the experimental group using bionutrient-S267, 9 trees were selected as experimental group for bionutrient-S367, and 9 trees were selected as control group (using commercial fertilizer). The three groups of citrus trees were separated by a series of other citrus trees, functioned as the border between group.

In the application stages, we have used bionutrient-S267, bionutrient-S367, and commercial fertilizer (control). The two bionutrients were applied by spraying them against the citrus leaves. Application of the bionutrients were done once a week, in the morning. For the control group, a kind of commercial fertilizer, a granule form, was applied just as the farmer usually did on applying the fertilizer.

Observations were carried out once every two weeks for about sixteen weeks. Observations were conducted to measure the length and width of the leaves, number of flowers, and number of fruits. The leaves were divided into three categories, i.e., the leaves exhibit the end part of twig, the leaves exhibit the middle part of twig, and the leaves exhibit the base part of twig. The yield, expressed in term of mass of harvested fruit, was observed starting from the third week up to the fourth week. During this period, the harvesting was carried out once a week.

Analysis of the of nitrogen (N), phosphorus (P), and potassium (K) content level on the leaves was carried out once a month. The procedure of examination was as follow:

Examination of nitrogen content level in leaf. Five pairs of leaves on each tree (9 trees in each group) have been taken from the three group of treatment as samples. The samples were washed and dried at 65 °C, and grinded. As much as 1 gram of dried-powdered leaf has been added with 7.0 grams of potassium sulphate, 0.8 grams of cupric sulphate, and 12 mL of sulphuric acid. After a while, the system was heated until a green colour in solution was appeared, then cooled for about 20 minutes. After all, the solution was added with 25 mL of distilled water, 50 mL of sodium hydroxide, 30 mL of boric acid, and 3 drops of BCG-MR indicator, then distilled. The distillate was then directly titrated with hydrochloric acid solution.

Examination of phosphorus content level in leaf. As much as 0.1 grams of sample was destructed using 1.0 mL concentrated sulphuric acid and 0.5 mL of hydrogen peroxide 30%. The solution was heated until the colour slightly black and frothy, then the solution was allowed to cool. A quantity of hydrogen peroxide 30% was added to the solution until the solution was clear, then heated at 180 °C for 15 minutes, and cooled. The solution was then diluted until 100 mL and filtered using filter paper Whatman number 40, and the filtrate was then collected. To 1.0 mL of the filtrate was added 5 mL aquadest and 1.0 ml of a solution (prepared by mixing 50 mL of sulphuric acid 5 N, 15 mL of ammonium molybdate 4%, 30 mL of ascorbic acid 0.1 N, and 5 mL of potassium antimoniltatrate). The solution was then homogenized until the colour emerging, then the absorbance was determined using UV-vis spectrophotometer at wavelength 700 nm. The blank and the standard solution were made at concentration from 0 to 6 ppm.

Examination of potassium content level in leaf. As much as 25 grams of sample was heated in a porcelain crucible at 200 °C, ignited with a furnace at 500 °C, cooled, added with 5 mL of nitric acid (1:1), then put in a volumetric flask 100 mL and diluted until the mark of the flask. The standard solution of potassium (1000 ppm) was pipetted as much as 1.0 mL, and placed in a volumetric flask 100 mL, diluted by distilled water up to the mark (the concentration of standard solution II was 10 ppm). The solutions for calibration curve were made by pipetting the standard solution II as much as 1.0 mL, 2.0 mL, 3.0 mL, 4.0 mL, and 5.0 mL, each of them was placed in a volumetric flask 50 mL, added with 2.5 mL of cesium chloride solution and diluted by distilled water to the mark of the flask so that the concentration of obtained standard solution were 0.2 ppm, 0.4 ppm, 0.6 ppm, 0.8 ppm, and 1.0 ppm. Instrumentation was then carried out at wavelength 766.5 nm.

