EFFECT OF AMMONIUM SULPHATE FERTILIZATION ON THE MACRONUTRIENTCONTENT OF LEAVESAT ZALACCA (*SALACCA SUMATRANA* BECC.)

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Abstract. *Adelina, R., Suliansyah, I., Syafief, A., Warnita. 2018. Macronutrient Content on Leaves as Effect of Fertilization of Ammonium Sulfate and Potassium Chloride in Zalacca* ***(Salacca sumatrana Becc.).***Cultivation Technique of Salak Sidimpusn (*Salacca sumatrana* Becc.) needs to be improved in an effort to increase the production of salak which has continued to decline. Optimal production of salak Sidimpuan can be achieved if the factors internally and externally that support the growth and development of plants are well available for plants. There are three essential nutrients that determine the growth and development of plants, namely nitrogen, phosphorus and potassium. The application ofammonium sulfateand Potassium Chloridefertilization is one of the efforts to improve the cultivation technique of Salak Sidimpuan so that the production increase is achieved. This study aims to determine the ratio of Nitrogen, Phosphorus and Potassium content leaves of Salak Sidimpuan plants before and after fertilization. This research has been carried out in zalacca planting in Palopat Maria Village, Padangsidimpuan Hutaimbaru Subdistrict, Padangsidimpuan City with altitude of ± 450 m above sea level. This research starts from November 2017 to June 2018. The research method used is survey and experimental methods with purposive sampling technique in determining sample plants. Number of plants sample 60 plants. Data processing was carried out using the Independent Test sample t-test. Based on the results of this study, it was found that the comparison of nitrogen and phosforus content of leaves before and after fertilization-1 was not significantly differenthowever potassium content is significantly different , while the content of nitrogen, phosphorus and potassium content before and after the 2nd fertilization was significantly different. After application of **ammonium sulfateand Potassium Chloride** fertilization was carried out there was an increase in the average production of zalacca by 7.31 kg / plant from which before fertilization was only 4.03 kg / plant.

Keywords: **Leaf Macro Nutrient,Production, Ammonium Sulfate, Potassium, Fertilization and Zalacca**

A. INTRODUCTION

One type of tropical fruit that is quite well known on the island of Sumatra even on the island of Java is Sidimpuan zalacca*(Salacca sumatrana* Becc.) Which is one of the leading commodities of the City of Padangsidimpuan. Zalacca Sidimpuan plant is distributed throughout the districts in the South Tapanuli Regency and at the same time as zalacca Sidimpuan production centers which are more precisely in the districts of Angkola Barat, Angkola Timur and Angkola Selatan. Zalacca Sidimpuan fruit has high water content and sweet, kelat, and tamarind flavor that makes it different from Zalacca Bali and Pondoh from Sleman.

Sidimpuan zalacca plant began to be cultivated since 1930. Sidimpuan zalacca plant is quite potential to be developed in South Tapanuli, has a salak area reaching 13,928 ha with production potential, more or less can reach 340,485 tons / year (BPS Tapanuli Selatan, 2015). Sidimpuan bark type is quite a lot, which is based on fruit character (shape, aroma, taste and color of fruit skin) or the location where zalacca is grown or cultivated. At present there are 3 varieties of salacca according to the decision of the Minister of Agriculture, namely Sidimpuan Merah salak (SK. No.763 / Kpts / TP.240 / 6/99), white Sidimpuan salak (SK. No.764 / Kpts / TP.240 / 6 / 99) and Salak Sibakua (SK. No.427 / Kpts / TP.240 / 7 2002).

Sidimpuan zalacca plant belongs to the same palm family as coconut and oil palm, which has flowering properties throughout the year and should bear fruit throughout the year. However, based on information obtained from Sidimpuan Zalacca farmers, they could no longer harvest all year. Until now, fruit harvesting or production activities can be carried out only twice a year in a year even sometimes only one harvest season. The low productivity and quality of the production of Sidimpuan zalacca plants caused by inadequate cultivation practices are even very simple, among them farmers are very rare and never even at all in fertilizing activities. This is certainly very influential on land fertility and crop productivity. Fertilization that is commonly carried out by farmers is only by using fertilizers derived from organic materials such as midribs and weeds that are in the zalacca cultivation area (Adelina et. al., 2017)

