Effect of Nitrogen Phosphorus and Potassium Fertilization on Sago Growth

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Abstract

Fertilization is an important act of cultivation in an effort to provide plant nutrients to increase sago crop productivity. This research aimed to study the effect of nitrogen, phosphorus and potassium fertilizers towards the growth of sago palm. The study included three separate experiments i.e. experimental fertilization of nitrogen, phosphorus and potassium. The experiment was conducted by using a randomized block design (RBD) consisting of four levels of treatments and each treatment was repeated 3 times. The four levels of treatment were respectively nitrogen fertilization experiment consisting of 0, 405, 810, and 1215 g clump-1. Phosphorus fertilization experiment consisting of 0, 216, 432, and 648 g clump-1. The experiment of potassium fertilization consisted of 0, 480, 960 and 1440 g clump-1. The variables of morphological characters observed were number of leaves, increase of the new leaf and trunk height of the parent palm plants. The results of nitrogen and potassium fertilization showed that these fertilizations, Nitrogen and potassium, had not increased the number of leaf of parent palm plants, however, phosphorus fertilization showed the increase of leaf number after 10-month treatment (MAT). Nitrogen fertilization provided an impact on the number of leaves on the sago suckers which started from 7-month treatments, phosphorus fertilization after 10-month treatment, while potassium fertilization did not give any influence. Fertilization of nitrogen, phosphorus and potassium did not give any effect to increase the number of new leaf at the parent palm plants except for the sago suckers. Phosphorus and potassium fertilization treatment improved the trunk height of the parent palm plants.

Key Words: Parent palm plants, Sago suckers, the number of leaves, the increase of new leaf, the height of sago trunk

Introduction

Sago is one of plants producing carbohydrate that is used as the staple food for most of Indonesian especially for those in East Indonesia. Besides as the staple food, sago starch will be used for industrial business like bread material, noodle, cake, high fructose syrup, adhesive material, and plastic which is easily unravelled naturally (biodegradable). Sago starch is also used in medical industry, cosmetic, paper, ethanol, and textile. Moreover, the waste of sago management can be used as livestock food (Bintoro et al., 2010)

Sago starch production which derives from one tree can produce 200-400 kg of dry starch. In Jayapura, some researchers found a sago tree which contained 800-900 kg starch per one tree. If one tree contains 300 kg of dry starch, one hectare of sago plants will produce 30 ton of dry starch (Bintoro, 2008). Sago is a quite potential food resource in Indonesia. The quality of sago calorie and nutrient is not different from other staple food like rice, corn, sweet potato, and potato. Therefore, sago can be a pillar in developing national food security (Budianto, 2003)

Considering the importance of sago plants now and later and in line with the increasing of world citizen’s need over the food and energy, it is then necessary to increase the quality and quantity of sago production. Planting sago plant takes quite long time, therefore, in order to obtain the harvest time well, it is very important to consider the aspect of fertilizing the plant.

Fertilization is an important thing in farming to provide the element of nutrient for plants in order to increase the productivity of the sago plants (Bintoro et al., 2010). According to Bintoro (2008), sago can grow in turf soil, however, the area shows nutrient deficiency symptoms that cause the number of leaves decreased and the age of the cutting time longer. There are three essential nutrient elements that play an important role in the growth and development of plants, i.e. nitrogen, phosphorus and potassium. Lack one of the three elements could make the plants experience growth, development and production of sago starch disturbances. Nitrogen has the role in increasing the growth of plants, the vegetative tissue forming of plants and the controller of potassium, phosphorus and other composers(Tisdale et al. 1985). Phosphorus plays an important role in the process of metabolism and biosynthesis reaction. Phosphorous is needed by plants to form the cell in root and shoot tissues which are still growing, to strengthen the stem so that it does not easily fall down. Furthermore, it can foster the flowering age, help the forming of flowers and strengthen the durability of plants towards the disease and pest attack (Gardner et al. 1991). Likewise, potassium has an important role in sugar translocation of starch forming and in the process of the opening and closing of stomata. Translocation of potassium nutrient from the adult organ to the young organ so that the the symptoms of lacking could be seen in the old leaves, whereas in monocots plants like serealia, the symptoms is shown by necrosis in the end and the edge of leaves (Salisbury and Ross 1995).

The observation of morphology character aimed to observe the growth of plants. Based on this, this research was done to learn the effect of nitrogen, phosphorus and potassium fertilization towards the growth of sago plants.

