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EFFECTS OF N, P, AND K FERTILIZERS ON JAPANESE MINT (*MENTHA ARVENSIS* L. VAR. *PIPERASCENS*)

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อิทธิพลของปุ๋ย N, P และ K ต่อผลผลิต ของมินต์ (*Mentha arvensis* L. var. *piperascens*)

โดย อดิศักดิ์ สัจจพงษ์

บทคัดย่อ

การทดลองครั้งนี้เป็นแบบ factorial design ประกอบด้วย 64 ลักษณะ (4 ระดับของปุ๋ยแต่ละชนิด คือ ยูเรีย, ทริเพิลซูเปอร์ฟอสเฟต และ โปตัสเซียมคลอไรด์)*. แปลงที่ทดลองเป็นดินทรายชุดร้อยเอ็ดและมีการให้น้ำด้วยระบบชลประทาน.

ผลการทดลองแสดงให้เห็นว่า ผลผลิตของมินต์เนื่องจากอิทธิพลของปุ๋ยไนโตรเจน และปุ๋ยฟอสเฟต มีความแตกต่างกันอย่างมีนัยสำคัญ, ส่วนอิทธิพลของปุ๋ยโปตัสเซียมนั้นทำให้ผลผลิตของมินต์ลดลงเล็กน้อย. ดังนั้นจากการทดลองนี้จึงสรุปได้ว่า เพื่อเพิ่มผลผลิตของมินต์ที่ปลูกในดินชุดร้อยเอ็ดนี้จึงควรใส่ปุ๋ยไนโตรเจนและฟอสเฟต ส่วนปุ๋ยโปตัสเซียมนั้นยังไม่จำเป็นต้องใส่.

*ทำการทดลองเพื่อศึกษาผลของการใช้ปุ๋ยต่อผลผลิตของมินต์พันธุ์ญี่ปุ่น.

EFFECTS OF N, P, AND K FERTILIZERS ON JAPANESE MINT (*Mentha arvensis* L. var. *piperascens*)

By Adisakdi Sajjapongse*

ABSTRACT

A 4^3 factorial in a randomized complete block design consisting of 4 levels each of N as urea, P as triple superphosphate, and K as potassium chloride was carried out to study the effect of fertilizer application on the Japanese mint herbage yield. The experiment was conducted on sandy soil, under irrigation.

Yield differences due to N and P applications were highly significant. The K application had a slight depressing effect on yield. It can be concluded from the study that in order to increase yield, the application of N and P is necessary but that of K is not.

INTRODUCTION

Although the Japanese mint (*Mentha arvensis* L. var. *piperascens*) was introduced into Thailand many years ago, research concerning its cultivation requirements has not been so far carried out actively and thoroughly. Information on mineral requirement and the role of minerals in the production of essential oil from the mint is very meagre. It is well understood, as far as cultivation is concerned, that there are many factors controlling the productivity of plants and Japanese mint is of no exception. The influences of these factor have been thoroughly reviewed by Baslas (Baslas 1970). It was found that under various day lengths, the mint plants responded differently to the photoperiod. With long photoperiod and high temperature (summer), they produced more aerial growth (leaves and stems) whereas short photoperiod and low temperature (winter) favored the vegetative type of stems growth and retarded the production of leaves (Singh and Singh 1970). On the other hand, the mint plant tended to produce higher yield with the heavier textured soils (Dutta et al. 1964). It was also found that

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Japanese mint requires particularly high amount of nitrogenous and phosphatic fertilizers (Gupta 1972). The effect of phosphate fertilizer was very pronounced and has been widely studied (Hamon and Zuch 1972); Singh and Singh 1971).

The objective of this investigation is to study the effects of nitrogenous, phosphatic, and potash fertilizers on the Japanese mint plants grown on sandy soil, under sufficient irrigation.

MATERIALS AND METHODS

The experiment was conducted on sandy soil on the Irrigation Pilot Farm Project, Huai Si Thon in the North-eastern part of Thailand. A 4 x 4 x 4 factorial in a randomized complete block design with 3 replications was employed. The treatments consisted of 4 rates (0, 9.92, 14.88, and 19.84 kg/rai) each of N, P, and K. Nitrogen was applied as urea, phosphorus as triple superphosphate, and potassium as potassium chloride. The fertilizers were split equally into two parts, one was applied before planting and the other after the first harvest. The first application was broadcast and then plowed down. After that, the Japanese mint seedlings of one month old were transplanted and grown for 72 days before the first harvest, by cutting the above-ground portion of the plant except the stolon. The second fertilizer application by broadcasting and flooding, to leach down any fertilizer particles that may be left on the stolon or trailing part of the plant, then followed. Sixty days later, the plants in the whole plot were harvested again. The herbages were then weighed and sub-sampled, rinsed with deionized water, dried at 65°C in the oven for 2 days, and ground for the analysis of N, P, and K.

