Growth response of *Salacia reticulata* (Kothalahimbutu) seedlings to different rates of Nitrogen, Phosphorus and Potassium

K. K. I. U. Arunakumara [1.]
E. K. E. C. Nayana [2.]
S. Subasinghe [3.]

ABSTRACT

Effective fertilization, due to its practical implication, plays a key role in the development of agro-technological packages for the species which have high demand in the market. *Salacia reticulata* (Kothalahimbutu), a woody shrub belonging to family Hippocrateaceae has an increasing demand due to its wide range of medicinal uses. The present investigations were carried out to study the effect of Nitrogen, Phosphorus and Potassium on the growth of *Salacia reticulata* seedlings. The growth response to N, P and K were assessed in three separate pot experiments. Uniform, disease and pest-free seedlings were planted in poly bags filled with a potting mixture of river sand, top soil and compost (1:1:1 by volume). Recommended fertilizer mixture for Tea seedlings were served as the control (T_5) while in other treatments the N, P and K levels in the fertilizer mixture were increased by 5 % (T_1), 10 % (T_2), 15 % (T_3) and 20 % (T_4) using Urea, CSP and MOP respectively. The growth of the seedlings was assessed monthly by measuring the plant height and counting the number of leaves. CRD was used with 10 replicates. Results revealed that the height increase in P treated seedlings was significantly (p £ 0.05) higher than that of the control at the end of first month. However, no significant (p £ 0.05) differences in plant height were found among different N and K treatments. Results also revealed that growth response to the added fertilizer was more pronounced in first four weeks than the second month. Findings must be confirmed by the investigations carried out under field conditions.

Key words: *Salacia reticulata,* growth, Nitrogen, Phosphorus and Potassium

Introduction

Economic conditions in modern agriculture demand high crop yields which depend on factors such as the development of new high yielding varieties, pest and disease control and the application of appropriate agronomic practices[1]. In fact, the productivity of modern agriculture is highly dependant upon nonrenewable resources such as application of fertilizers. Major nutrients; nitrogen (N), phosphorus (P) and potassium (K) are utilized in the largest amounts by crops, and therefore, are applied as fertilizers. Nitrogen is an essential nutrient as it promotes rapid growth, increases leaf size and quality, hastens crop maturity and promotes fruit and seed development[3]. As a constituent of amino acids, which are required to synthesize proteins and other related compounds, nitrogen plays a role in almost all plant metabolic processes[4]. Potassium is another important nutrient that has favorable effects on the metabolism of nucleic acids, proteins, vitamins and growth substances[7]. Furthermore, K plays an important role in the translocation of photosynthates from sources to sinks[8]. Normal plant growth cannot be achieved without phosphorus as it is a constituent of nucleic acids, phospholipids, the coenzymes DNA and NADP, and most importantly ATP. Therefore, influence of N, P and K on growth of economically important plant species is a matter of great concern. *Salacia reticulata*, a Hippocrateaceae plant distributed in Sri Lankan and Indian forests, has widely been

1. 2. 3. Department of Crop Science, Faculty of Agriculture, University of Ruhuna, Mapalana, Kamburupitiya, Sri Lanka. Ayurveda Sameekshawa II/VII - P. 195 - 199

used as a supplementary food in some countries to prevent obesity and diabetes[9,10] and thus has a ready demand in the market. The present paper discusses growth responses of *Salacia reticulata* to different rates of N, P and K.

Materials and Methods

The present study was conducted at the Department of Crop Science, Faculty of Agriculture, University of Ruhuna from May 2007. *Salacia reticulata* seeds collected from naturally growing mother plants at Denagama, Southern Sri Lanka were sown in a sand nursery on 15th May, 2007. When seedlings reached to 5 cm height, thinning was done to get healthy and strong seedlings and they were watered as needed. Six months old, healthy seedlings of uniform size were selected and transplanted from nursery beds to poly bags (15x 30 cm) filled with a potting mixture of river sand, top soil and compost (1:1:1 by volume). Before transplantation, nursery beds were moistened well so that seedlings could easily be taken out from beds without damaging the root system.