3. Results and Discussion

3.1. Effect of bionutrient on the level of nitrogen, phosphorus, and potassium in citrus leaf

Nitrogen concentrations as a result of the treatment by bionutient-S267, bionutrient-S367, and commercial fertilizer (control) are shown in Fig. 1. Figure 1 shows that the nitrogen content level of the leaf in the plants treated with bionutrient-S267 was slightly decreased from the first month up to the second month period and continue decreased after experiencing a small increase in the third month, where the nitrogen content level in the first month was 2.89% and in the fourth month was 2.76%. The nitrogen content level in the leaf of the plants treated by bionutrient-S367 decreased consistently starting from the first month until the fourth month of experiment period, with quantity 3.17% in the first month and 2.78% in the fourth month. In the control group, nitrogen level decreased from the first month up to the second month period. In the third month the nitrogen level experienced an increase. However, in the fourth month, the nitrogen content in this control group decreased. For the control group, the level of nitrogen content in the first month was 2.81% and in the fourth month was 2.64%. Although the supply of nitrogen was constantly done once a week, there was also a slightly constant decline in the content level of nitrogen from time to time. This may be addressed to the conversion of nitrogen to other substance, manifested of the change in any part of the plant. Changes in the quantity of nitrogen in plant leaves can be attributed to the formation of flower and the formation of new leaves [20]. This result is also in accordance with that found in the work conducted by other researcher, which stated that the increasing levels of nitrogen given to citrus plants leads to a decrease in the level of vitamin C [21]. Other researcher also observed that the use of 50% of N/tree/year content showed the higher increase in levels of vitamin C compared to that using the full dose of 400 g N/tree/year [22].

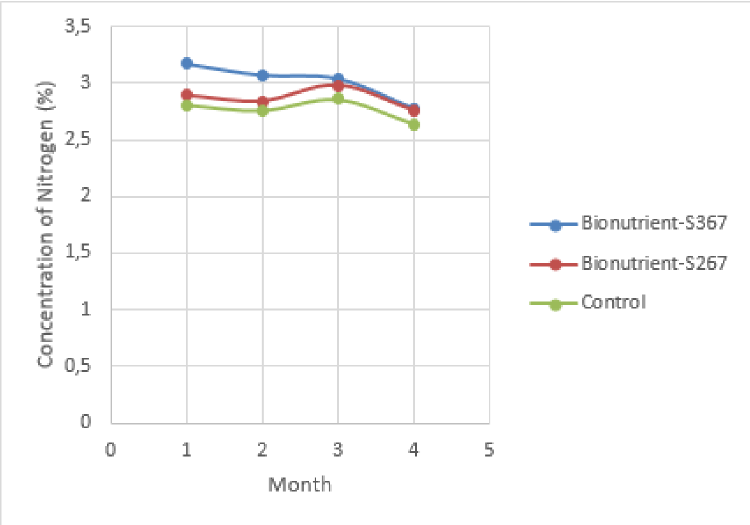

Fig. 1. Concentration of nitrogen in leaf.

Concentration of phosphorus as the result of the bionutrient-S267, bionutrient-S367, and commercial fertilizer (control) treatment is given in Fig. 2. It can be seen in Fig. 2 that the graphical trend of the content level of phosphorus in the leaf of the plant treated by bionutrient-S267, bionutrient-S367, and commercial fertilizer was quite similar, but different in quantity. There was an increase starting from the first month up to the third month and declined in the fourth month. For bionutrient-S267, the highest concentration of phosphorus in the leaf was found in the third month (0.20%), and the lowest level was found in the first month (0.11%), while in the fourth month was 0.19%. For bionutrient-S367, the highest concentration of phosphorus in the leaf was found in the third month (0.22%), and the lowest level was found in the first month (0.13%), while in the fourth month was 0.21%. Whereas for commercial fertilizer, the highest concentration of phosphorus in the leaf was found in the third month (0.19%), and the lowest level was found in the first month (0.11%), while in the fourth month was 0.18%. It looked like that the leaves absorbed phosphorus effectively. The trees treated by bionutrient-S367 absorb more phosphorus, compared to bionutrient-267 and commercial fertilizer, because in our experimental setting the bionutrient-367 has a higher concentration of phosphorus.

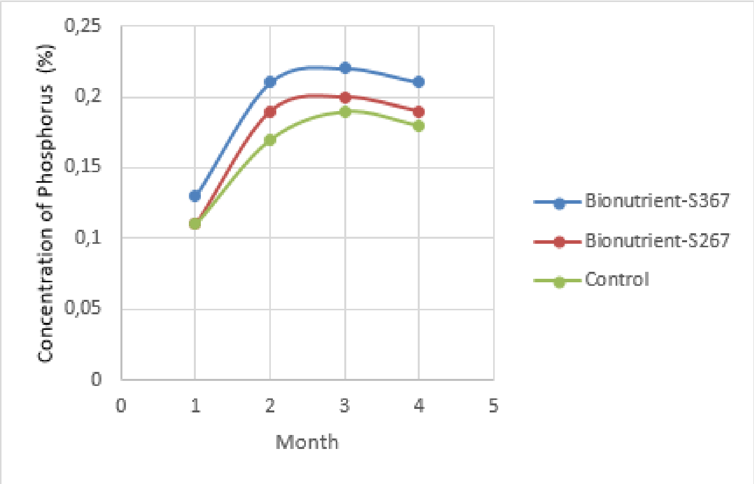

Fig. 2. Concentration of phosphorus in leaf.

