Bangladesh J. Bot. **46**(1): 489-495, 2017 (March) supplementary

EFFECTS OF DIFFERENT TYPE OF FERTILIZERS ON GROWTH AND PHYSIOLOGY OF MD2 PINEAPPLE

SITI ZAHARAH SAKIMIN*, MOHD NOR GHANI ABU SAMAH, ABDUL SHUKOR JURAIMI, MD AMIRUL ALAM[1] AND FARZAD ASLANI

Department of Crop Science, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

Keywords: Pineapple, Fertilizer, Field experiment, Physiological parameters

Abstract

Study was conducted to evaluate the effects of two types of fertilizers (SRI and Kamila) on growth and physiological changes of MD2 pineapple. Results showed significant changes to the growth of the MD2 pineapple due to either use of soil with NPK or in combination. Application of NPK and SRI fertilizers showed the best performance on plant height and width from beginning until 10 weeks after treatment (WAT) while for leaf length fertilizer-Kamila combination showed the best performance until 10 WAT. Equally for the chlorophyll content, the treatment Kamila also showed the best performance at 6 MAT. Analysis of leaf of the pineapple plant showed that there was a decrease in nutrient content of most the elements in 3 MAT. But for nutrient analysis of soil, the outcomes showed that at 3 MAT the nutrients content increased especially in treatment of Kamila fertilizer combination. The nutrient contents of most of the elements were also very low from what has been expected, but the result of nutrient content in soil treated with Kamila - a controlled-release fertilizer showed a good result. Addition of controlled release fertilizer (Kamila) with SRI formulation showed positive improvement in the plant growth of pineapple variety MD2 compared to the plants without SRI formulation.

Introduction

Pineapples fruit (*Anana scomosus* [L.] Merr.) is a member of the Bromeliaceae family, growing in several tropical countries such as Hawaii, Indonesia, Malaysia, Philippines and Thailand. Pineapple has been recognized as the most economically important crop in tropical countries; however our major concern is on the excessive use of chemical fertilizers. This situation has raised the environmental problem issues in the producing countries (Syed 2009).

Commonly, urban community demands safer foods supply free from any of chemical used. Pineapple crops require relatively higher amount of chemical fertilizers to increase its growth rate and fruit quality. This issue must be handled strictly so that farmers may not use excessive chemical fertilizers on this crop (Obiefuna 1987). However, lack of study in our tropical pineapple fruit makes us unable to compete with other producing countries in terms of information and technological development in this field. The finding in the growth and physiology changes of MD2 varieties on different type of fertilizers application may provide additional information into the technology development in Malaysian pineapple industry. Thus, this study was taken into account to evaluate the influence of different types of fertilizers (TR) on growth and physiological changes of MD2 pineapple and to recommend the types of fertilizers that show good performance to MD2 pineapple crops.

*Author for correspondence: <sitizaharah.sakimin@gmail.com>. [1]School of Agriculture Science and Biotechnology, Faculty of Bioresources and Food Industry, Universiti Sultan Zainal Abidin,Tembila Campus, 22200 Besut, Terengganu, Malaysia.

Materials and Methods

An experiment was conducted in open field condition in Faculty of Agriculture, Universiti Putra Malaysia (UPM) consisting of four treatments either sole application or in combination including NPK (control) (T1), NPK + SRI (T2), Kamila (T3), Kamila + SRI (T4) arranged in CRD with three replications (40 pineapple plants per replication). A total of 480 plants were used in this study.

Method of application was different according to the different types of fertilizer used. The NPK and Kamila fertilizers used were in the form of granular and pellet, respectively. NPK at the rate of 200 kg/ha/year of N, 50 kg/ha/year of P, and 200 kg/ha/year of K (Obiefuna 1987) were used. Kamila fertilizers at amount of 3 pieces of nuggets were applied based on localized placement. The fertilizers (NPK and Kamila) were placed in between the rows of the pineapple plant at every two months interval.