Materials and Methods

This research consisted of three fertilization experiments, namely, the fertilization experiments of nitrogen, phosphorus and potassium which were done separately. The research was carried out for 12 months from Januari to December 2012. The location of the research was in sago plantation, PT. National Sagu Prima, Kepau Baru Village, East Tebing Tinggi Regency, Meranti Islands Regency, Riau Province. The material used was sago plants (Metroxylon sagu Rottb) which were 6-7 years old. The fertilizers used were urea fertilizer (45% N), SP-36 fertilizer (36% P2O5) and KCL fertilizer (60% k2O). The experiment of nitrogen, phosphorus and potassium fertilizations was carried out by using Group Randomize Design. It had 4 stages of treatment and each treatment was repeated 3 times, each unit of experiment used 4 sago plant families. The four stages of treatment were the experiment of nitrogen fertilization (0, 495, 810, and 1215 g N clump-1), the experiment of phosphorus fertilization (0,480,960 and 1440 g clump-1). Nitrogen, phosphorus and potassium fertilizations were given in three stages. The dose of fertilizer allocation in each application is presented in Table1 below.

Table 1. The dose of fertilizer in each application based on each element.

Application	Fertilizers (g/clump)											
	N (N)				P (P_2O_5)				K (K_2O)			
	N0	N1	N2	N3	P0	P1	P2	P3	K0	K1	K2	K3
1	0	135	270	405	0	72	144	216	0	160	320	480
2	0	135	270	405	0	72	144	216	0	160	320	480
3	0	135	270	405	0	72	144	216	0	160	320	480
Amount	0	405	810	1215	0	216	432	648	0	480	960	1440

The observation of plant morphology character in sago plant clump covered the parent and sucker sago plants that were maintained. The variables of morphological character observed were:

a. The number of midrib

The calculation of leaf number was done by counting the number of emerging leaves and fully open leaves. The counting was done monthly.

b. The increasing number of midrib

Increasing the number of leaves of parent and sucker sago plants was done monthly during the research. The calculation was done by counting the earlier number of leaves and adding the emergence of new leaves.

c. The height of parent plant stem

The measurement of parent plant stem height was done by measuring the height of the stem base to the midrib base of the last leaf attaching to the trunk. The observation was done at the beginning and end of the study.

The statistical analysis was carried out by using SAS program and figure tabulation was done by using excel program.

Result and Discussion

A. Number of leaves

The result showed that overall nitrogen and potassium fertilization had not increased the number of midrib in parent plant except in phosphorus fertilization after 10–month treatment.

Table 2.Effect of nitrogen, phosphorus and potassium fertilizers towards the number of midribs in parent plant.

Treatment	Number of midribs during the Months After Treatment (MAT)									
	1	2	3	4	5	6	7	8	9	10
Nitrogen										
Dose N (g clump^{-1})										
0 (control)	7.2a	7.3a	7.1a	7.2a	7.4a	7.6a	7.8a	7.9a	7.8a	7.7a
405	7.2a	7.1a	7.1a	7.3a	7.5a	7.4a	7.6a	7.8a	7.9a	7.8a
810	7.2a	7.7a	7.4a	7.4a	7.8a	7.9a	7.8a	7.9a	8.1a	8.6a
1215	7.8a	7.8a	7.8a	7.9a	8.1a	8.3a	8.6a	8.6a	8.7a	8.5a
Phosphorus										
Dose P (g clump^{-1})										
0 (control)	6.7a	6.8a	6.8a	6.7a	7.1a	7.1a	7.4a	7.6a	7.7a	7.6b
216	7.4a	7.4a	7.4a	7.5a	7.6a	7.7a	8.1a	8.3a	8.3a	8.1ab
432	7.3a	7.3a	7.5a	7.5a	7.7a	8.1a	8.3a	8.4a	8.4a	8.5a
648	7.2a	7.4a	7.6a	7.5a	7.7a	8.0a	8.2a	8.3a	8.5a	8.5a
Potassium										
Dose K (g clump^{-1})										
0 (kontrol)	6.9a	6.9a	7.0a	7.2a	7.4a	7.7a	7.6a	7.8a	7.9a	7.8a
480	6.6a	6.8a	7.0a	6.9a	7.4a	7.4a	7.5a	7.7a	7.8a	7.7a
960	7.0a	6.9a	7.3a	7.4a	7.5a	7.8a	8.0a	8.1a	8.2a	8.1a
1440	7.1a	7.3a	7.2a	7.2a	7.4a	7.4a	7.8a	8.3a	8.3a	8.4a

Explanation. The number followed by the same alphabet in the same column indicates slight difference in Duncan Multiple Range Test in 5% level.