Concentration of potassium in the leaf as the result of application the bionutrient-S267, bionutrient-S367, and commercial fertilizer (control) is given in Fig. 3. Figure 3 shows that the potassium level on leaf treated by bionutrient-S267 increased since the first until the fourth month. The level of potassium content of the leaf was found to be 1.03% in the first month and 1.33% in the fourth month. A different feature of graph profile was demonstrated by the result on application bionutrient-367, which was curvature in shape. The potassium level in the leaf of the trees treated by bionutrient-S367 increased starting from the first month up to the third month, then decreased up to the fourth month. The highest potassium level was found in the third and the third month (1.39%), while the lowest concentration was found in the first month (1.07%), whereas at the fourth month was 1.26%. In the control group, the potassium level in the leaf was increased starting from the first month up to the fourth month, with the highest level was in the fourth month (1.59%), and the lowest was in the first month (0.96%).

It seems that the condition could be related to plant transport systems and potassium transport functions. The fact that the potassium levels tend to decrease in the group of bionutrient-S367 may be explained as the consequences of the functions of potassium in transporting dissolved material to the fruit and eventually stored in the fruit, which consequently causes enlargement the fruit mass. The decreased concentrations of potassium in the leaf occurs at the time of induction of flower until the development of fruit with a range of potassium levels between 1.73% and 3.64% [20]. Meanwhile, in the period of plant development, potassium moves from leaf to fruit and seed [23].

3.2. Effect of bionutrient on leaf growth

The effect of bionutrient on leaf growth was observed on the basis of length and width parameters of leaf along the twig. In this case, the twig was divided into three parts i.e., the end part (composed by youngest leaf), the middle part, and the base part (composed by oldest leaf). For simplicity, we have labelled the end part of twig as E, the middle part of twig as M, and the base part of twig as B. The effects of bionutrient on the leaf length at the end, the middle, and the base of the twig of citrus trees are presented in Fig. 4.

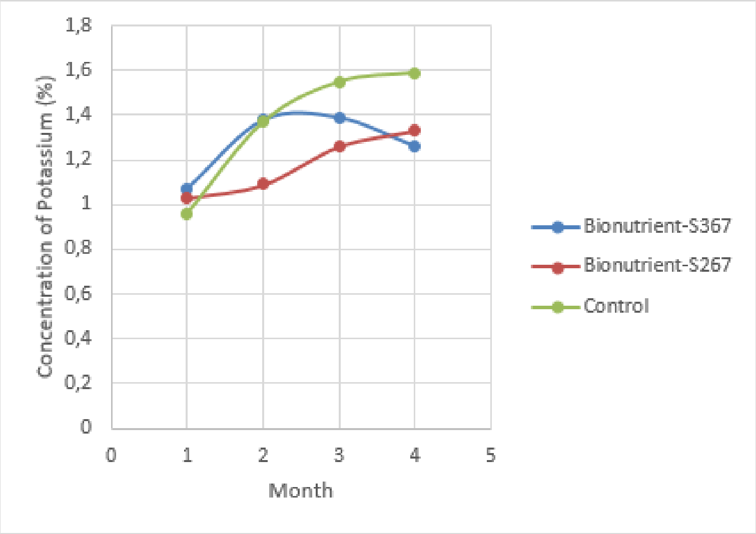

Fig. 3. Concentration of potassium in leaf.

