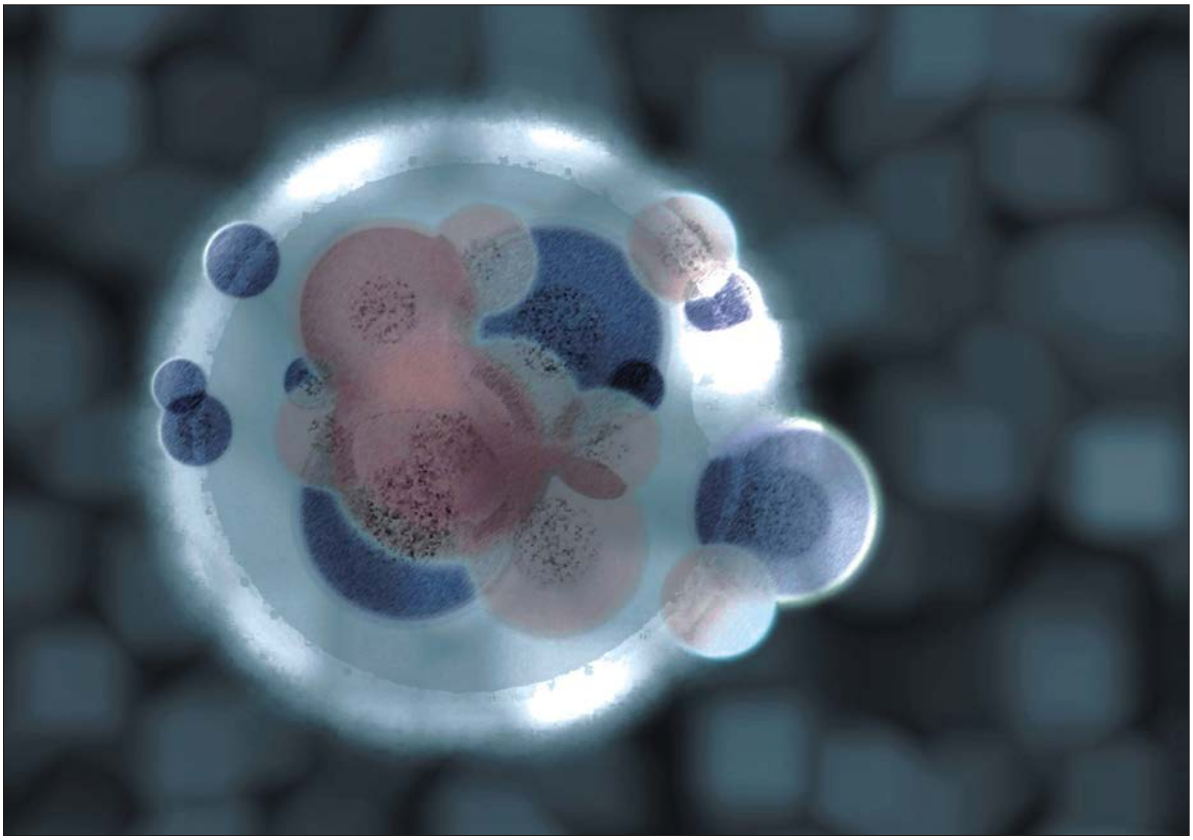

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Effect of Inorganic Fertilizers on the Initial Growth Performance of *Michelia champaca* Linn. Seedlings in the Nursery

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Abstract: The study describes the effect of 2 commonly used inorganic fertilizers (Urea and TSP) on *Michelia champaca* Linn. seedlings in the nursery of the Institute of Forestry and Environmental Sciences, University of Chittagong, Bangladesh with a view to standardize an optimum doze of inorganic fertilizers for raising quality seedlings. There were combinations of 16 treatments including a control one (N_oP_o). Seedlings were supplied 0, 50, 77 and 175 kg ha^{-1} of N and P of each in solution form in all possible combinations. Seedlings were evaluated for 22 weeks (150 days) in the nursery. Seedling mortality along with different growth parameters was measured. Different growth variables were also calculated. The fertilization that seedling growth was in general markedly better for fertilized one in comparison to the control one. Nitrogen additions significantly promoting the collar dia. increment and total dry matter production of seedlings experimented. Seedling mortality was not noticed. The study suggested that application of nitrogen and phosphorus (77 kg N ha^{-1}+ 77 kg P ha^{-1}) on this type of soil (forest top soil collected from Chittagong University Campus) is necessary to boost the diameter and total dry matter production of *M. champaca* seedlings.

