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Effect of Applying Several Types of Foliar Fertilizers on Total N and K Levels in Leaves and Production of Apple (Malus sylvestris Mill.) Rome Beauty Varieties in Batu

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ABSTRACT

The aim of this experiment is to compare the effect of foliar fertilizer application with many nutrients (AMIDA, AMIDA+, AJIFOL and BAYFOLAN) and foliar fertilizer with single nutrient (UREA) in the increasing N and K total content of leaf and apple production. The hypotheses are (1) Application of foliar fertilizer with many nutrients having better effect to N and K total content of leaf than foliar fertilizer with single nutrient, (2) Application of foliar fertilizer with many nutrients can increase apple crop product better than foliar fertilizer with single nutrient. The experiment was carried out in the orchard of apples in Batu town from July until December 2006. Soil and leaf analysis was carried out in Soil Chemical Laboratory, Faculty of Agriculture, and University of Brawijaya. Factorial trial was arranged on Randomized Complete Block Design with 3 replications. The treatment is P1=Water, P2=UREA, P3=AJIFOL, P4=AMIDA, P5=AMIDA+ and P6=BAYFOLAN. The result of experiment showed that the application of foliar fertilizer did not give significantly effect to N total content of leaf, K total content of leaf, biomass, fruit diameter, weight and amounts every tree. Application of foliar fertilizer with many nutrients having better effect to N and K total content of leaf and can increase apple crop product than foliar fertilizer with single nutrient. AMIDA+ and AJIFOL foliar fertilizer give biggest fruit diameter (7.2 cm), while the smallest fruit diameter on BAYFOLAN foliar fertilizer (6.7 cm). AJIFOL foliar fertilizer give highest fruit production equal to 59.16 ton/ha, while fruit production lowest on BAYFOLAN treatment equal to 40.42 ton/ha.

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1. INTRODUCTION

Fertilization is a very important factor in plant production. Fertilizer is needed for plants that lack nutrients, especially plants that are on critical land. Soil fertilizer is a substance that is added to the soil to improve the physical, chemical and biological properties of the soil. The materials applied to the soil can vary, for example: manure, green manure, compost, plant ashes, manure or animal excrements, blood meal and factory-made fertilizers (Setyamijaya, 1996).

The use of nitrogen fertilizers for agriculture is increasing every year, so is the price due to reduced fertilizer subsidies. Even at this time with the monetary crisis, fertilizers are increasingly scarce in the market and the price is quite expensive. The most widely used fertilizer by farmers is nitrogen fertilizer because it has a very large effect on plant growth and yield. Nitrogen fertilizers

that are commonly used and often found on the market are UREA and ZA, in addition to compound fertilizers and liquid fertilizers.

In general, farmers apply fertilization through the soil, so that these nutrients are absorbed by plant roots and transformed into materials that are useful for their growth. However, sometimes the soil is unable to provide all the nutrients needed by plants because they are fixed by clay particles or lost from the soil due to washing and evaporation processes.

Raharja (2005) argued, one of the efforts to increase crop production and fertilization efficiency is to use alternative fertilizers according to plant needs and applied by spraying on leaves. Plant nutrient solution can be immediately absorbed by plants when sprayed on the leaves. Some of the nutrients that are effectively sprayed on the leaves are N, P, K, S, Ca, and Mg, as well as micronutrients.

AMIDA, AMIDA+ and AJIFOL are one of the types of cypramine (a by-product of the Monosodium Glutamate (MSG) industry of PT. Ajinomoto contains relatively high levels of nitrogen (± 10%), so AMIDA, AMIDA+ and AJIFOL fertilizers can be used as nitrogen fertilizers. AMIDA+ and AJIFOL are organic fertilizers that contain essential macro and micro nutrients such as N, P, K, Ca, Mg, S, Mn, Cu, Zn, Fe, Cl, Mo and B.