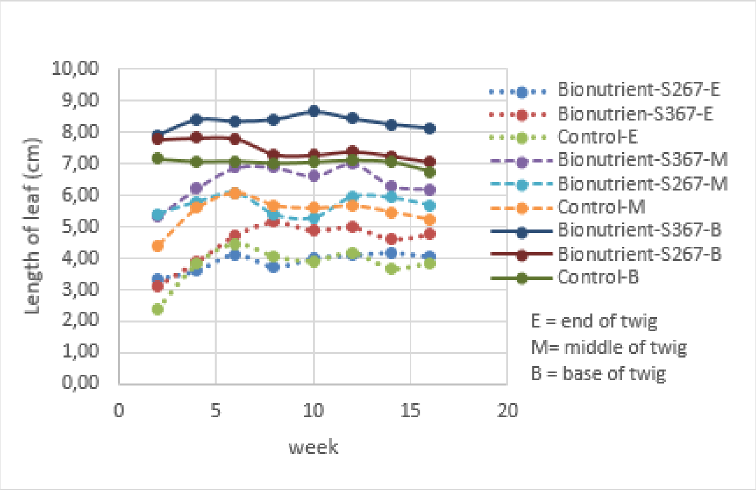

Fig. 4. Effect of bionutrient on the length of leaf at the end, the middle, and the base part of twig.

The graph in Fig. 4 shown the feature of effect of application of bionutrient-S267, bionutrient-S367, and commercial fertilizer on the length of leaf at the end, the middle, and the base part of the twig. The leaf at the end part of the twig (1) experienced an increase in length starting from the second week until the sixth week, where the highest length is attained (4.19 ± 0.48 cm), and after while the trend was roughly plat, when bionutrient-S267 was applied; (2) increased in length starting from the second until the eighth week, where the highest length was attained (5.17 ± 0.75 cm), and after while the trend was roughly plat, when bionutrient-S367 was applied; (3) increased starting from the second week until the sixth week, where the longest measure of leaf length was attained (4.47 ± 0.83 cm), and then decreased gradually, when commercial fertilizer was applied.

The leaf at the middle part of the twig (1) increased from the second week two up to the sixth week, where the maximum length is obtained (6.09 ± 0.36 cm), when bionutrient-S267 was applied; (2) increase starting from the second week until the sixth week, at the measure of length 6.89 ± 0.82 cm, and then tend to decrease gradually, when bionutrient-S367 was applied; and (3) increased since the second week until the sixth week, and then tend to plat, with the highest value was 6.09 ± 0.59 cm, when commercial fertilizer was applied.

The leaf at the base part of the twig (1) tend to have a constant measure up to the sixth week (around 7.81 ± 0.37 cm), and there was slight decrease and then constant up to the sixteenth week, when bionutrient-S267 was applied; (2) tend to have a constant measure at around 8.65 cm, when bionutrient-S367 was applied; and (3) tend to have a constant value at 7.09 ± 0.63 cm, when commercial fertilizer was applied.

In general, it can be seen in Fig. 4 that the length of leaf on the twig decrease with the order of decrease starting from the leaf exhibit the base, middle, and the end part of the twig. The feature is valid for the treatment using bionutrient-S267, bionutrient-S367, as well as commercial fertilizer. Leaf condition at the end and the middle part of the twig, in terms of leaf length parameter, showed that the better growth was found when bionutrient-S367 was applied, which produced longer leaf. The leaf condition at the base part of the twig also shown the same feature, where the application of bionutrient-S367 provides longer leaf, but with stagnant growth. This stagnant state of leaf growth could be understood because the older leaf has reached the end of growth period. In this context, we can conclude that the increase of leaf length is better achieved when we use bionutrient-S367, compared to bionutrient-S267 and commercial fertilizer.

The effect of bionutrient on the leaf width in the end, the middle, and the base of the twig of citrus trees are presented as Fig. 5. The graph in Fig. 5 shows that the leaf at the end part of the twig (1) experienced an increase in width starting from the second week until the sixth week (1.64 ± 0.46 cm) and then attained relative plat condition, when bionutrient-S267 was applied; (2) increased in width starting from the second until the eighth week, where the highest width was attained (2.34 ± 0.52 cm), and after while suffering small decrease, and then the trend was roughly plat, when bionutrient-S367 was applied; (3) increased starting from the second week until the sixth week, where the highest value was attained (1.68 ± 0.39 cm), and then attained relative plat condition, when commercial fertilizer was applied.

The leaf at the middle part of the twig (1) increased from the second week up to the sixth week, where the highest width is attained (2.78 ± 0.39 cm), and after suffering a decline in the eighth week, the trend of increasing in width was regained up to the sixteenth week, when bionutrient-S267 was applied; (2) increase since the second week until the eighth week, with the maximum width was 3.33 ± 0.59 cm, and then tend to decreased, when bionutrient-S367 was applied; and (3) increased from the second week up to the sixth week, and after suffering a decline in the eighth week, the trend is then relatively constant up to the sixteenth week, where the highest length is attained (2.67 ± 0.19 cm), when commercial fertilizer was applied.