Nitrogenfertilizer had no effect on the number of leaves of the parent plant, however, the highest dose of fertilizer applied tended to give more number of stemscompared to the dose givenunder 7 to 10 MAT. The absence of such influence was suspected that in parent plant, the intake of nitrogen nutrient was slow and the dose of the nitrogen fertilizer was low as well. Furthermore, the seedling grown in the clumps caused the competition in the absorption of nutrient in parent plant.

The dose of phosphorus fertilizer given showed significant difference after 10-month treatment. The dose of phosphorus fertilizer (648 and 432 g clump^{-1}) produced the highest number of midribs - 8.5 midribs.Meanwhile,the control (0 g clump^{-1}) yielded 7.6 midribs. The adaptation of parent plant to produce midribs towards the phosphorus fertilizer took quite long time. There was a tendency that the phosphorus fertilizer given was insufficient, or it could be associated with the nature of phosphorus fertilizer that could not melt away quickly, therefore, the plant found it difficult to absorb.

The results showed that the application of potassium fertilizer with various dose levels had not given any significant effect on the number of midribs in parent and sucker plants maintained. It was thought that potassium fertilizer applied was only a little, so it could notbe able to increase the number of midribs formed.

Table 3.Effect of nitrogen, phosphorus and potassium fertilizers towards the number of midribs in sucker sago plant.

Treatment	Number of midribs during The Months After Treatment (MAT)									
	1	2	3	4	5	6	7	8	9	10
Nitrogen										
Dose N (g clump^{-1})										
0 (Control)	5.1a	5.2a	5.4	5.6a	5.7a	5.8a	5.8b	5.9b	5.8b	6.0b
405	4.8a	5.1a	5.5	5.6a	5.8a	5.8a	6.0ab	6.0b	5.9b	6.3ab
810	4.9a	5.2a	5.4	5.6a	5.7a	5.7a	5.9b	6.0b	5.9b	6.1b
1215	4.9a	5.3a	5.6	5.8a	6.0a	6.1a	6.2a	6.4a	6.4a	6.6a
Phosphorus										
Dose P (g clump^{-1})										
0 (Control)	4.4a	4.8a	5.1a	5.4a	5.7a	5.8a	6.0a	6.0a	6.0a	6.0b
216	4.5a	5.0a	5.4a	5.4a	5.8a	6.0a	6.0a	6.1a	6.2a	6.1ab
432	4.6a	5.0a	5.4a	5.6a	5.9a	6.2a	6.2a	6.4a	6.4a	6.5a
648	4.9a	5.0a	5.4a	5.6a	5.9a	6.2a	6.2a	6.3a	6.5a	6.6a
Potassium										
Dose K (g clump^{-1})										
0 (Control)	4.4a	5.0a	5.4a	5.6a	5.8a	6.0a	6.1a	6.1a	6.3a	6.3a
480	4.2a	4.6a	5.2a	5.4a	5.7a	5.9a	6.0a	6.0a	6.1a	6.3a
960	4.3a	4.8a	5.4a	5.5a	5.7a	6.0a	5.1a	6.1a	6.2a	6.4a
1440	4.4a	4.7a	5.2a	5.6a	5.9a	6.2a	6.3a	6.4a	6.4a	6.6a

Explanation. The number followed by the same alphabet in the same column indicates slight difference in Duncan Multiple Range Test in 5% level.

Nitrogen fertilizer affected the growth of sucker sago plant maintained. The effect of fertilization could be determined after 7-month treatment. The highest number of leaves(6.2 midribs) was obtained in sucker sago plant given the amount of nitrogen fertilizer dose (1215 g clump^{-1}) (Table 3)

Phosphorus fertilizer given had not shown real effect, except after 10-monthtreatment (Table 3). However, when it was observed after 2 and 10-month treatment, it showed that there was an increase in the number of midribs thoroughly from each dose applied compared to that in the control. That condition indicated that fertilizer played the role in midrib growth. This could be seen after 10-month treatment. The highest number of midribs(6.6 midribs) was produced in the highest dose of phosphorus fertilizer (648 g clump^{-1}) and the lowest (6.0 midribs) was produced in the 0 g clump^{-1}dose of phosphorus fertilizer (control).