Batu area is one of the centers of apple production in East Java. Several apple varieties that are widely cultivated in this area are Manalagi (yellow apple) and Rome Beauty (red apple). However, from 1998 until now apple production has decreased. One tree that used to produce one quintal of fruit, now has a maximum of 20 kilograms of fruit (Ariyanto, 2003). One of the factors affecting the decline in apple production is the availability of nutrients needed by plants. Apple plants absorb nitrogen and potassium in nearly the same amount with the ratio K:N = 1:1.05 (Soemarno, 1993). The element nitrogen plays a role in the process of plant growth, among others for the formation and enlargement of stems and the formation and expansion of leaves. Meanwhile, the element potassium plays a role in the process of photosynthesis and improves the quality of the fruit of the apple plant. Efforts to meet the nutrient needs of apple plants can be done by fertilizing the leaves. The apple variety used in the study was Rome Beauty because the fruit harvest period is relatively short.

2. METHOD

2.1 Place and time

The research was conducted in Mr. Haryono's garden, Tulungrejo Village, Bumiaji District, Batu City. The research was carried out during the dry season, from July to December 2006. Laboratory analysis was carried out at the Soil Chemistry Laboratory, Soil Department, Faculty of Agriculture, Brawijaya University, Malang.

2.2 Tools and materials

Leaf sampling was carried out using scissors, plastic buckets, paper bags. Equipment for applying foliar fertilizers includes: measuring cups, jerry cans, tree sprayers and plastic tree covers. While other equipment, namely: ruler, fruit scales and analytical scales.

The apple plants of the Rome Beauty variety used in the study were on average 17 years old, with a spacing of ± 2 x 2 meters. The fertilizers used are: UREA, AJIFOL, AMIDA, AMIDA+, BAYFOLAN, goat manure, SP-36, KCl and Dolomite.

2.3 Research methods

This study was arranged based on a randomized block design (RBD) using 6 treatment combinations, namely P1 (water, 38,750 l ha-1), P2 (UREA (3 mg l-1 water, dose 116.25 g ha-1), P3 (AJIFOL (3 mg l-1 water), dose 116.25 g ha-1), P4 (AMIDA (3 mg l-1 water), dose 116.25 g ha-1), P5 (AMIDA+ (3 mg l- 1 water), dose 116.25 g ha-1), P6 (BAYFOLAN (3 mg l-1 water), dose 116.25 g ha-1) with 3 replications and each treatment consisted of 2 plants, so there were 36 sample tree.

2.4 Observation Parameters

Leaf samples were analyzed in the laboratory according to the observed parameters, namely: N total leaves, K total leaves, number of fruit per tree, fruit weight per tree, fruit diameter and leaf biomass weight.

2.5 Implementation Procedure

This research started with plant selection, preliminary soil analysis, harvesting, fertilizer application, maintenance, harvesting, post-harvest to observation.

2.6 Data analysis

The statistical analysis used was RAK analysis of variance using the F test (5%) to determine the difference in effect between treatments. If there is a difference, continue with Duncan's test at the 5% level. Correlation test is used to determine the closeness of the relationship between parameters. Data is processed using a computer application with Microsoft Excel 2003 and SPSS 11 auxiliary programs.

3. RESULTS AND DISCUSSION

3.1 Research result

3.1.1 The Effect of Foliar Fertilizer on Total N and K Levels of Leaves

a. Leaf Total N Content

Based on the results of the analysis of variance, it was shown that the application of several types of foliar fertilizers did not have a significant effect on the total N content of the leaves at 8 WAP observations (Sunday after treatment) and 16 WAP.