Key words: Nursery, *Michelia champaca,* inorganic fertilizers, initial growth performance, seedlings

INTRODUCTION

The primary purpose of forest nurseries is to produce and supply quality seedlings to form new forests. Maintaining of adequate fertility of nursery soils is important to assure production of high quality planting stock. Works on the fertility of nursery for temperate forest species are available[1-4]. More works on the Nursery soil fertility undoubtedly necessary as conditions change and newly information becomes available and species-specific information are very much important for producing better seedlings. Failure to manage nursery soil adequately can result in depletion of site fertility[5] and a reduction in seedling growth[6]. However, a healthy seedling must be well supplied with all nutrients in proper proportions[7,8]. Nutrient requirement for different species are different and it also differ with environmental conditions. If a particular nutrient is deficient, seedlings may compensate to some extent by increasing their capacity to take up their deficient ion.

Michelia champaca Linn. is an important species of interest in Government plantation programmes and in homestead and commercial (recent approach) planting by people of Bangladesh. In Bangladesh, *Michelia champaca* occurs naturally in the hill forests but has become very scarce. The wood is light to moderately hard, olive brown coloured, durable and takes good polish[9]. Wood is suitable for valuable furniture, door and window panels, house construction posts, boards, scantlings and general joining works, boat building, handicrafts, bobin, plywood, tea-chests, match sticks, match boxes, lumber and other uses[9]. Quality seedlings lead to better survival in the plantation and reduce the rotation of the plantations. The present study involved a factorial combination of two nutrients nitrogen and potassium at four levels in the potting mixture to observe the effects of added inorganic fertilizers (N and P) on the seedlings of *Michelia champaca.*

The objective was to find out an optimum dose of inorganic fertilizers for raising quality seedlings of *Michelia champaca*. The recommended dose will produce healthy seedlings for large-scale plantation programmes to ensure successful plantation and to ensure proper feedback from the plantains in desired time.

MATERIALS AND METHODS

The study was conducted during the month of November to August 1997-1998 in the nursery of Institute of Forestry and Environmental Sciences, University of Chittagong (IFESCU) campus, Chittagong, Bangladesh. The soil used in the nursery was moderately coarse to fine

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Table 1: Level of nutrients applied

			Grams added per pot			
Commercial fertilizer		Elements	(0 kg ha^{-1})	(38 kg ha^{-1})	(77 kg ha^{-1})	(175 kg ha^{-1})
Urea	46% of N	N	0	0.135	0.293	0.6413
TSP	48% of P_2O_5	P	0	0.144	0.287	0.6298

textured. It has a gray to olive gray, sandy loams sub soil with moderate coarse and medium angular blocky structure. The nursery site enjoys a tropical monsoon climate characterized by hot, humid summer and cool, dry winter. The average monthly mean temperature varied between 21.8 to 29.2°C maximum and between 15° to 26°C minimum. Relative humidity was generally the lowest (64%) in February and highest (95%) in June-July-August and September.

For these experiments Urea and TSP were used as nutrients. Urea contains 46% of nitrogen, TSP (Triple super phosphate) 48% of P_2O_5. The seeds used in the experiment were collected from the Seed Orchard Division of Bangladesh Forest Research Institute, Chittagong, Bangladesh. 9"x6" polybags were used for the experiment. The potting media used were a mixture of forest topsoil and cow dung in a ratio of 3:1. Topsoil were collected 6-8 weeks before filling the bags. The mixture was made more or less uniform before filling in the polybags, so that it was free form root splinters and other foreign materials. A 2^4 factorial design based on randomized complete block with four replicates and ten seedlings were used in each replicates of 16 treatments. There were altogether 640 seedlings involving 16 treatment combinations. The germination bed was prepared by mixing the forest topsoil and cow dung with 3:1 ratio. Seeds were spread on the germination bed and a thin layer of soil was spread over the seeds. Within three weeks almost all the viable seeds were germinated. After 63 days of first germination, seedlings were transferred to poly bags of size 9"x6" and the average size of the seedlings was 3 cm in height.