For the SRI treatment, stock solution of SRI (6 ml/l) was diluted into water and sprayed at weekly basis to the whole pineapple leaves.

Growth analysis was measured from five samples selected randomly, for each treatment. Samples were analyzed for length of leaf, width of leaf, and height of plant by using hand ruler. All the data collected for growth analysis were expressed in centimeter (cm). The data were collected for every two weeks interval.

Each sample was soaked in 80% acetone solution and keep in dark for a week, then analyzed by using UV-Scanning Spectrophotometer (Shimadzu UV-3101PC). Every time of sampling, a total of 12 samples were used to analyse chlorophyll content.

For leaf and soil nutrient analyze, three samples from every treatment were randomly collected from experimental plot. The amount of 0.5 grams of each sample was put into a digestion tube. Five ml concentrated sulfuric acid (H_2SO_4) was added and the tube rotated until all the plant material and soil samples were moistened. The samples were allowed to stand overnight and heated up in the digestion block to 285°C. Then, 2 ml of 50% hydrogen peroxide (H_2O_2) was slowly added down to the sides of the tube while rotating it. The reaction was allowed to subside and then the tubes were placed into a port in the digestion block. The digestion tube then removed from the block and let it cool. Slowly 2 ml of 50% H_2O_2 was added and the tubes placed back into the digestion block. The heating process was continued for 45 minutes until the content became clear colour or colorless. If it is not clear, repeat adding 2 ml of 50% H_2O_2 and repeat the heating again. Allow cooling then diluting and filtering the digest with distilled water and made up to 100 ml in plastic vial for analysis. Nutrient element viz. N and P were determined using the Auto analyser (AA3 Bran + Luebbe). While K, Ca and Mg were determined by using Atomic Absorption Spectrophotometer (Perkin Elemer Model 310).

Three samples for each treatment were collected randomly. Ten gram of each sample was added to 100 ml of distilled water (1 : 10 v/v) prior to place on shaker for 30 min and incubated for 24 hrs. Acidity was determined using a pH meter (Orion 410A, Beverly, USA).

All statistical analyses were carried out by using Statistical System Software (SAS) version 9.1. All means were analyzed using one-way ANOVA followed by LSD test at 5% significant level for comparison between treatments.

Results and Discussion

ANOVA showed that there were no significant ($p \geq 0.05$) differences for the interaction between type of fertilizers and week after treatment (WAT). Data analysis showed that pineapple plant treated with different types of fertilizer had significant difference ($p \leq 0.05$) on plant height,

leaf length, plant width and chlorophyll content of pineapple (Figs 1-5) over weeks after treatment (WAT). However, if the supply of that limiting nutrient is increased even slightly, the resulting increase in growth will increase the demand for all other nutrients (Berry 2010).

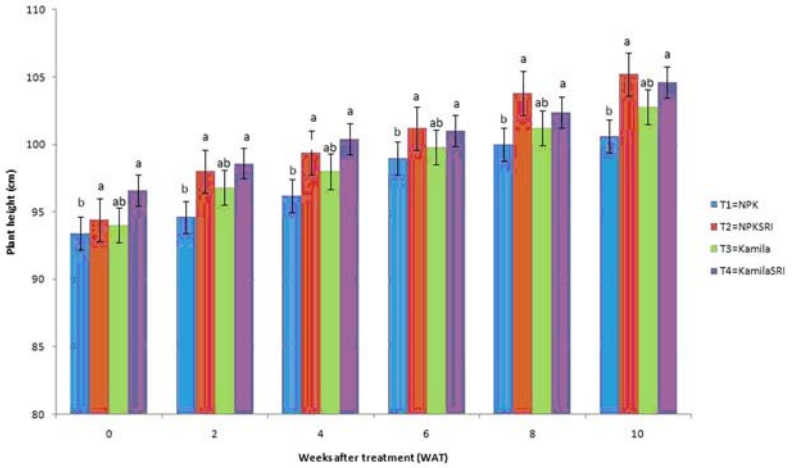

Fig. 1. Influence of different TF on pineapple plant height during 0, 2, 4, 6, 8 and 10 WAT. Vertical bar represents standard error (SE) of mean and invisible when the values are smaller than the symbol.