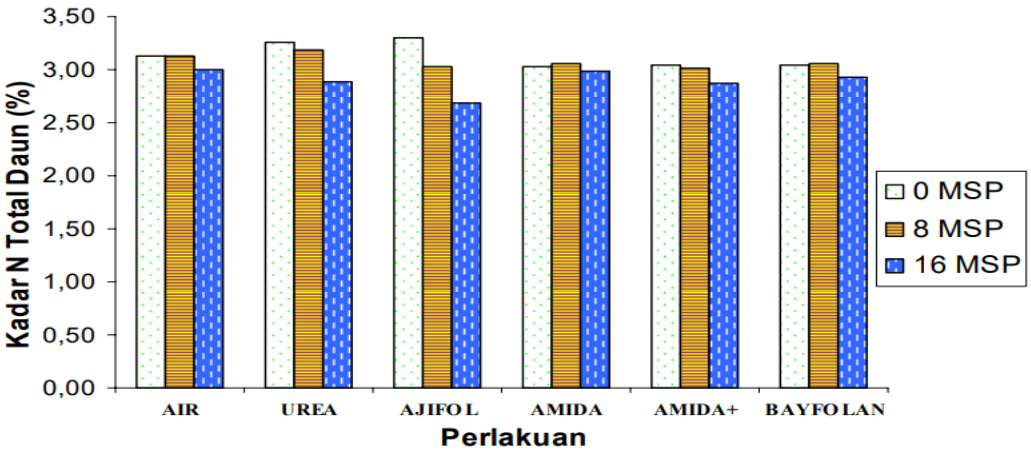

Figure 1. Average Leaf Total N Content in Various Foliar Fertilizer Treatments

In the observation of 8 MSP the highest total N leaf content was found in the UREA treatment with a value of 3.18%, while the lowest was in the AJIFOL treatment with a value of 3.01%. At 16 MSP observations (at harvest) the total N content of the leaves sequentially from the highest to the lowest value was the AIR>AMIDA>BAYFOLAN>UREA>AMIDA+>AJIFOL treatment (Appendix 7). The highest total leaf N content was found in the AIR treatment with a value of 3.01% and the lowest in the AJIFOL treatment with a value of 2.68%.

b. Total K Content of Leaves

The results of the analysis of variance showed that the application of several types of foliar fertilizers had no significant effect on the total leaf K content, both at 8 WAP and 16 MSP observations.

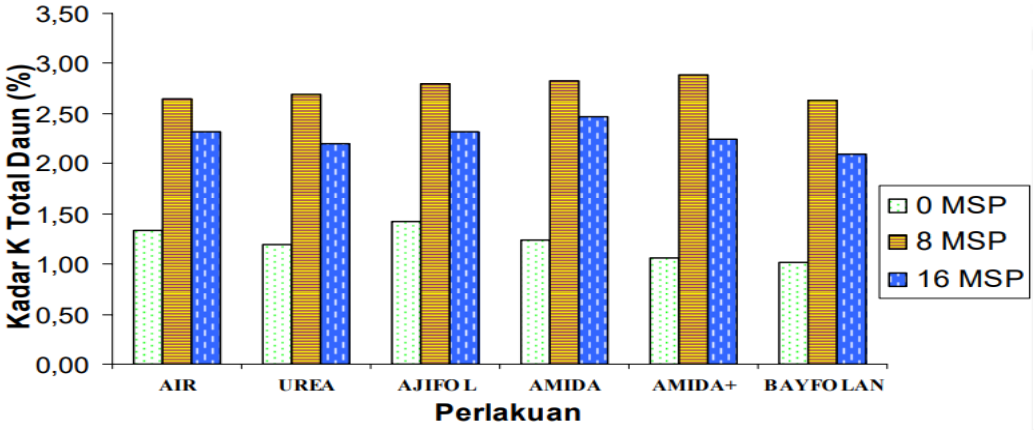

Figure 2. Average Total K Levels of Leaves on Various Foliar Fertilizer Treatments

In the observation of 8 MSP the highest total leaf K content was found in the AMIDA+ treatment with a value of 2.89%, while the lowest was in the AIR treatment with a value of 2.64%. In the observation of 16 MSP (at harvest) the total K content of the leaves sequentially from the highest to the lowest value, namely the AMIDA> AJIFOL> WATER> AMIDA+>UREA> BAYFOLAN treatment (Appendix 7). The highest total leaf K content was found in the AMIDA treatment with a value of 2.47% and the lowest in the BAYFOLAN treatment with a value of 2.09%.