Effects of N, P and K on growth of *S. reticulata* were studied separately using three pot experiments. Urea, Concentrated super phosphate and Murate of potash were used as the sources of N, P and K respectively. T_{65}, the recommended fertilizer mixture (Sulphate of ammonia, Potassium nitrate, Ammonium phosphate and Epsom salt) for Tea seedlings at nurseries was used as the control. N, P and K concentrations in T_{65} were increased by 5 % (T1), 10 % (T2), 15 % (T3) and 20 % (T4) using Urea, Concentrated super phosphate and Murate of potash respectively in the three experiments. The plant height and the number of leaves were recorded at monthly intervals as the growth parameters. The experiment was laid out in Completely Randomized Design (CRD) with ten replications and five treatments. One-way ANOVA and Duncan's multiple range tests (SPSS ver.10.0 software, Chicago, Illinois, USA) were used in analyzing the data. Mean differences were considered significant at $P< 0.05$.

Results and Discussion

No significant ($P< 0.05$) differences in average plant height were recorded among the different N applications during the period of first two months. Similar results were also observed from the plants treated with different K applications. In both experiments the highest increase in plant height was recorded from T_3. Whereas, in the case of P, the height increase in plants treated with different concentrations of P was significantly ($P<0.05$) higher than that of in the control at the end of first four weeks. However, no significant ($P < 0.05$) differences were found at the end of second month. Results further revealed that height increase in all the three experiments was poor in the second month compared to the first four weeks (Figure 1, 2 and 3). Increase in average leaf number was found significant ($P < 0.05$) in T_3 for both P and K treated seedlings during the first four weeks (Table 1). However, in the case of N, T_4 produced more leaves than any other treatment.

Early seedling growth followed by accelerated canopy closure are essential contributors to formation of yield potential[11,12,13,14]. Crop management practices that support early growth vigor are likely to result in higher biomass production[13]. Total dry matter production is believed to be high with the increased fertilization. In the present findings, the growth response to added fertilizers was found to be pronounced during the first four weeks. Height increase at decreasing rate became obvious only toward the end of the second month and this might be due to gradual depletion of nutrients from the growing media.

Starter fertilization is a common practice in agriculture to enhance early growth and then to ensure higher grain yield. At higher starter fertilization rates, however, enhanced early vegetative growth in some cases, but had no significant effects on grain yield[16]. *Salacia reticulata* is a species with vegetative parts known to have commercial and/or medicinal value and thus starter fertilization could play a vital role. Borges & Mallarino[17] (2000) have observed a significant ($P < 0.1$) increased in early growth of soybean due to P fertilization, but non-significant effects of K, which are in general agreement with the present results with *S. reticulata*. Previous researches have also reported that responses to N, P and K starter fertilization usually are due to P, but often are also explained by the N in the starter when pre-plant N rates are not high enough, and seldom are explained by K[20]. Early growth response to starter fertilization does not relate consistently to soil-test values or weather conditions[22] and thus present results could be considered as a reflection of the species depended manner of fertilizer responses.

Conclusion

Early growth responses of *Salacia reticulata* to fertilization seemed not significant. However, results must be confirmed by the trials conducted under field conditions.

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Table 1. Effect of different concentrations of N, P and K on growth of *Salacia reticulata* seedlings as measured by leaf number/plant.

Days after planting		Increment of the average leaf number/plant		
		N	P	K
	T_1	0.34±0.11	1.09±0.10	1.26±0.13
	T_2	0.12±0.06	0.70±0.09	0.91±0.06
30	T_3	0.94±0.04	1.29±0.06	1.48±0.15
	T_4	1.21±0.12	0.82±0.15	1.07±0.25
	T_5	0.63±0.02	0.48±0.24	0.36±0.07
	T_1	2.13±0.08	1.59±0.21	0.56±0.15
	T_2	1.70±0.22	1.20±0.08	0.92±0.12
60	T_3	2.34±0.08	0.93±0.12	1.68±0.09
	T_4	2.51±0.17	1.81±0.12	0.87±0.15
	T_5	1.73±0.12	0.38±0.04	0.61±0.07

Mean ± S.E. n = 10.