Result of leaf length of pineapple shows the highest and the lowest mean of leaf length accounting 85.4 cm and 80 cm grown in T4 and T3, respectively. No significant difference was observed on leaf length between T1, T2 and T3 at 0 WAT as influenced by different type of fertilizers. Foliar application of fertilizers can increase the nutrient uptake by the plant thus successfully obtain the better growth and yield (Zhao 2009).

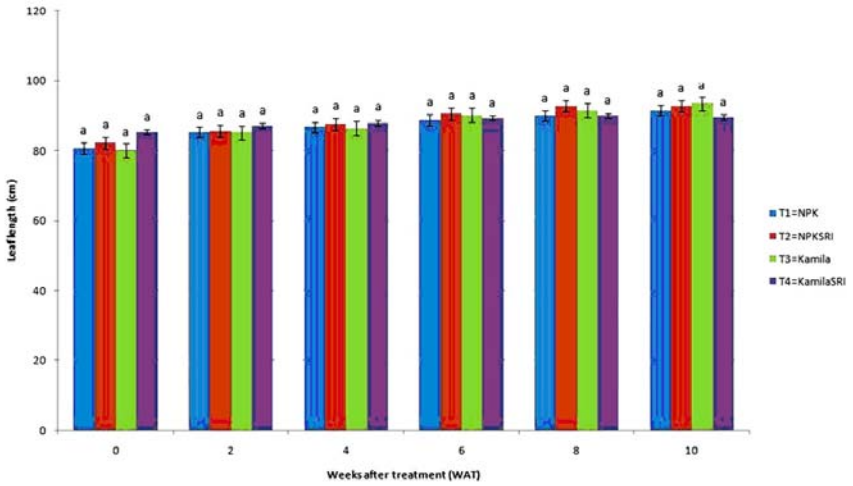

Fig. 2. Influence of different TF on pineapple leaf length during 0, 2, 4, 6, 8 and 10 WAT. Vertical bar represents standard error (SE) of mean and invisible when the values are smaller than the symbol.

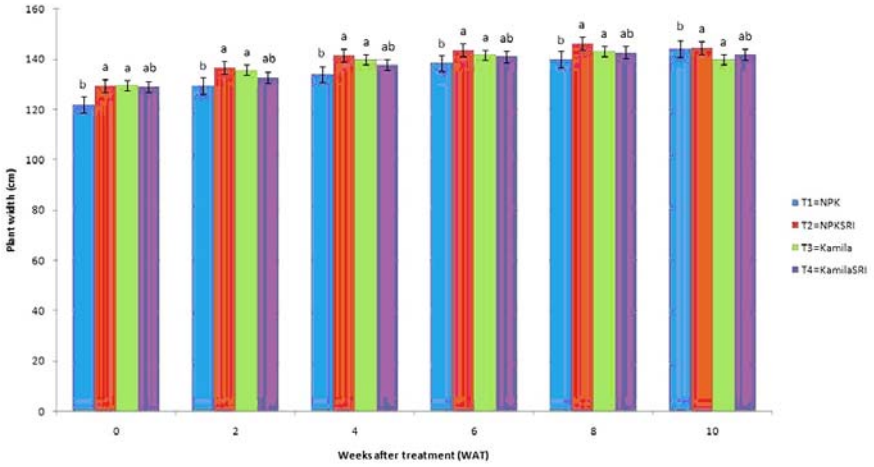

Fig. 3. Influence of different TF on pineapple plant width on 0, 2, 4, 6, 8 and 10 WAT. Vertical bar represents standard error (SE) of mean and invisible when the values are smaller than the symbol.