3.1.2 Effect of Foliar Fertilizer Application on Leaf Biomass Weight, Fruit Diameter and Fruit Production

a. Leaf Biomass Weight

Based on the results of the analysis of variance showed that the application of several types of foliar fertilizers did not have a significant effect on the weight of leaf biomass.

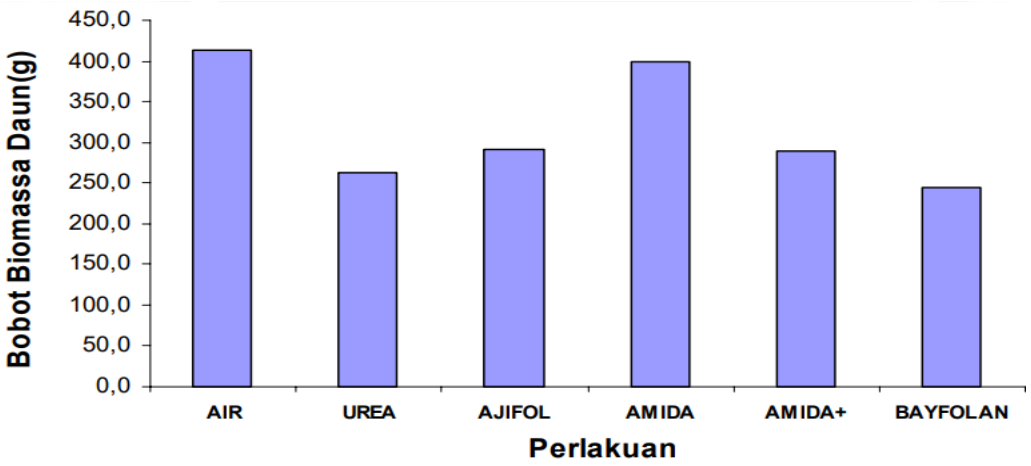

Figure 3. Average Weight of Leaf Biomass in Various Foliar Fertilizer Treatments

The results showed that leaf biomass weight sequentially from the largest to the smallest value was in the WATER>AMIDA>AJIFOL>AMIDA+>UREA>BAYFOLAN treatment. The highest leaf biomass weight was obtained in the AIR treatment with a weight of 413.30 g, while the lowest leaf biomass weight was obtained in the BAYFOLAN treatment with a weight of 245.00 g. The high weight value of leaf biomass in the AIR treatment was due to the accumulation of nitrogen in the leaf tissue, which was 3.01%, while in the Bayfolan treatment it was 2.93%.

b. Fruit Diameter

Based on the results of the analysis of variance, it was shown that the application of several types of foliar fertilizers did not have a significant effect on fruit diameter, both at 8 MSP, 12 MSP and 16 MSP observations.