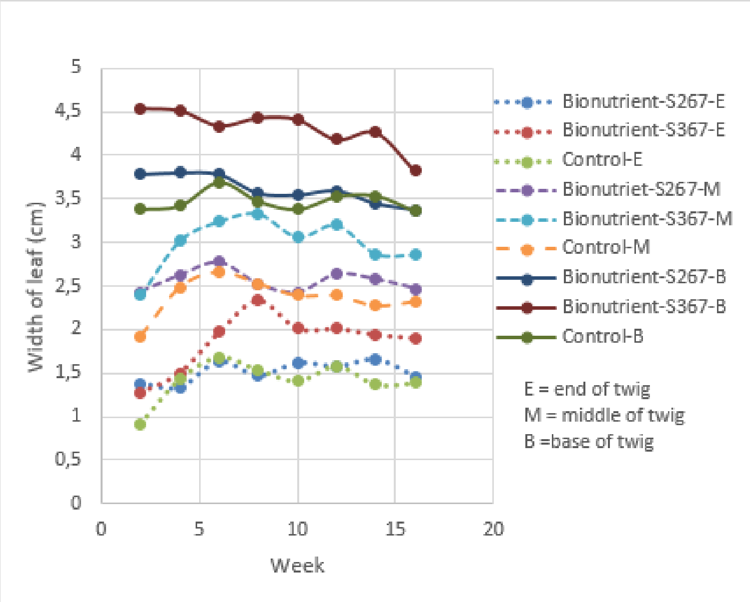

Fig. 5. Effect of bionutrient on the width of leaf at the end, the middle, and the base part of twig.

The leaf at the base part of the twig (1) tends to have small decrease in width for all kind of treatment, i.e., bionutrient-S267, bionutrient-S367, as well as commercial fertilizer. However, the application using bionutrient-S367 resulted in wider leaf during the observation compared to the treatment using bionutrient-S267 and commercial fertilizer. The highest value of the leaf width was found in the second week of experiment period, i.e., 4.54 ± 1.39 cm for bionutrient-S267, 3.78 ± 0.55 cm for bionutrient-S367, and 3.68 ± 0.29 cm for commercial fertilizer.

As shown in Fig. 5, the width of leaf on the twig decreases with the order of decrease starting from the leaf exhibit the base, the middle, and the end part of the twig. The feature is valid for the treatment using bionutrient-S267, bionutrient-S367, as well as commercial fertilizer. Leaf condition at the end and the middle part of the twig, in terms of leaf width parameter, shows that the best growth was found when bionutrient-S367 was applied, which produced wider leaf. The leaf condition at the base part of the twig also shows the same feature, where the application of bionutrient-S367 provides wider leaf length, but with the growth profile tend to be stable. This relative stagnant state of leaf growth could be addressed to the age factor of the leaf, where the leaf has reached the end of growth period. Based on our observation, we can infer that the increase of leaf width is better achieved when we use bionutrient-S367, compared to bionutrient-S267 and commercial fertilizer.

3.3. Effect of bionutrient on the number of flower and fruit

The emergence of flowers was observed to determine the effects of bionutrient-S267 and bionutrient-S367 on the number of flowers. The more flowers appear, the more likely the fruit can be produced. Observations were conducted on one branch of each observed tree. The emergence of flowers has begun to be seen in the first two weeks after the application of bionutrient-S267 and bionutrient-S367. The graph of the flower and fruit emergence is given in Fig. 6.

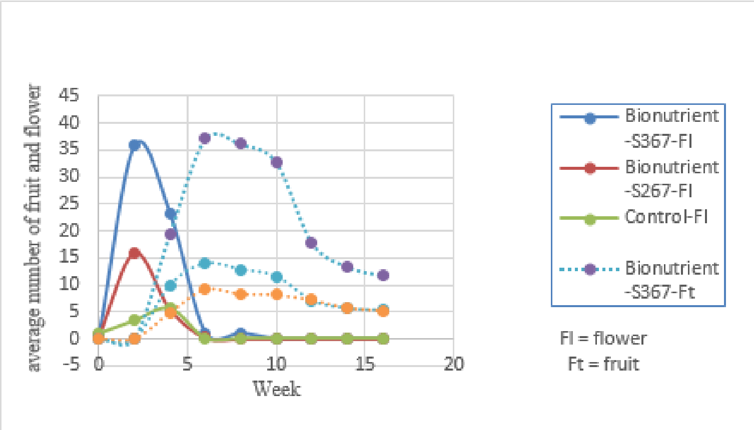

Fig. 6. Effect of bio nutrient on number of flower and fruit.