The sustainability of flowering and fruit formation processes on zalacca plants, as well as other plants, is strongly influenced by internal factors such as macro and micro nutrients and growth regulating substances and external factors such as climate, rainfall and plant growing

environment. If the flowering process and fruit formation are disturbed, it is certain that it will greatly affect the level of production of zalacca fruit. One of the cultivation techniques that is very influential on plant growth and development is application of fertilization. Fertilization activities are one of the efforts to meet the needs of macro and micro nutrients for plants. The nutritional status of macro and micro nutrients in plants can be identified through analysis of nutrient content of nutrients in the leaves. Plant tissue analysis, generally is a leaf which is the place where photosynthesis and other metabolic processes are very active. Leaves are also a major place in the storage of carbohydrates and minerals. The nutrients present in the leaves not only contribute to photosynthesis but also represent the status of nutrients in plants. (Susila, et al, 2006).

Ammonium sulfate fertilizer is a type of fertilizer as a source of nitrogen and sulfur for plants. While potassium chloridefertilizer is a source of potassium nutrition. One standard for measuring dose accuracy, type and frequency of fertilization applications. Will be seen in increasing production achievements. While the analysis of leaf nutrient content is an element of reinforcement for the assessment of the accuracy and effectiveness of fertilizer applications that have been carried out on plants.

Based on the background above it is necessary to conduct a Study of Leaf Macronutrients Content and Production as The Influence of Ammonium Sulfate and Potassium Fertilization on Zalacca Plants (*Salacca sumatrana* Becc.). This study aims to compare the nutrient content of macro nutrients (Nitrogen, phosphorus and potassium) and Sidimpuan salak production before and after application of Ammonium sulfate and potassium chloride fertilizers..

B. MATERIALS AND METHODS

This research has been carried out in Palopat Maria Village, Padangsidimpuan Hutaimbaru Subdistrict, with an altitude of ± 450 m (above the sea level)starting in November 2017 – March 2018.

Materials and tools

The materials used in this study were Sidimpuan zalacca plants that were ± 20 years old, ammonium sulfate fertilizer, potassium chloride fertilizer, water, infusion hose.

The tools used in this study were research label boards, buckets, dippers, water taps, pipes, jerry cans, blenders, markers, scales, machetes, hoes, erlenmaye, refractometer (atago IPR 201 model)

Research methods

This study uses a survey method and sample selection based on purposive sampling, which is the technique of determining samples with certain considerations, as has been done in previous studies. The criteria of the sample plants in this study were zalacca plants that were in production.
Analysis of the data used in this study, to determine the ratio of nutrients Nitrogen, Phosphorus and Potassium leaves Sidimpuan zalacca plants before the application of fertilization and after application of fertilization. Furthermore, the results of the analysis data from the laboratory were analyzed using SPSS with the Independent Test sample t-test.

$$= \frac{[M1 - M2] - Mh}{SDbm}$$

Note:
t = r-ratio / t-test / t analysis calculated
M1 = average in group 1 (before fertilization application)
M2 = average in group 2 (after application of fertilization)
Mh = hypothetical mean. In this case the hypothetical mean is 0. Because it is hypotheticallymentioned that the mean between 2 groups is the same / there is no difference.
SDbm = standard error difference in mean the null hypothesis is rejected if the t ratio or the results of the analysis go beyond the critical point (t.> T table), if the nitrogen nutrients and chlorophyll of each leaf at the time before and after fertilization application the null hypothesis is rejected if the p value <alpha is specified
(Sarwono, 2006).

Research Implementation

The implementation of this research has been carried out with the following stages: determination of sample plants with criteria for choosing healthy and productive zalacca plants. Number of sample plants 30. And the number of leaves taken by each sample plant is one leaf of a child located in the middle part of each leaf midrib. Previously, the first fertilization activity was carried out in August 2017 and the second fertilization in November 2018 with the following fertilizer dosage: P1: 250 g ammonium sulfate + 40 g potassium chloride / plant, P2: 300 gammonium sulfate + 40 gpotassium chloride / plant , P3: 350 g ammonium sulfate+ 40 g potassium chloride / plant, P4: 400 g ammonium sulfate + 40 gchloride / plant. Data on nutrient content of nitrogen, phosphorus and leaf potassium before fertilization

have been obtained from Syaldina's (2017) research results.