Result of pineapple plant width on initial data collection (Day 0) shows that the highest and the lowest mean of plant width were in T3 and T1 with the value of 129.6 cm and 122 cm, respectively. No significant difference was observed on pineapple plant width between T1, T2 and T4 at 0 WAT (Fig. 3).

Fig. 4 shows the influence of different type of fertilizers in chlorophyll content of pineapple plant. Nitrogen enhances vegetative growth by increasing cell division, leading to increased leaf numbers, stem elongation, branching, and flowering. Plants with adequate nitrogen look healthy and deep green (Osman 2013).

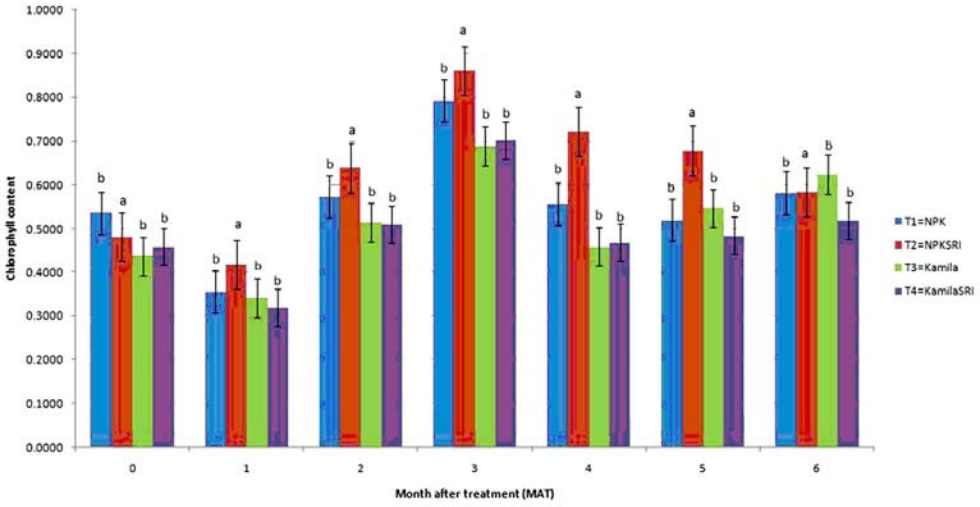

Fig. 4. Influence of different TF on chlorophyll content in pineapple leaf during 0 to 6 MAT. Vertical bar represents standard error (SE) of mean and invisible when the values are smaller than the symbol.

ANOVA showed no significant differences ($p \geq 0.05$) between type of fertilizers (TF) and the interaction between type of fertilizers and MAT nitrogen (N), phosphorus (P), potassium (K) content in pineapple leaf. Fig. 7 showed the influence of different type of fertilizer on N content of pineapple leaf from 0, 3 and 6 MAT.

The results indicate that the nitrogen content was of highest value in treatment, receiving NPK fertilizer and SRI formulation at 3 and 6 MAT compared to other treatments. This probably due to the fast-release fertilizer (NPK) applied to the soil. NPK provided easily nutrients compared to controlled-release fertilizer (Kamila). This supports that the SRI formulation enhanced nutrients uptake by the roots. In regard to the nutrient content, it can be interfered that soil nitrogen fertilization and foliar urea applications increased the content of almost all nutrients in leaves (Zhao 2009).