The research result of potassium fertilization in sucker plant maintained had not given any impact on the number of midribs. Nevertheless, after 10-month treatment, the highest dose of potassium (1440 g clump^{-1}) yielded more number of midribs compared to that in the low dose given, but statistically, the difference was not very significant.

Based on the research result in sucker sago plant, it indicated that the sensitivity of sucker sago plant in response to the fertilizer application made the increase of midrib number in sucker sago plant faster than that in parent plant. The condition caused the sucker sago plant became more responsive in absorbing nitrogen nutrient to form the vegetative parts of plant. According to Eguchi et al. (2006) nitrogen was an essential element for the growth and development of plant, and it was one of the elements in the growth of chlorophyll which was needed in the process of photosynthesis. Moreover, the application of phosphorus fertilizer showed that the highest dose of phosphorus fertilizer had the potency to produce more number of midribs in sucker sago plant. It supported the research of parent sago plant indicating that the higher dose of fertilizer phosphorus given, the more number of midribs would be produced. Nevertheless, the adaptation of the parent sago plant and its sucker in producing midrib towards the fertilizer given required a quite long time.The same results were obtained by Kakuda et al (2005). He explained that thegiven macro fertilizer in high dose caused the number of midrib increase.

The research result showed thatnitrogen, phosphorus and potassium fertilizers did not give any effect on the increase of new midribsper unit of time in parent plant (Table 4)

B. The increase of new midrib.

Table 4. Effect on nitrogen, phosphorus and potassium fertilizers towards the growth of new midribs in parent sago plant.

Treatment	The Increase of New Midribs during the Months After Treatment (MAT)									Average
	2	3	4	5	6	7	8	9	10	
Nitrogen										
Dose N (g clump^{-1})										
0 (control)	0.5a	1.1a	1.8a	2.5a	3.2a	3.9a	4.7a	5.4a	6.0a	0.67
405	0.5a	1.2a	1.9a	2.7a	3.4a	4.1a	4.7a	5.4a	6.1a	0.68
810	0.6a	1.1a	1.9a	2.5a	3.2a	3.9a	4.5a	5.3a	6.0a	0.67
1215	0.6a	1.2a	1.9a	2.5a	3.3a	4.0a	4.7a	5.3a	6.1a	0.68
Phosphorus										
Dose P (g clump^{-1})										
0 (control)	0.6a	1.3a	1.9a	2.6a	3.3a	4.1a	4.8a	5.4a	6.0a	0.67
216	0.6a	1.3a	1.8a	2.6a	3.2a	4.0a	4.5a	5.3a	5.9a	0.66
432	0.7a	1.4a	2.0a	2.7a	3.3a	4.0a	4.6a	5.2a	5.8a	0.64
648	0.7a	1.4a	2.0a	2.6a	3.4a	4.1a	4.8a	5.5a	6.1a	0.68
Potassium										
Dose K (g clump^{-1})										
0 (control)	0.4a	1.0b	1.6a	2.2b	3.0a	4.1a	4.5a	5.0a	5.6a	0.62
480	0.5a	1.2a	1.8a	2.6a	3.3a	4.4a	4.8a	5.4a	6.0a	0.67
960	0.4a	1.2a	1.7a	2.2a	3.0a	4.2a	4.6a	5.2a	5.8a	0.64
1440	0.6a	1.2a	1.9a	2.6a	3.3a	4.4a	4.8a	5.4a	6.1a	0.68
1440	4.4a	4.7a	5.2a	5.6a	5.9a	6.2a	6.3a	6.4a	6.4a	6.6a

Explanation: The number followed by the same alphabet in the same column indicates slight difference in Duncan Multiple Range Test in 5% level.

The increase of new midribsafter 10-month treatmentof nitrogen fertilizer experiment produced almost the same number of new midribs (6.0-6.1 midribs) with the average of new midribs (0.67-0.68 of moon midrib^{-1}). The results obtained in phosphorus fertilizershowed that the increase of new midribs was between 5.8-6.1 midribs. The application of phosphorus fertilizer dose resulted in the average greatest increase of 0.68 midribsof mood midrib^{-1}. The highest dose of fertilizer showed 648 g clump^{-1}, but it did not show significant differencein the treatment of 0,216 and 432 g clump^{-1}. The results of potassium fertilizershowed the increase of new midribs between 5.6-6.1 with the average of 0.62-0.68 moon midrib^{-1}.