The activity of analyzing the nitrogen, phosphorus and potassium content of leaves after and before the -1 and 2nd fertilization applications were carried out in the Laboratory of Soil Department, Faculty of Agriculture, Andalas University in December 2017 (after the first fertilization) and March 2018 (after fertilizing - 2). Determination of nitrogen nutrition using wet adhesion with H2SO4. Determination of phosphorus and potassium nutrients using ignorance with HNO3 and HClO4. While harvesting activities carried out during the study lasted 1 time 2 weeks. The last activity is processing and analyzing observational data during the study using the SPSS program with the Independent sample t-test.

C. RESULTS AND DISCUSSION

After analyzing the T sample independent test on the average nitrogen content of the leaves before and after the 1st application of fertilization, the results of the analysis are obtained at the 1st drop below.

Table 1. Results of Independent Sample T Test Analysis of Average Nitrogen Content of LeavesBefore and After 1st Fertilization

Description	Before Fertilization	After Fertilization
Number of Sample Plants (N)	20	20
Average Content Nitrogen Leaves (%)	1,774	1,743
Significance	: 0,681< 0.05 ; (significantly different if the significance <0.05 is not different real if the significance number> from 0.05)	
Comparing Note	**:** 0,126- 0,189 % **: not Significantly**	

Based on Table 1, the results of the analysis of the T test are independent of the sample, the average nitrogen leaf content obtained is almost the same. The average leaf nitrogen content obtained before fertilization was 1.774 ppm while after fertilizing the average nitrogen content of leaves was 1,743 ppm. The significance value obtained was 0.681, whose value was greater than 0.05. This means that before and after the first fertilization, the average nitrogen content of leaves is not significantly different. Based on these results, the effect of fertilizer 1 which has been applied to zalacca plants has not significantly affected the average leaf nitrogen content. It is suspected that this is because zalacca plants are also an annual plant. In general, annual crops if fertilization is carried out, the response of the plants to the fertilization plants will only begin to be seen as early as around 5-6 months after fertilization. Nitrogen nutrient status obtained in this study, after the application of ammonium sulfate and potassium chloride fertilizer has reached enough. According to opinion Adelina, et., al. (2018),the type of fertilizer most needed by salak Sidimpuan, based on the results of thier study is a fertilizer that has nitrogen and potassium nutrients. As stated by Havlin et al. (1999), the adequacy of nitrogen in plant tissues is 1-5%.

Table 2. Results of Independent Sample T Test Analysis Average Nitrogen Content before and after2nd fertilization

Description	Before Fertilization	After Fertilization
Number of Sample Plants (N)	20	20
Average Content Nitrogen Leaves (%)	1,774	2,544
Significance	: 0,000< 0.05 ; (significantly different if the significance <0.05 is not different real if the significance number> from 0.05)	
Comparing Note	**:** 0,996- 0.543 % **: Significantly**	

Based on the results of the analysis of the independent sample t test, the average nitrogen content of the leaves of Sidimpuan zalacca before and after the 2nd fertilization, can be seen in Table 2. The average leaf nitrogen content obtained in these two conditions is significantly different. nitrogen content before the 2nd fertilization is 1,774%. While after the second fertilization, the average average nitrogen content of leaves is 2.544%, a significance value of 0.000 is obtained. This means that the average nitrogen content of leaves before and after fertilization differs significantly. The application of ammonium sulfate fertilizer as a source of nitrogen nutrients for plants, began to show its effect in the form of an increase in leaf nitrogen nutrient content after the 2nd fertilizer application. After the second fertilization, the nitrogen content of the leaves was significantly different between before and after fertilization (table 2). This is because after the 2nd fertilization, the nutrients contained in ammonium sulfate fertilizer can affect the Nitrogen content of the leaves. Nutrients in the decomposition fertilizer gradually on the ground so that the roots are able to absorb nutrients that are given plant fertilizer on plants well. According to Gardner et al (1991).