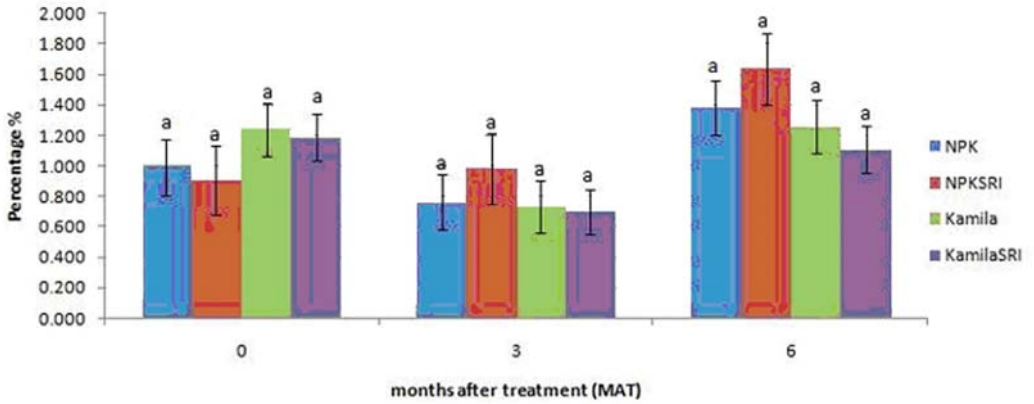

Fig. 5. Influence of different TF on N content on 0, 3 and 6 MAT. Vertical bar represents standard error (SE) of mean and invisible when the values are smaller than the symbol.

Table 1. Influence of different type of fertilizers on P content at 0, 3 and 6 MAT.

Treatments	P content (%)		
	Month 0	Month 3	Month 6
T1	0.012	0.006	0.078
T2	0.015	0.004	0.023
T3	0.012	0.013	0.016
T4	0.013	0.012	0.006
LSD ($p \leq 0.05$)	NS	NS	NS

Table 1 shows that at 0 MAT, the P content in leaf tissue was higher (1.25-folds) in T2 than in T1 and T3. The P content in the leaves was very low than expected. This probably due to leaching of the nutrients in the soil caused by the heavy fall rain. This possibly caused by the early stunted growth of the pineapple plant in the field.

Fig. 6 shows that at 0 MAT, the K content in pineapple leaf was 3.32% higher in treatment T4 and was higher than T2 (2.58%). The K content in pineapple leaves were higher than N and P contents. This maybe caused by the readily available potassium in the soil but still lower than expected K content. Morton (1987) stated that addition of more potassium than optimum level was apparently of no advantage to the plant.

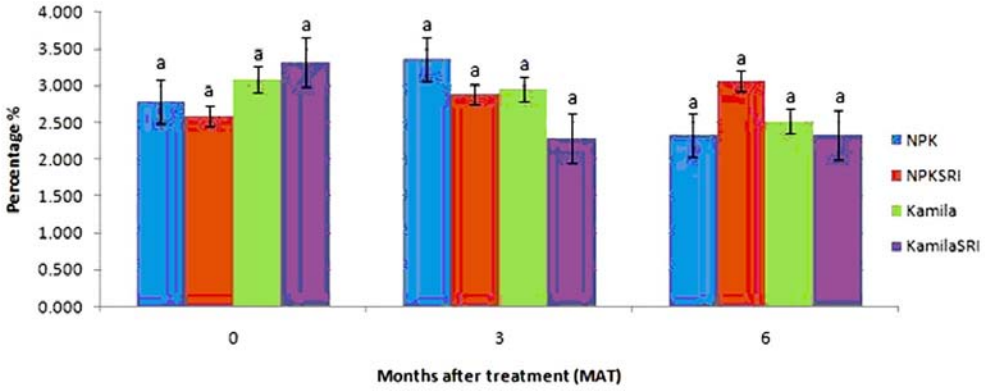

Fig. 6. Influence of different TF on K content at 0, 3 and 6 MAT. Vertical bar represents standard error (SE) of mean and invisible when the values are smaller than the symbol.