Table 5.Effect on nitrogen, phosphorus and potassium fertilizers towards the increase of midribs in the sucker.

Treatment	The Increase of New Midribs during the Months After Treatment (MAT)									Average
	2	3	4	5	6	7	8	9	10	
Nitrogen										
Dose N (g clump^{-1})										
0 (control)	0.7a	1.5a	2.2a	2.7b	3.5b	4.0a	4.6b	5.2b	5.8b	0.64
405	0.7a	1.5a	2.7a	2.7b	3.5b	4.2a	4.8ab	5.4ab	6.1b	0.68
810	0.7a	1.4a	2.2a	2.7b	3.5b	4.1a	4.7b	5.3b	6.0b	0.67
1215	0.7a	1.5a	2.3a	2.9a	3.8a	4.4a	5.1a	5.7a	6.5a	0.72

Phosphorus										
Dose P (g clump^{-1})										
0 (control)	0.6a	1.4a	2.0a	2.5a	3.2b	3.9b	4.3b	4.9b	5.4b	0.60
216	0.7a	1.5a	2.1a	2.7a	3.4ab	4.1ab	4.6ab	5.3ab	5.8ab	0.64
432	0.7a	1.5a	2.1a	2.8a	3.6a	4.2a	4.8ab	5.4a	6.1a	0.68
648	0.7a	1.5a	2.1a	2.7a	3.6a	4.3a	4.9a	5.6a	6.2a	0.69
Potassium										
Dose K (g clump^{-1})										
0 (control)	0.7a	1.5a	2.0b	2.7a	3.3b	3.9b	4.5b	5.0b	5.6b	0.62
480	0.6a	1.5a	2.0b	2.7a	3.3b	3.9b	4.6b	5.1b	5.6b	0.63
960	0.6a	1.5a	2.1ab	2.8a	3.4b	4.1ab	4.7b	5.2b	5.8b	0.64
1440	0.7a	1.5a	2.2a	2.8a	3.6a	4.4a	5.1a	5.7a	6.4a	0.71

Explanation: The number followed by the same alphabet in the same column indicates slight difference in Duncan Multiple Range Test in 5% level.

The result showed that nitrogen, phosphorus and potassium fertilizers increased the new midribs in the sucker plants (table 5). The application of nitrogen fertilizer gave significant influence after 5 to 10-month treatment. The increase of new midribs mostly resulted from the fertilizer dose of 1215 g N clump^{-1}, i.e. 6.5 midribs after 10-month treatment with the average moon midrib^{-1} of 0.72 midribs.

Phosphorus fertilizer influenced significantly towards the increase of midribs in sucker plants maintained. The application of phosphorus fertilizer gave significant influence after 6 to 10-month treatment. The increase of new midribs mostly resulted from the fertilizer dose of 648 g P clump^{-1}, i.e. 6.2 midrib after 10-month treatment with the average moon midrid^{-1} of 0.69.

Potassium fertilizer gave significant influence towards the increase of new midrib starting from the fourth to tenth month of treatment. The dose application of potassium fertilizer yielded the increase of new midribs of 6.4 midribs in the highest dose given (1440 g clump^{-1}) with the average increase of 0.71 moon midrib^{-1}.

The results of nitrogen, phosphorus and potassium treatments of sucker sago plants showed that the application of nitrogen, phosphorus and potassium fertilizers with various doses increased the new midribs in sucker sago plant maintained. It indicated that the application of fertilizer in sucker sago plant would produce new midribs. Suckers were more responsive towards the application of fertilizers because the nutrient element given was used in the vegetative growth of plant. This result supported the statement of Darwis (2012) and Halim (2012) that the application of nitrogen, phosphorus and potassium fertilizers on the palm oil seed could increase the number of new midribs. In contrast, in parent sago plants, the application of fertilizers had not shown the increase of new midribs. This because the growth of parent plants had already been in slow phase, consequently, the initiation process of new midribs went slowly.

However, the results showed that the increase of new midribs in sago plant was considered low. If compared to Flach's research (1984), in the condition of optimum, sago plants in the phase of rosette could produce two midribs and one midrib every month especially for the plants that had already had trunk. In this research, the slow increase of midribs was caused by the location of plant growth that was in peat area. According to Jong et al. (2008), the slow growth and production could be caused by the deficiency of nutrient element especially in infertile soil like peat**.** This condition resulted in the slow growth of midrib number and the short life span of leaf. Thus, it took a quite long time for plant to enter the next growth phase.