It can be seen in Fig. 6 that both the bionutrient-S267 and bionutrient-S367 cause the number of flowers tend to decrease, starting from the second week until the sixth week, and then no more flowering has occurred. The highest number of flower emergence occurred in the second week, with the average number of flowers for bionutrient-S267 was 15.88, and for bionutrient-S367 was 35.88. Meanwhile, in the control, the flowering has occurred in a slow manner, where the peak of flowering has occurred in the fourth week, with the average number of flowers was 5.67.

The emergence of fruits was first observed at the time when the flowering process has been completed. Observation was performed once every two weeks from the first month until the fifth month of the experiment period. The results of the observation are shown in Fig. 6. The graph in Fig. 6 shows that the bionutrient-S267, bionutrient-S367 group, or control group caused the conversion of flower into fruit starting after the second week, but with different conversion gradient. The highest emergence of fruit was in the sixth week for bionutrient-S367 (37.11 in average), bionutrient-S267 (13.89 in average, as well as for control group (9.22 in average). This fact indicated that bionutrient-S367 was able to produce more fruit compared to bionutrient-S267 and control one.

It is the fact that bionutrient-S367 application resulted in a higher nitrogen level compared to bionutrient-S267 and control. Therefore, the quantity of fruit produced in the bionutrient-S367 was higher than that of the bionutrient-S267 and control. This fact seems to be in accordance with the results found by Aslam et al.[24] on the study of the impact of nitrogen and potassium on growth, flowering, and seed yield of African marigold (*Tagetes erecta L.*)

3.4. Effect of bionutrient on yield

Harvesting was performed five times, starting from the third month until the fourth month. Qualitatively, taste of citrus fruits resulted in bionutrient-S267 and bionutrient-S367 had a sweet taste, different from the citrus fruits resulted in control group, which was tasted sour. In term of size parameter, the average diameter of the fruits obtained in bionutrient-S267 was 5.79 ± 0.38 cm, bionutrient-S367 was 6.09 ± 0.33 cm, and control group was 5.85 ± 0.53 cm.

The harvested citrus fruit was weighed to determine the mass of fruit produced in each group. The data of fruit mass is presented in Fig. 7.

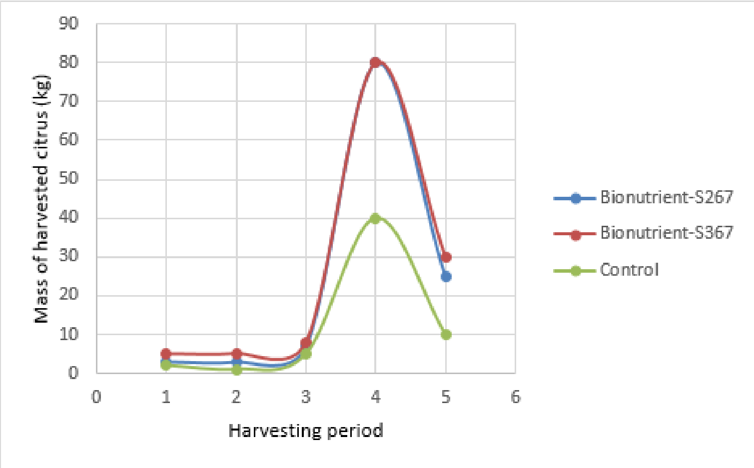

Fig. 7. The mass of harvested citrus during the harvesting period.

As shown in Fig. 7, the mass of harvested fruit in bionutrient-S267 group and bionutrient-S367 group have a similar tendency, with the highest yield, in term of mass, was obtained at the fourth harvesting day, i.e., 80.00 kg. In control group, the highest yield was also gained at the fourth harvesting day but only as much as 40.00 kg.

The mass average of harvested fruit on the tree group treated by bionutrient-S367 was 25.62 kg, bionutrient-S267 was 23.59 kg, and control was 11.60 kg. Thus, the mass average of the fruit was higher in the trees treated by bionutrient-S367 compared to that treated by bionutrient-S267 and control.