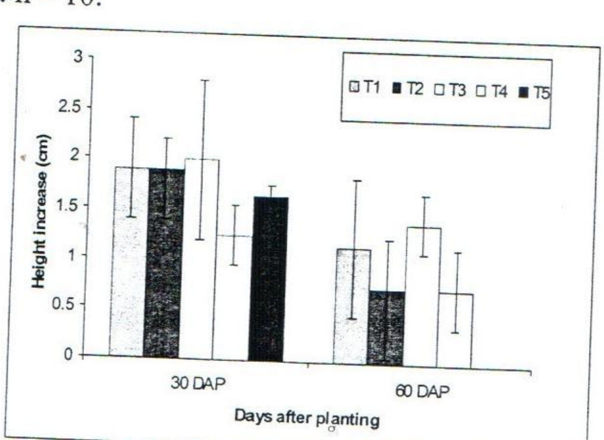

Figure 1: Effect of N on growth of *Salacia reticulata* seedlings as measured by height increase (cm). Six months old seedlings were planted in poly bags (15x 30 cm) filled with a potting mixture of river sand, top soil and compost (1:1:1 by volume) and treated with different concentrations of N. Growth was assessed at monthly intervals. n = 10.

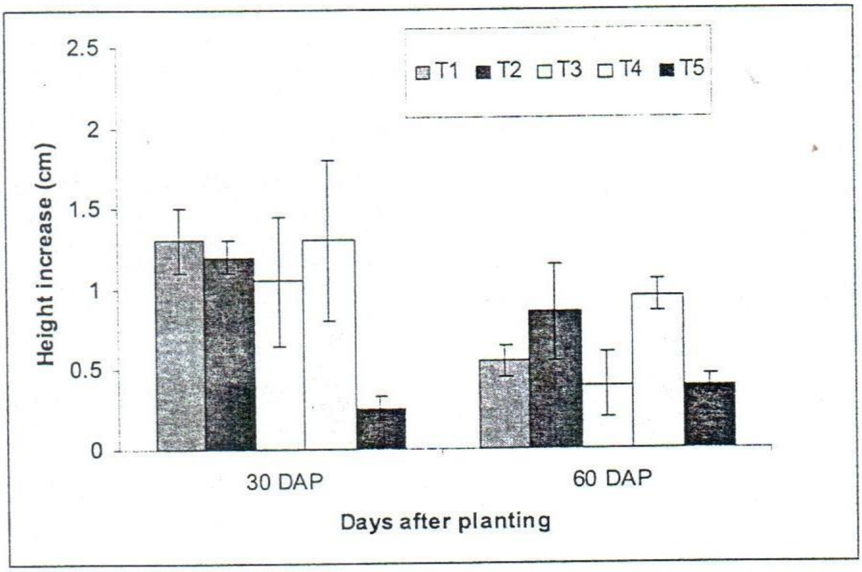

Figure 2: Effect of P on growth of *Salacia reticulata* seedlings as measured by height increase (cm). Six months old seedlings were planted in poly bags (15x 30 cm) filled with a potting mixture of river sand, top soil and compost (1:1:1 by volume) and treated with different concentrations of P. Growth was assessed at monthly intervals. n = 10.