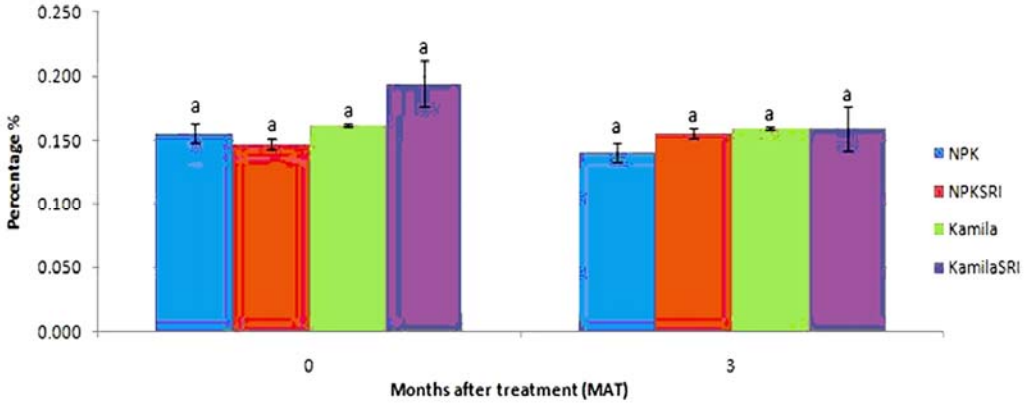

Fig. 7. Influence of different type of fertilizers on N content at 0 to 3 MAT. Vertical bar represents standard error (SE) of mean and invisible when the values are smaller than the symbol.

Nutrient analysis in soil: Result on influence of the different type of fertilizers on the N content in soil at 0 and 3 MAT was measured (Fig. 7). Fig. 7 shows that the highest mean of N content at 0 MAT was in treatment T4 (0.19%) and the lowest mean was in treatment T2 (0.15%). The ANOVA table also indicated that there were no significant differences between the treatments applied on the N content in soil.

ANOVA table proved that there was no significant difference as influenced by different type of fertilizers on P content in soil. Table 2 shows that the highest mean of P content at 0 MAT was 0.009% at T4 compared to other treatments applied. While at 3 MAT the T1 showed the highest mean of P content (0.021%). This also shows that the application of different TF does not have any effects on the P content of soil.

Table 2. Influence of different TF on phosphorus content at 0 to 3 MAT.

Treatments	P content (%)	
	Month 0	Month 3
T1	0.005	0.021
T2	0.000	0.000
T3	0.001	0.000
T4	0.009	0.000
LSD ($p \leq 0.05$)	NS	NS

Table 3. Influence of different TF on K content at 0 to 3 MAT.

Treatments	K content (%)	
	Month 0	Month 3
T1	0.000	0.095
T2	0.043	0.100
T3	0.093	0.181
T4	0.171	0.046
LSD ($p \leq 0.05$)	NS	NS

ANOVA table showed that no significant differences on K content in soil was observed as influenced by different type of fertilizers. Table 3 shows the highest mean of K content in treatment T4 (0.17%) at 0 MAT. While at 3 MAT, it shows the highest mean, 0.18% for treatment T3. It shows that different type of fertilizers does not have any effects on K content of soil.

In conclusion, it can be assessed that the combination of NPK and SRI fertilizers showed the best performance on the growth of pineapple plants from beginning until 10 week after treatment (WAT) while for leaf length controlled release fertilizer Kamila showed the best performance until 10 WAT.

References

Berry W 2010. Symptoms of Deficiency in Essential Minerals Plant Physiology (5 ed.): Sinauer Associates, Inc.

Obiefuna JC, Majumder PK and Ucheagwu AC 1987. Fertilizer rates for increased pineapple production in the tropical ferrallitic soils of south western Nigeria. Fertilizer Research. **12**: 99-105.

Morton J 1987. Papaya. In: Fruits of warm climates. Julia F. Morton, Miami, pp. 336-346.

Osman, KT 2013. Soils: Principles, Properties and Management. Springer, Dordrecht. http://dx.doi.org/10.1007/978-94-007-5663-2

Syed Omar SR 2009. Soil Science Department, Universiti Putra Malaysia, Serdang, Selangor.

Zhao LM, Wu LH, Li YS, Lu XH, Zhu DF and Uphoff N 2009. Influence of the system of rice intensification on rice yields and nitrogen and water use efficiency with different application rates. Experimental Agric. **45**: 275-286.

(Manuscript received on 19 January, 2017; revised on 23 February, 2017)