Table 3. Results of Analysis of Independent

Sample T Tests Average Content Phosphorus Before and After 1 st Fertilization

Description	Before Fertilization	After Fertilization
Number of Sample Plants (N)	20	20
Average Content Phosphor Leaves (%)	0,344	0,336
Significance	: 0,801> 0.05; (significantly different if the significance <0.05 is not different real if the significance number> from 0.05)	
Comparing	**:** 0,060- 0,774 %	
Note	**: not Significantly**	

The results of the analysis of the Independent sample t test in table 3 the mean content of phosphorus leaves Sidimpuan zalacca before and after fertilization to 1, can be seen in table 3. The average content of leaf phosphorus before fertilization - 1 is 0.344% while after fertilization to - 1 average phosphorus content of 0.336%. While the results of the analysis of the Independent sample t test obtained a significance of 0.801, meaning that the average phosphorus content of leaves obtained before and after fertilization - 1 is not significant.

Nutrient absorption is related to metabolic activity which then depends on temperature. Nutrient concentrations in larger soil solutions are often needed to achieve maximum growth rates in cold soil conditions compared to warm soils. This has been proven by the nutrient P, the phosphorus-soluble nutrient in water, it has been known that if the amount of water in the soil decreases, its availability is also reduced (Soemarno, 2010).

Table 4: Results of Analysis of Independent T Testr AverageContent Phosphorus Before and After 2ndFertilization

Description	Before Fertilization	After Fertilization
Number of Sample Plants (N)	**20**	**20**
Average Content Phosphorus Leaves (%)	**0,344**	**0,536**
Significance	: 0,003< 0.05 ; (significantly different if the significance <0.05 is not different real if the significance number> from 0.05)	
Comparing	**:** 0,310- 0,073 %	
Note	**: Significantly**	

Comparison of the phosphorus content of leaves of Sidimpuan zalacca before and after the 2nd fertilization which can be seen in table 4. The average leaf phosphorus content before fertilization was 0.344% and increased after fertilization which reached 0.536%. The results of the analysis of the t test of the independent sample average phosphorus content on the average obtained by the phosphorus content obtained a significance of 0.003. This means that the ratio of the average phosphorus content of leaves before and after fertilization is significantly different. Soemarsono, (2010) states that the temperature usually affects the speed of the soil reaction, the speed of the chemical reaction will increase with increasing temperature. In hot soil it is generally more binding to P when compared to soil in temperate climates. A hot climate can cause the levels of hydrous Al and Fe in the soil to be quite high, so that P is also much bound to this metal.

Phosphorus plays an important role in the process of metabolism and biosynthetic reactions, consequently ADP phosphorylation to ATP will be disrupted if phosphorus is deficient. Likewise potassium, is a silvery-white metal and is not free in nature, this element plays an important role in regulating the metabolic process, strengthening rod tissue and increasing pest resistance (Novizan, 2005).'

Table 5. Results of Analysis of Independent T Test Sample Average Potassium Content Before and After 1 st Fertilization.

Description	Before Fertilization	After Fertilization
Number of Sample Plants (N)	**20**	**20**
Average Content Potassuim Leaves (%)	**0,385**	**0,735**
Significance	: 0,000 <0.05 ;(significantly different if the significance <0.05 is not different real if the significance number> from 0.05)	
Comparing	**:** 0,927- 0,746 %	
Note	**: Significantly**	

Based on Table 1, the analysis of T sample independent test, the average content of potassium obtained obtained has increased from before to after the first fertilization. The average content of potassium obtained before fertilization based on Table 5 is 0.385% and after the first fertilization is 0.735%. The results of the T test analysis are independent of the sample, indicating that the significance value obtained is 0.000 whose value is smaller than 0.05. These results indicate that the average content of potassium before and after the 1st fertilization is significantly different. In the body of the plant potassium is not as a constituent of plant tissue, but has a greater role in the metabolic processes of plants such as activating

enzymes, opening and closing stomata (in the regulation of evaporation and breathing), transport of photosynthetic products (carbohydrates), increasing plant resistance to drought and plant diseases (Hasibuan 2006).

Table 6. Results of Analysis of T Test for Independent Potassium Content Samples Before and After 2 ndFertilization 2

Description	Before Fertilization	After Fertilization
Number of Sample Plants (N)	**20**	**20**
Average Content Potassuim Leaves (%)	**0,437**	**0,707**
Significance	: 0,000<0.05; (significantly different if the significance <0.05 is not different real if the significance number> from 0.05)	
Comparing	**:** 0,390- 0,305 %	
Note	**: Significantly**	