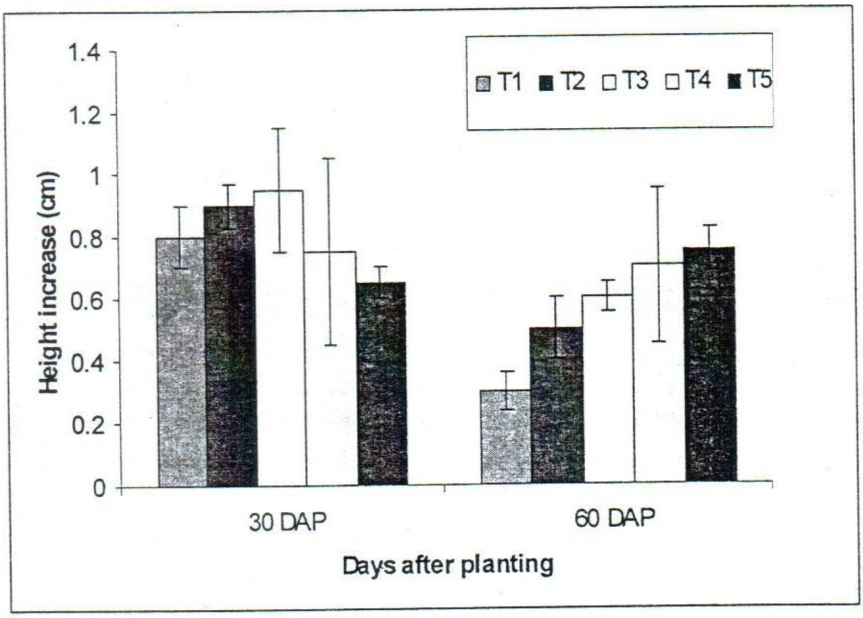

Figure 3: Effect of K on growth of *Salacia reticulata* seedlings as measured by height increase (cm). Six months old seedlings were planted in poly bags (15x 30 cm) filled with a potting mixture of river sand, top soil and compost (1:1:1 by volume) and treated with different concentrations of K. Growth was assessed at monthly intervals. n = 10.

References

1. Sawana Z.M., Hafezb S.A., Basyonyb A.E. & Alkassasb A.R., (2007), Nitrogen, potassium and plant growth retardant effects on oil content and quality of cotton seed, *GRASAS Y ACEITES*, **58** (3), 243-251.

3. Patil B.N., Lakkineni K.C. & Bhargava S.C., (1996), Seed yield and yield contributing characters as influenced by N supply in rapeseed-mustared, *J. Agron. Crop Sci.* **177**, 197-205.

4. Frink C.R., Waggoner P.E. & Ausubel J.H., (1999), Nitrogen fertilizer: retrospect and prospect, *Proc. Natl. Acad. Sci. USA* **96**, 1175-1180.

7. Bednarz C.W. & Oosterhuis D.M., (1999), Physiological changes associated with potassium deficiency in cotton, *J. Plant Nutr.* **22**, 303-313.

8. Cakmak I., Hengeler C. & Marschner H., (1994), Partitioning of shoot and root dry matter and carbohydrates in bean plants suffering from phosphorus, potassium and magnesium deficiency, *J. Exp. Botany* **45**, 1245-1250.

9. Yoshikawa M., Shimoda H., Nishida N., Takada M. & Matsuda H., (2002), *Salacia reticulata* and its polyphenolic constituents with lipase inhibitory and lipolytic activities have mild antiobesity effects in rats, *J. Nutri.* **132**(7), 1819-1824.

14. Richards R.A. & Lukacs Z., (2002), Seedling vigour in wheat: Sources of variation for genetic and agronomic improvement. *Aust. J. Agric. Res.* **53**:41-50.

15. Rebetzke G.J., Botwright T.L., Moore C.S., Richards R.A. & Condon A.G., (2004), Genotypic variation in specific leaf area for genetic improvement of early vigour in wheat. *Field Crops Res.* **88**:179-189.

16. Bermudez M. & Mallarino A.P., (2002), Yield and early growth responses to starter fertilizer in no-till corn assessed with precision agriculture technologies, *Agron. J.* **94**:1024-1033.

17. Borges R. & Mallarino A.P., (2000), Grain yield, early growth, and nutrient uptake of no-till soybean as affected by phosphorus and potassium placement Agronomy Journal, **92**, 380-388.

20. Scharf P.C., (1999), On-farm starter fertilizer response in no-till corn. *J. Prod. Agric.* **12**:692-695.

21. Mengel D.B., Hawkins S.E. & Walker P., (1988), Phosphorus and potassium placement for no-till and spring plowed corn. *J. Fert. Issues* **5**:31-36.

22. Bullock D.G., Simmons F.W., Chung I.M. & Johnson G.I., (1993), Growth analysis of corn growth with or without starter fertilizer. *Crop Sci.* **33**:112-117.