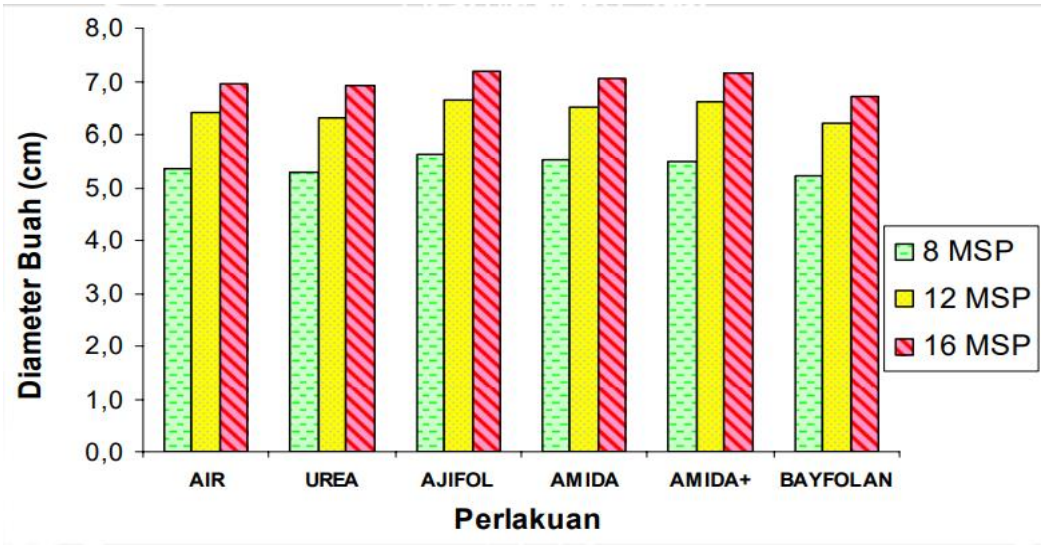

Figure 4. Average Fruit Diameter on Various Foliar Fertilizer Treatments

The results showed that all treatments experienced an increase in fruit diameter with increasing time. At all observation times, both the 8 MSP, 12 MSP and 16 MSP observations showed fruit diameter patterns sequentially from the largest to the smallest value, namely AMIDA+=AJIFOL>AMIDA>UREA>AIR>BAYFOLAN. The largest average fruit diameter was found in the AMIDA+ and AJIFOL treatments, namely 8 27 MSP = 5.6 cm, 12 MSP = 6.6 cm and 16 MSP = 7.2 cm. While the smallest average fruit diameter was found in the BAYFOLAN treatment, namely 8 MSP = 5.2 cm, 12 MSP = 6.2 cm and 16 MSP = 6.7 cm.

c. Number of Fruits

Based on the results of the analysis of variance, it was shown that the application of several types of fertilizers did not have a significant effect on the number of fruits per tree.

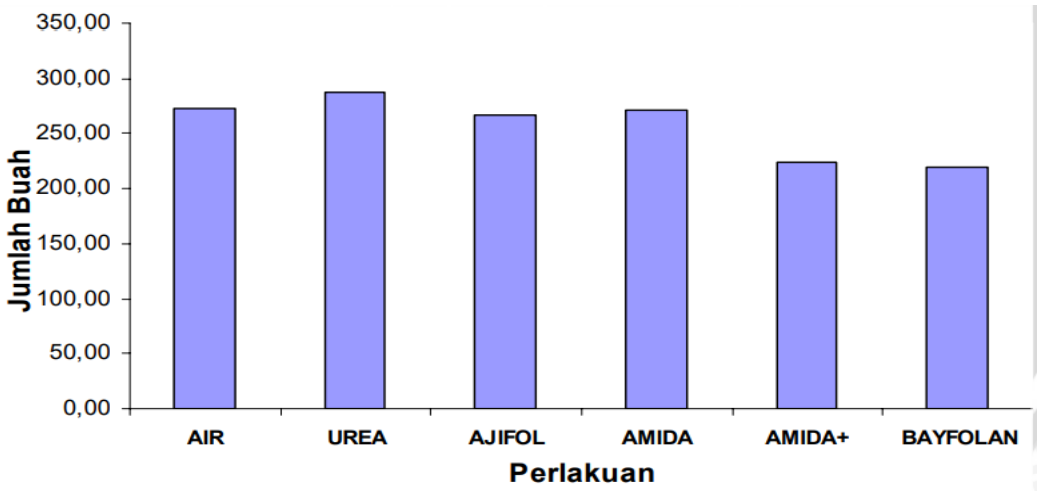

Figure 5. Average Number of Fruits per Tree on Various Foliar Fertilizer Treatments

The results showed that the number of fruits sequentially from the highest value to the lowest was in the UREA>AIR>AMIDA>AJIFOL>AMIDA+>BAYFOLAN treatment. The highest number of fruits was obtained in the UREA treatment with 288 seeds, while the lowest number of fruits were obtained in the BAYFOLAN treatment with 219 29 seeds. The average value of the number of fruits per tree in all treatments showed almost the same value, between 219–288 seeds and was not significantly different. This is because foliar fertilizers are started to be given to plants after the growth period of flowers becomes fruit. The period of growth of flowers into fruit determines the number of fruits per tree (Notodimedjo, 1995).

d. Fruit Weight

The results of the analysis of variance showed that the application of several types of foliar fertilizers had no significant effect on fruit weight per tree.