Based on table 6, the average content of potassium before fertilization is 0.437% while after fertilizing the content of potassium leaves has increased to 0.707%. Based on table 1, the results of the T test analysis of independent samples, obtained a significance of 0,000. This means that the average content of potassium leaves before and after fertilization is significantly different. The availability of potassium is potassium that can be exchanged and can be absorbed by plants that depend on additions from the outside, fixation by their own soil and the addition of their own potassium. The availability of potassium nutrients in the soil can be divided into three forms: relative potassium is not available, slow potassium is available, potassium is very available. Potassium is an element of the car so it is easy to experience washing if conditions allow movement. The nature of this K mobility is related to the ease of exchange with other cations and their availability to plants (Hakim, et al, 1986). Even though the potassium chloride fertilizer application is combined with ammonium sulfate fertilizer

Through the application of fertilization in this study, it was already able to increase the leaf potassium content even though, the leaf potassium status below 1-2% was still in the low / low nutrient status. This is in line with Islamy (2010), that the content of potassium salak pondoh leaf and sumedang salak reached 1-2%. Therefore, further research is needed, among others, by increasing the dose of ammonium sulphate andpoassium chloride fertilizers.

In table 7, the following is obtained that the average harvesting weight of zalacca has started to increase from before fertilization with after fertilization, from an average production of 4,370 kg / plant increased to 7,307 kg / plant. There is an increase in the average weight of this production, in line with an increase in the average content of nitogen nutrients, phosphorus and leaf potassium, even though it has not reached the optimal nutrient content status. With the increase in fertilizer dosage or the application frequency of fertilization until it reaches the year, it is assumed that it will be able to obtain improved results both on the leaf nutrient content status as well as the weight of crop production.

Table 7. Production of sidimpuan zalacca plants (kg / sample)

No Sample	WeightBefore Fertilization	WeightAfter Fertilization
1	3.50	8.780
2	4.70	3.477
3	5.20	7.555
4	1.30	5.405
5	4.60	9.479
6	3.80	6.876
7	5.70	6.463
8	4.70	4.796
9	3.80	5.108
10	6.40	15.129
Average	**4.370**	**7.307**

Production levels can be achieved if the existence of limiting factors in the form of internal and external can support the growth and development of plants well. Especially those that are directly related to the results of this study, that an increase in the nutrient content of nitrogen, phosphorus and potassium after application of ammonium sulphate and potassium chloride fertilizer has begun to show its effect in increasing the production weight of Sidimpuan zalacca plants.

Increased nutrient content of nitrogen, phosphorus and potassium leaves as a response to the application of fertilizing ammonium sulfate and potassium chloride showed that the nutrient status of the three nutrients gave the optimum response to the production of Sidimpuan zalacca.

These results are in accordance with the results of research by Liferdi and Poerwanto (2011), that if the leaf nitrogen content is low, plant growth is inhibited or production decreases. Conversely, if the content of high leaf nitrogen means the plant will be able to produce maximum.This is also in accordance with Marschner (1995) which states that phosphorus

affects the formation and development of reproductive organs such as flowers, fruit and seeds. Furthermore, this is also in line with that reported by Safrizal (2014) that the phosphorus content plays an important role in increasing the production of mangis per tree.

D. CONCLUSION

Comparison of nitrogenand phosphorus content of leaves before and after fertilization-1 was not significantly different however potassium content is significantly different. While the content of nitrogen, phosphorus and potassium content before and after the 2nd fertilization was significantly different. after application of ammonium sulfateand potassium chloride fertilization was carried out there was an increase in the average production of zalacca by 7.31 kg / plant from which before fertilization was only 4.03 kg / plant.

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REFERENCES

Adelina, R., Irfan, S.,.Auzar, S., and Warnita. 2017. Study of Cultivation Technique on Salak Sidimpuan (*Salacca sumatrana*Becc.). Grahatani Vol. 03(1): 434-443. Agriculture Faculty. Graha Nusantara University. Padangsidimpuan. [Indonesian]

Adelina,. Irfan, S.,. Auzar, S., and Warnita 2018. Evaluation Nutrients Content in Salak Sidimpuan Leaves (*Salacca sumatrana* Becc.). International Journal of Agriculture Innovations and Research Volume 6, Issue 5, ISSN (Online) 2319-1473.

Mitchell.1991. Cultivating Plant Physiology (Terjemahan). Universitas Indonesia.