The increase in mass of citrus fruit could be addressed to the addition of potassium content in bionutrient. Increasing the availability of potassium over the minimum required level can increase the size of the fruit [23]. In the period of plant development, potassium moves from leaf to fruit and seed. Potassium regulates several enzyme functions, plant water connections, electrochemical cell balance, and the transportation of the vascular plant [25]. Potassium is needed for physiological functions such as sugar and starch formation, protein synthesis, cleavage, and cell growth. In this work, the increase in fruit mass indicates that photosynthesis occurs at optimum condition, the resulted carbohydrate (photosynthesis) is also well distributed into the fruit. Potassium also assists the absorption of carbon dioxide for citrus trees by controlling the opening and closing of the stomata, thus increasing rate of photosynthesis [26].

With the increase of photosynthesis rate, there is an increase in the number of photosynthate, which is then distributed to the plant organ so that the fruit produced is greater in size or more in number. Increase in nitrogen quantity also affects the yield rate of photosynthesis, which may be related to the process of carbohydrate formation in citrus plants. In this context, it is the fact that bionutrient-S367 give better productivity compared to bionutrient-S267 and control due to the levels of nitrogen and potassium content in bionutrientt-S367.

4. Conclusion

In this work, we conclude that (1) the content level of nitrogen in the leaves tended to decrease, while that of phosphorus increased at the beginning of application then achieved maximum value at the third month and after a while it tended to be constant or slightly decreased for all kind of fertilizers in concern, whereas the potassium level decreased constantly when bionutrient-S367 was applied; (2) the length and the width of leaves on the twig decreased with the order of decrease starting from the leaf exhibit the base, the middle, and the end part of the twig for all kind of fertilizers in concern; (3) bionutrient-S367 and bionutrient-S267 may provoke flowering earlier compared to the control, and so that for the emergence of the fruit, whereas the highest emergence of fruits was attained in the sixth week for all kind of fertilizers in concern; and (4) the diameter and mass of the fruit in the trees treated by binoutrient-S367 was superior to that resulted by both bionutrient-S267 and control.

Acknowledgements

We would like to thank Universitas Pendidikan Indonesia for financial support in this research.

References

1. Sudrajat, J. (2018). Siam citrus marketing annexation history in sambas. *Paramita: Historical Studies Journal*, 28(1), 70-79.
2. Srivastava, A.K.; and Singh, S. (2005). Zinc nutrition, a global concern for sustainable citrus production. *Journal of Sustainable Agriculture*, 25(3), 5-42.
3. Graham, J.H.; Syvertsen, J.P.; and Smith Jr, M.L. (1987). Water relations of mycorrhizal and phosphorus-fertilized non-mycorrhizal citrus under drought stress. *New Phytologist*, 105(3), 411-419.
4. Magwaza, L.S.; Mditshwa, S.; Tesfay, S.Z.; and Opar, U.L. (2017). An overview of preharvest factors affecting vitamin C content of citrus fruit. *Scientia Horticulturae*, 216,12-21.
5. Beltrán-Esteve, M.; Picazo-Tadeo, A.J.; and Reig-Martínez, E. (2012). What makes a citrus farmer go organic? Empirical evidence from Spanish citrus farming. *Spanish Journal of Agricultural Research*, 10(4), 901-910.
6. Pereira, G.V.; Pereira, D.C.O.; Pinto, D.F.P.; Filho, L.C.D.; Homma, S.K.; and Botelho, R.C. (2016). Organic fertilizer: Effect on yield and qualitative traits of Brachiaria Brizantha cv. Marandu after the third harvest. *Revista Brasileira de Agropecuária Sustentável*, 6(3), 40-44.
7. Adhikari, B.K.; Trémier, A.; Barrington, S.; Martinez, J.; and Daumoin, M. (2013). Gas emissions as influenced by home composting system configuration. *Journal of Environmental Management*, 116, 163-171.
8. Spokas, K.; Bogner, J.; Chanton, J.P.; Morcet, M.; Aran, C.; Graff, C.; Golvan, Y.M.-L.; and Hebe, I. (2006). Methane mass balance at three landfill sites:

What is the efficiency of capture by gas collection systems? *Waste Management*, 26(5), 516-525.