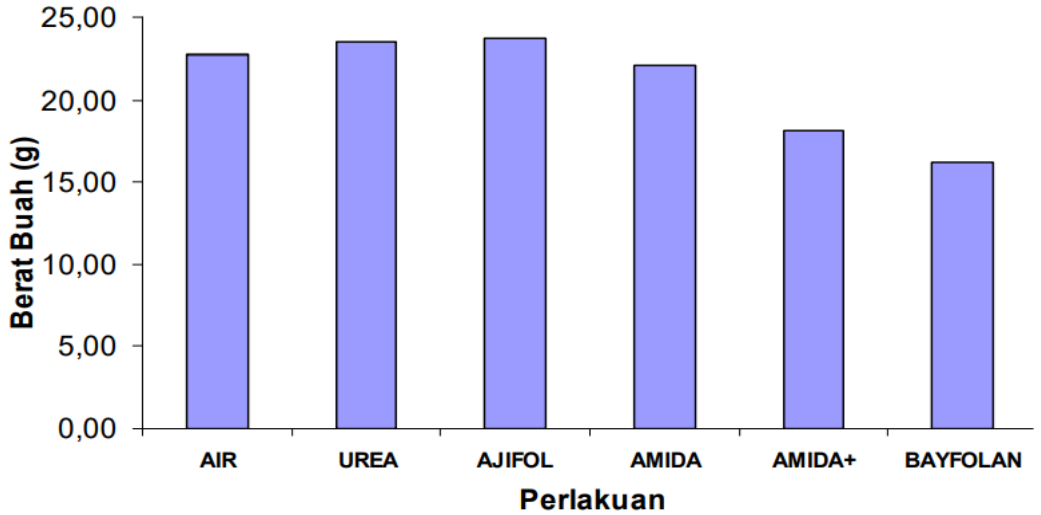

Figure 6. Average Fruit Weight per Tree on Various Foliar Fertilizer Treatments

The results showed that the fruit weight per tree sequentially from the largest to the smallest value was in the AJIFOL>UREA>WATER>AMIDA>AMIDA+>BAYFOLAN treatment. The highest fruit weight value was obtained in the AJIFOL treatment with a weight of 23.67 kg, while the lowest fruit weight was obtained in the BAYFOLAN treatment with a weight of 16.17 kg.

3.2 Discussion

Observations showed that all treatments experienced a decrease in total N content of leaves over time. This is because the nitrogen element is used by plants in the growth process, which is translocated from the leaves to all parts of the plant body that need it. Tisdale and Nelson (in Suwarsono, 1977) explained that the element nitrogen is needed as a constituent of amino acids, nucleic acids and energy transfer materials. It is also used for the formation of new cells including the elongation and enlargement of stems as well as the formation and expansion of leaves.

The total N content of the leaves in the WATER treatment had the highest value because the application of water to the leaves could increase the photosynthetic process. In the process of photosynthesis, carbon dioxide, water and sunlight are needed to produce sugar and oxygen. The process of photosynthesis encourages the absorption of soil nutrients through the roots, woody shoots and finally to the leaves (Salisbury and Ross, 1995). The high rate of photosynthesis process increases the nitrogen content in the leaves. The element nitrogen in leaves cannot be utilized in the process of plant growth, due to the lack of availability of other nutrients such as phosphorus. Phosphorus acts as a basic constituent of proteins, polysaccharides, fats and nucleic acids (Novizan, 2002). In Andisol soils in the Batu area, even though the soil P content is very high, but not available to plants because the soil is acidic which may contain Fe and Al. As a result, nitrogen accumulates in the leaves and is used for leaf growth. This can be seen in the leaf biomass of the WATER treatment which was higher than the foliar fertilizer treatment.