Harahap. Y. M. H., Bayu. S. E. dan Siregar. M. A. L., 2013. Morphological identification of Salak Sumatera Utara (*Salacca sumatrana*Becc) atVarious District Regions Tapanuli Selatan. Jurnal Online Vol. 1. No. 3. ISSN. 2337-6597. [Indonesian]

Havlin J. L, Beaton J. D, Tisdale S. M, Nelson W. L. 1999. Soil fertility and fertilizers.6th edition. New Jersey. Prentice Hall. 499p.

Jones, J. B, Wolf, B and Mills, HA 1991, Plant analysis Hanbook, A Pratical sampling, preparation, analysis, and interpretation guide,Micro-macro Publishing, Inc.

Islamy, D.,. 2010.Identification of Nutrient Characteristics of Soil and Plant Nutrients associated with the Sumedang Local Salak Flavor**.** Essay. Bogor Agricultural Institute. Bogor**.** Bogor.

Kaputra, I. 2006. Salak Sidimpuan, It Feels Kelat.Yayasan BITRA Indonesia. Medan

Liferdi, L. dan R. Poerwanto. 2011.Correlation of Nutrient Concentration of Leaf Nitrogen with Soil Chemical Properties and Mangosteen Production. J. Hort. 21 (1): 14-23.[Indonesian]

Liferdi, L.,. R. Poerwanto and Susila A.D. 2009. Determination of nutrient status of nitrogen through leaf tissue analysis in mangosteen (*Garcinia mangostana* L.) plants. Collection of 2009 PERHORTI Scientific Seminar Paper.

Marschner H. 1995. Mineral nutrition of higher plants (Ed). Acad press. San Diego. 889p.

Nazaruddin,Regina Kristiawati,1992.18.Varieties of Salak, Cultivation, Business and Marketing Prospects PT. Penebar Swadaya. Anggota IKAPI.

Novizan, 2005. Effective Fertilization Instructions. Agromedia Pustaka. Jakarta.

Rai, I. N., C. G. A. Semarajaya, I. W. Wiratmaja, 2010. Phenophysiology study of flowering of Salak Gula Pasir as an effort to overcome failure fruit set.J. Hort. 20 (3): 216-222.

Rai, I. N., C. G. A. Semarajaya, I. W. Wiratmaja, 2010.Efforts to Overcome the Fruit-Set Failure by Trimming Trees and Used Flower Bunches to Produce Fruit Salak Gula Pasir (*SalaccaZalacca* Var. Gulapasir) di Luar Musim. Jurnal Hortikultura.

Rukmana, R.2003. Salak: Agribusiness Prospects and Farming Techniques.Kanisius. Bali.

Safrizal. 2007Study of Nitrogen, Phosphorus and Potassium Fertilization in Mangosteen in the Third Year of Production.. Tesis. Agronomy Study Program. Graduate School. Bogor Agricultural Institute.

BPP Iptek (Field of Science and Technology Utilization and Correction,), 2010. Salak. http://www.ristek.go.iddiakses tanggal 20 Februari 2017.

Soemarno, 2010. Nutrient Availability.Accessed Date 27 Juliy2017.

Syaldina, 2017. Comparison of Nitrogen, phosphorus and leaf potassium content in two flowering periods in plants Salak Sidimpuan (*Salacca sumatrana* Becc.).

Skripsi. Faculty of Agriculture. Graha Nusantara University. Padangsidimpuan. [Indonesian]

Team Karya Tani Mandiri (TKTM) 2010. Guidelines for Salak Nusantara.Fruit Cultivation .

Taiz, L. and E. Zeiger. 2002 Plantphysiology. thirdedition.SinauerAssociatiesInc.Publishers. Massachussetts. 690 p.

Unit Pelaksana Teknis-Balai Penyuluh Pertanian (UPT-BPP) Pronojiwo, 2013. Engineering of Simple Technology for the Out-of-Season Salak Fertilization. Retrieved April 13, 2017.

Wijaya, K. 2010. Effect of concentration and frequency of giving organic fertilizer liquid from the results of Anaerobic food waste over the growth of mustard plants. Essay. Department of Biology, Faculty of Mathematics and Natural Sciences, Sebelas Maret University.

Zekri M, Obreza T. 2013. Nitrogen (N), Phosphorus (P) and Potassium (K) for Citrus Trees [Internet]. [12 Juni 2017]. Tersedia pada: http:// edis. ifas. ufl. edu.