The plot size of each treatment was 2 x 3 m and the seedlings were planted at 30 x 30 cm spacing. Water was supplied through irrigation. Weeds were kept at minimum by hoeing. There was no apparent pest or disease problems.

RESULTS

Soil used for this experiment was the Roi Et series. It has sandy texture with the following chemical and physical properties; pH 5.2, sand 73%, silt 20%, clay 3%, total N 0.05%, P 0.0001%, and K 0.073%.

The effect of nitrogen on the plants was very obvious. Plants received no nitrogen fertilizer were stunt and chlorotic. Budding and branching of the plants were very poor. The plants were not as vigorous as those received nitrogen. The effect of phosphate was less pronounced while that of potassium was not significant.

Dry matter yield as affected by N, P, and K

The herbage yield dry weight of the first harvest is presented in Table 1. The yields which were due to the nitrogen effect ranged from 194.03 to 240.85 kg per rai and were highly significant. The lowest yield was obtained when there was no nitrogen applied. As the nitrogen application rate increased, the mint herbage also increased and reached the maximum at the second highest application rate (14.88 kg N/rai). With the higher rate, the yield was consistently higher. The effect of phosphate fertilizer was very identical to that of nitrogen except that the maximum herbage yield was obtained at the highest P application rate. On the other hand, there was no effect due to potassium application. Although it appeared to have decreasing trend of herbage yield with increasing potassium application rates, it did not show any significant difference. Yields of the second harvest are presented in Table 2. It was obvious that the yields of this harvest were lower than that of the first harvest for every treatment. But the overall effects of N, P, and K were identical.

Nutrient contents of plant tissue and total uptake

Nutrient concentrations of the aerial plant parts are presented in Tables 3 and 4 respectively for the first and second harvests. Total nutrient uptake is also graphically shown in Figures 1, 2, and 3 for N, P, and K respectively.

TABLE 1. AVERAGE MINT YIELD DRY WEIGHT OF THE FIRST HARVEST AS AFFECTED BY FERTILIZER APPLICATION

Application rate (kg/rai)	Yield dry weight (kg/rai)		
	N	P	K
0	194.03	196.19	237.06
9.92	230.82	226.82	230.80
14.88	240.85	236.18	222.00
19.84	238.23	244.74	214.03

TABLE 2. AVERAGE MINT YIELD DRY WEIGHT OF THE SECOND HARVEST AS AFFECTED BY FERTILIZER APPLICATION

Application rate (kg/rai)	Yield dry weight (kg/rai)		
	N	P	K
0	164.71	174.76	203.39
9.92	212.27	204.67	198.00
14.88	206.03	222.58	211.73
19.84	220.58	204.16	190.46

TABLE 3. NUTRIENT CONCENTRATION OF THE AERIAL PLANT PARTS OF THE FIRST HARVEST

Application rate (kg/rai)	Plant nutrient concentration (%)		
	N	P	K
0	1.63	0.12	0.89
9.92	1.88	0.13	1.02
14.88	2.00	0.13	1.05
19.84	2.13	0.12	1.08

TABLE 4. NUTRIENT CONCENTRATION OF THE AERIAL PLANT PARTS OF THE SECOND HARVEST

Application rate (kg/rai)	Plant nutrient concentration (%)		
	N	P	K
0	1.36	0.21	0.70
9.92	1.63	0.23	0.97
14.88	1.80	0.25	1.07
19.84	1.90	0.26	1.16