The total N content of the leaves in all treatments did not show a significant difference. The causative factors include the effect of the application of manure given in the previous harvest season, in the initial fertilization and follow-up fertilization. Dong et al. (2002), explained that the amount of total N content in plants partly comes from N fertilization in the previous harvest season. So that at all times of observation the total N content of the leaves was in the range above normal with no significant difference. Manure decomposes until nitrogen mineralization occurs. The soil at the study site had a low C/N ratio and moderate total soil N content, namely 9.10 and 0.39%. Hakim et al. (1986) explained that an advanced decomposition of organic matter is characterized by a low C/N, while a high C/N indicates an incipient decomposition.

The results showed that there was an increase in total K levels in the leaves at 8 WAP observations and then decreased at 16 MSP observations. Application of foliar fertilizer can increase the total K content of leaves. Hardjowigeno (1992), explained that the advantage of foliar fertilization is the fast absorption of nutrients (through the mouth of the leaf), so that the effect on plants can be seen quickly. Meanwhile, at the end of the observation, the total K content of the leaves decreased due to translocation of nutrients from the leaves to the fruit Cohen, 1976 (in Soemarno, 1993).

The total K content of the leaves is caused by the "dilution effect". The amount of foliar fertilizer sprayed on the plants is the same measure. However, leaf growth is not the same for each plant, so plants with a large amount of leaf biomass will receive a large amount of fertilizer, while plants with a low leaf biomass will receive a small amount of foliar fertilizer. This was known from the weight of leaf biomass in the AMIDA treatment of 398.30 g, while in the BAYFOLAN treatment it was 245.00 g.

Tisdale and Nelson, 1999 (in Suwarsono, 1977) explained that nitrogen is the initial form of plant components, part of 26 protein molecules, enzymes, chlorophyll, protoplasm, amino acids, nucleids and alkaloids. Nitrogen gives green color to leaves, accelerates growth and increases leaf area. Cheng and Fuchigami (2002), also stated that about 50% of nitrogen from plant tissue is used for the growth of new leaves and shoots.

The research results of Smid and Peaslee, 1977 (in Soemarno, 1993) show that the provision of potassium nutrients can increase the process of photosynthesis in conditions of high light intensity, in the end the end result of the photosynthesis process can increase the growth of storage organs (fruit). Poerwowidodo, (1993) also suggested that potassium plays a role in photosynthate transfer. Photosynthate as a result of the photosynthesis process will be translocated from the leaves to other parts of the plant body, either for use or stored in the fruit. Potassium deficient plants will experience translocation system disorders. This will reduce the rate

of photosynthesis due to the accumulation of photosynthates in the leaves or because of the slow development of existing energy storage parts.

Apple production in this study showed higher production than the production produced by farmers. The highest apple production was found in the AJIFOL treatment with an average fruit weight per tree of 23.67 kg and a production per hectare of 59.16 tons. While the lowest production yield was in the BAYFOLAN treatment with an average fruit weight per tree of 16.17 kg and a production per hectare of 40.42 tonnes. Based on data from Dewi's research (2005), the average apple production in the Tulungrejo area is 12 kg per tree and the average production per hectare is 30 tons.

4. CONCLUSION

Based on the research objectives and the results of the discussion, several conclusions can be drawn as follows: The application of foliar fertilizers did not significantly affect the content of total leaf N, total leaf K, leaf biomass weight, fruit diameter, fruit weight per tree and number of fruit per tree. Application of compound leaf fertilizer has a better effect on total N and K levels in leaves and can increase apple production compared to single leaf fertilizer. AMIDA+ and AJIFOL foliar fertilizers gave the largest fruit diameter with a size of 7.2 cm, while the smallest fruit diameter was found in the BAYFOLAN foliar fertilizer treatment with a size of 6.7 cm. AJIFOL foliar fertilizer gave the highest average fruit production of 59.16 tons/ha, while the lowest average fruit production was in the BAYFOLAN foliar fertilizer treatment of 40.42 tons/ha.

ACKNOWLEDGEMENTS

The suggestions given in this study are: It is necessary to conduct further research on the effect of plant micro-nutrient levels on apple crop production. AJIFOL, AMIDA, and AMIDA+ can be used as substitutes for nitrogen fertilizers other than UREA and BAYFOLAN when applied as foliar fertilizers.

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