C. The trunk height of parent plant.

The research result showed that nitrogen, phosphorus and potassium fertilizers in the treatment of 10 month after treatment had not given any effect on the height of stem in parent plant(Table 5). The real influence of phosphorus and potassium fertilizers was shown in the measurement of the height of the stem, meanwhile, nitrogen experiment had not statistically shown the increase of stem height. However, there was a tendency that the application of nitrogen fertilizer had caused the increase of plant height which was greater than that in the control. Nitrogen fertilizer did not cause the increase of stem height. It was thought that there was a competition of nutrient absorption between the parent plant and sucker, and the dose of fertilizer applied was considered low.

Table 3. Effect of nitrogen, phosphorus and potassium fertilizers towards the stem height of parent plant.

Treatment	The Height of Parent Trunk		The Increase of Trunk Height (cm)
	0 BSP	**10 BSP**	
Nitrogen			
Dose N (g clump^{-1})			
0 (control)	138.75a	193.25a	54.50a
405	166.13a	242.50a	76.38a
810	196.33a	260.00a	63.66a
1215	175.67a	237.30a	61.67a
Phosphorus			
Dose P (g clump^{-1})			
0 (control)	181.7a	242.1a	60.4b
216	240.2a	289.2a	49.0d
432	167.8a	223.2a	55.5c
648	215.0a	285.8a	70.8a
Potassium			
Dose K (g clump^{-1})			
0 (control)	146.7a	209.2a	62.5ab
480	190.0a	247.5a	57.5b
960	185.0a	247.5a	62.5ab
1440	176.0a	249.8a	73.8a

Explanation: The number followed by the same alphabet in the same column indicates slight difference in Duncan Multiple Range Test in 5% level. MAT: Month After Treatment

The treatment of the highest phosphorus fertilizer (648 g clump^{-1}) was able to provide the increase of height of 70.8 cm, whereas a dose of 216 g clump^{-1}treatment caused the height increase of stem of 49.0 cm.The results showed that increasing dose of phosphorus fertilizer was needed to improve the ability of plants to produce the increase of sago stem height in parent plant.

The result of potassium fertilizer influenced the increase of stem height in parent plant. The application of potassium fertilizer with the dose of 1440 g clump^{-1} produced the increase of height stem which was higher (73.8 cm) than that of 480 g clump^{-1} (57.5 cm). Increasing the dose of potassium fertilizer resulted in the increase of stem height in parent plant. The observation of plant height after 10-month treatment showed that nitrogen, phosphorus and potassium fertilizers had not given any impact on the parent plant height. Statistically, the dose of nitrogen, phosphorus and potassium fertilizers given was not different among the fertilizer doses tested. However, the increase of stem height in parent plant in phosphorus and potassium treatments produced the greater increase of plant height in the highest dose of fertilizer. In addition, nitrogen fertilizer treatment with fertilizer dose of 810 gclump^{-1} had produced the increase of height which was higher than that in dose of 1215 gclump^{-1}.

The results of this study indicated that nitrogen, phosphorus and potassium fertilizers in sago plant played the role in increasing the stem height. Overall, phosphorus and potassium fertilizers with the highest dose applied in sago plants until after 10-month treatment could produce the increase of height respectively, i.e. 70.8 cm, 73.8 cm, and 63.6 cm. Yanagidate et.al. (2009) expressed that the increase of sago stem height in mineral soil without fertilizer was estimated one meter every year.

Conclusion

1. The results showed that overall, nitrogen and potassium fertilizers had not increased the number of midribs of parent plants except phosphorus fertilizer after 10- month treatment (MAT).The effect of nitrogen fertilizer towards the sucker influenced the

number of midribs starting from after 7-month treatment, and phosphorus fertilizer showed the influence after 10-month treatment, meanwhile, potassium fertilizer had not shown any influence.
2. The treatment of nitrogen, phosphorus and potassium fertilizers in parent plants did not give any influence towards the increase of new midribs. The treatment of nitrogen, phosphorus and potassium fertilizers had increased new midribs in suckers.
3. The treatment of phosphorus and potassium fertilizers had increased the stem height in parent plants.

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