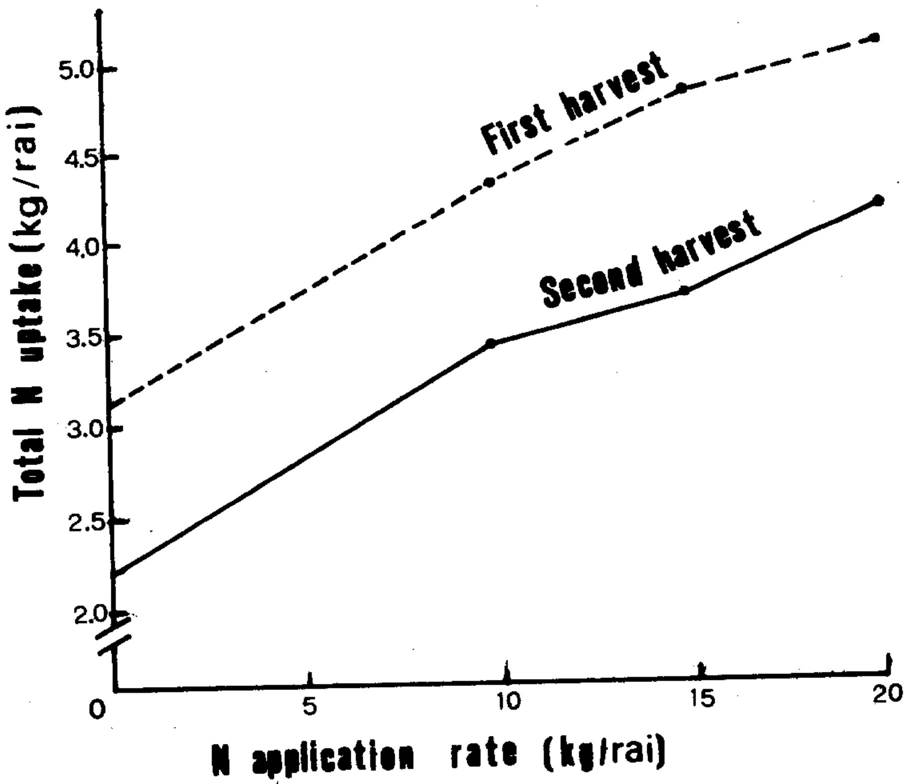

Figure 1. The relationship between total uptake and application rate of nitrogen from both harvests.

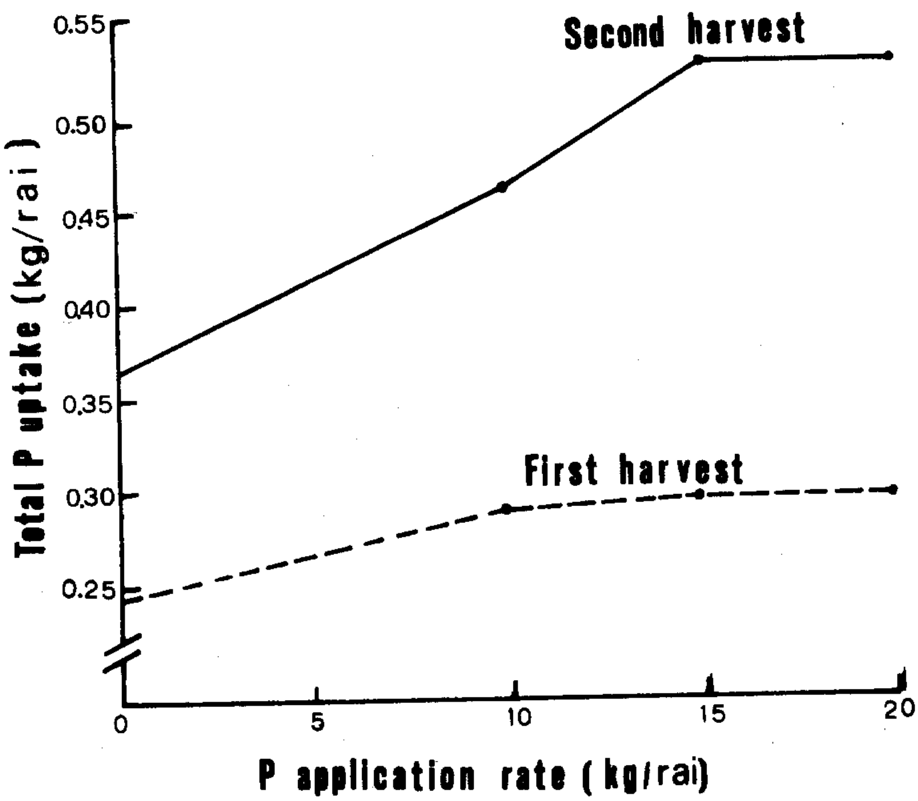

Figure 2. The relationship between total uptake and application rate of phosphorus from both harvests.