9. Hellebrand, H.J. (1998). Emission of nitrous oxide and other trace gases during composting of grass and green waste. *Journal of Agricultural Engineering Research*, 69(4), 365-375.
10. Evanylo, G.; Sherony, C.; Spargo, J.; Starner, D.; Brosius, M.; and Haering, K. (2008). Soil and water environmental effects of fertilizer-, manure-, and compost-based fertility practices in an organic vegetable cropping system. *Agriculture, Ecosystems and Environment*, 127(1-2), 50-58.
11. Szanto, G.L.; Hamelers, H.V.M.; Rulkens, W.H. and Veeken, A.H.M. (2007). NH_3, N_2O, and CH_4 emissions during passively aerated composting of straw-rich fig manure. *Bioresource Technology*, 98(14), 2659-2670.
12. Savci, S. (2012). An agricultural pollutant: Chemical fertilizer. *International Journal of Environmental Science and Development*, 3(1), 77-80.
13. Gooding, M.J.; and Davies, W.P. (1992). Foliar urea fertilization of cereals: a review. *Fertilizer Research*, 32(2), 209-222.
14. Hossain, M.B.; and Ryu, K.S. (2009). Effect of foliar applied phosphatic fertilizer on absorption pathways, yield and quality of sweet persimmon. *Scientia Horticulturae*, 122(4), 626-632.
15. Blandino, M.; and Reyneri, A. (2009). Effect of fungicide and foliar fertilizer application to winter wheat at anthesis on flag leaf senescence, grain yield, flour bread-making quality and DON contamination. *Europen Journal of Agronomy*, 30(4), 275-282.
16. Hameda, El-S.E.A.; Amen El-S.A.; El-Morsy, A.H.; and Tolba, M.H. (2012). Effects of foliar spraying with microelements and different fertilizer sources on quality and yield of *Pisum sativum, L.* plant. *International Research Journal of Agricultural Science and Soil Science,* 2(1), 017-024.
17. Afshari, M.; Afsharmanesh, G.R.; and Yousefi, K. (2014). The effect of enriched organic fertilizer and methanol spray on the greenhouse-tomato yield. *Journal of Agricultural Science,* 6(11), 14-20.
18. Hendrawan; Sonjaya, Y.; Khoerunnisa, F.; Wijayanti, C.R.; Anugrah, D., Hana, M.N.; and Musthapa, I. (2020). Foliar application of bionutrient-C213 on coffee plant. *Journal of Engineering Science and Technology,* 15(1), 320-330.
19. Enwonwu, C.O.; and Meeks, V.I. (1995). Bionutrition and oral cancer in humans. *Critical Reviews in Oral Biology and Medicine*, 6(1), 5-17.
20. Picchioni, G.A.; Brown, P.H.; Weinbaum, S.A.; and Muraoka, T.T. (1997). Macronutrient allocation to leaves and fruit of mature, alternate-bearing pistachio trees: Magnitude and seasonal patterns at the whole-canopy level. *Journal of the American Society for Horticultural Science*, 122(2), 267-274.
21. Lee, S.K.; and Kader, A.A. (2000). Preharvest and postharvest factors influencing vitamin C content of horticultural corp. *Postharvest Biology and Technology*, 20(3), 207-220.
22. Hifny, H.A.; Fahmy, M.A.; Bagdady, G.A.; Abdrabboh, G.A.; and Hamdy, A.E. (2013). Effect of nitrogen fertilization added at various phenological stages on growth, yield and fruit quality of Valencia orange trees. *Nature and Science*, 11(12), 220-229.

23. Gerardeaux, E.; Jordan-Meille, L.; Constantin, J.; Pellerin, S.; and Dingkuhn, M. (2010). Changes in plant morphology and dry matter partitioning caused by potassium deficiency in *Gossypium hirsutum* (L.). *Environmental and Experimental Botany*, 67(3), 451-459.
24. Aslam, A.; Zaman, F.; Qasim, M.; Ziaf, K.; Shaheen, I.; Afzal, N.; Quratul-Ain.; Hussain, S.; and Hussain, S. (2016). Impact of nitrogen and potash on growth, flower and seed yield of African marigold (*Tagetes erecta L*.). *Scientia Agriculturae*, 14(2), 266-269.
25. Clarkson, D.T.; and Hanson, J.B. (1980). The mineral nutrition of higher plants. *Annual Review of Plant Physiology*, 31(1), 239-298.
26. Obreza, T.A. (2003). Importance of potassium in a Florida citrus nutrition program. *Better Crops,* 87(1), 19-22.