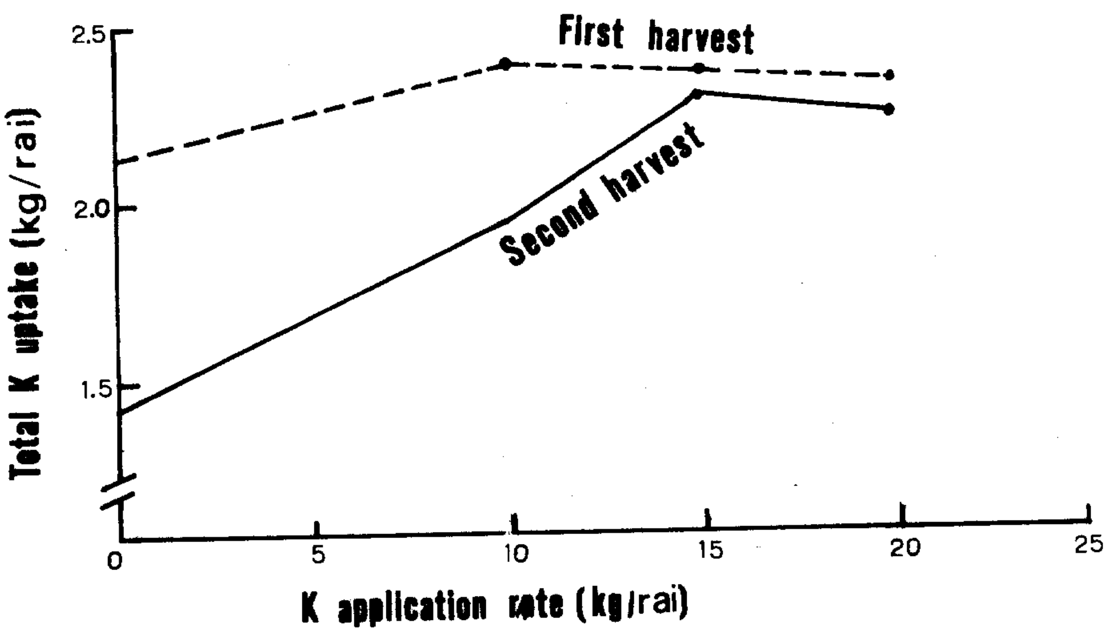

Figure 3. The relationship between total uptake and application rate of potassium from both harvests.

Nitrogen concentration in the plant tissue increased positively with the increasing rate of N application. The concentration varied from the lowest value of 1.63 per cent to the highest of 2.13 per cent. The corresponding values for the second harvest were relatively lower. The range was from 1.36 to 1.90 per cent. Again, the concentration increased as more N was applied. The total N uptake (Figure 1) also followed this trend with the uptake of the first harvest, ranging from 3.20 to 5.07 kg per rai, which were greater than those for the second harvest, ranging from 2.24 to 4.19 kg per rai.

The concentration of P in the aerial plant parts was very much lower than those of the nitrogen concentration. For the first harvest, the concentrations were virtually unaffected, although the P application rates were increased. The values ranged from 0.12 to 0.13 per cent. The concentrations for the second harvest were different and were about twice as high as those for the first harvest. It increased positively with the increasing rates of application, ranging from a low of 0.21 per cent to a high of 0.26 per cent. When the total P uptake was considered (Figure 2), it was found that the amount of total P uptake increased with the increasing application rate, showing the maximum uptake at the highest application rate for both harvests.

The concentrations of K for the first and second harvests were very similar. They increased with the higher application rates and varied from 0.89 to 1.08 per cent for the first harvest and from 0.70 to 1.16 per cent for the second. Total K uptake (Figure 3) increased positively with the increasing application rates only up to a certain limit. The highest rates did not correspond to the maximum total uptake, indicating a decreasing trend of yield.

The correlation coefficients between the nutrient concentration in the aerial plant parts and yield dry weight of both harvests are presented in Table 5. The correlation coefficient for N was greater for the first harvest than for the second (0.926 vs 0.906). The corresponding values for P were relatively lower and conversely the correlation coefficient was greater for the second harvest than for the first. On the other hand, the values showed a negative correlation for K. The result was more pronounced for the first harvest (-0.8938).

TABLE 5. THE CORRELATION BETWEEN PLANT NUTRIENT CONCENTRATION AND MINT YIELD DRY WEIGHT OF BOTH HARVESTS

Harvest	The correlation coefficient (r)		
	N	P	K
1	0.926	0.301	-0.894
2	0.906	0.786	-0.294

DISCUSSION

The fertilizer application of N, P, and K has been successfully shown to increase yield of many crops among which mint is one.

Data show that urea used in this study contains nitrogen which is readily available to the plant. From a plant analysis of the first harvest, N concentration increased positively with urea application. The effect prevailed until the second harvest. This indicates that, besides being readily available, the more N is applied, the more it is taken up for producing yield. The optimum rate of N application for Japanese mint growing on this sandy soil is 14.88 kg/rai. Higher rates will only lead to luxurious consumption.

The application of phosphate fertilizer is somewhat different. Although the herbage yield dry weight for the first harvest increased considerably with the increasing application rate, the P concentration of the plant did not change. But the total P uptake showed positive correlation with the application rate. On the other hand, the P concentration and total uptake for the second harvest showed a close correlation with the application rate. This implies that triple phosphate used in this study is very slowly available to the mint plant. The availability is high after about two months of application as indicated by the concentration rate of the second harvest.

Luxurious consumption of K is very marked. While both K concentration and total K uptake increased with the increasing application rate, the mint yield dry weight did not differ significantly and showed negative correlation. Data also show that K from the fertilizer is readily available.

Thus, it can be concluded that the application of nitrogen and phosphate fertilizer is necessary in growing mint on this soil. On the other hand, K fertilizer can be ignored since the soil is able to provide sufficient indigenous K.

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