The amount of nutrients added and the experimental design were as follows Treatment 1: N_0P_0(0 g urea seedling^{-1}; 0 g TSP seedling^{-1}) ; Treatment 2: N_0P_1(0 g urea seedling^{-1}, 0.144 g TSP seedling^{-1}); Treatment 3: N_0P_2 (0 g urea seedling^{-1}; 0.287 g TSP seedling^{-1}); Treatment 4: N_0P_3 (0 g urea seedling^{-1}; 0.630 g TSP seedling^{-1}); Treatment 5: N_1P_0(0.135 g urea seedling^{-1}; 0 g TSP seedling^{-1}); Treatment 6: N_1P_1(0.135 g urea seedling^{-1}; 0.144 g TSP seedling^{-1}); Treatment 7: N_1P_2(0.135 g urea seedling^{-1}; 0.287 g TSP seedling^{-1}); Treatment 8: N_1P_3(0.135 g urea seedling^{-1}; 0.630 g TSP seedling^{-1}); Treatment 9: N_2P_0(0.293 g urea seedling^{-1}; 0 g TSP seedling^{-1}); Treatment 10: N_2P_1(0.293 g urea seedling^{-1}; 0.144 g TSP seedling^{-1}); Treatment 11: N_2P_2(0.293 g urea seedling^{-1}; 0.287 g TSP seedling^{-1}); Treatment 12: N_2P_3(0.293 g urea seedling^{-1}; 0.630 g TSP seedling^{-1}); Treatment 13: N_3P_0(0.641 g urea seedling^{-1}; 0 g TSP seedling^{-1}); Treatment 14: N_3P_1(0.641 g urea seedling^{-1}; 0.144 g TSP seedling^{-1}); Treatment 15: N_3P_2(0.641 g urea seedling^{-1}; 0.287 g TSP seedling^{-1}) and Treatment 16: N_3P_3(0 g urea seedling^{-1}; 0.630 g TSP seedling^{-1}). Following the treatments in each level 0, 38, 77 and 175 kg ha^{-1} Urea and TSP were applied (Table 1). Watering was carried regularly by fine shower, which could not disturb the seedlings physically. Removal of weeds, grasses etc. were done as far as possible.

Information recorded: After the establishment of the experiment, information were recorded periodically. The measurement of height was taken from the ground level to the tip of the seedlings by using meter scales. Measurement of diameter at collar region was taken at the ground level using slide calipers. Leaf area was determined by grid plate method. After 22 weeks of fertilization seedlings were harvested and separated into root, shoot and leaf components. Fresh and dry weights were taken for each seedling compound with electronic balance. Total biomass (Total dry weight) were taken by adding dry weight of root, stem and leaf. After harvesting fresh weight dry weight ratio (FWR), leaf area ratio (LAR), stem weight ratio (SWR), root weight ratio (RWR), leaf weight ratio (LWR) and root/shoot ratio (R/S) were derived by using formulae of Briggs *et al.* [10]. Relative height growth rate (RGRh) was estimated by using the formula of Hunt[11].

Analysis of variance was done for the factorial experiment. Individual responses were detected by following the factorial experiment example described by Zaman *et al.* [12]. Duncan multiple range tests (DMRT) were used to compare mean values of all the treatments and for the 4 levels of nutrient.

RESULTS

Seedling growth: Application of fertilizer dozes did not effect significantly on height growth and relative height growth rate, survival and total leaf area production. N doze significantly effected diameter growth, total biomass production of the seedlings. The effect of P was generally not significant. There was interaction effect on only fresh weight ratio but no effect on growth variables (Table 2).

Table 2: Analysis of variance for different growth parameters

Parameters	Source of variation: Main Factors: Nitrogen (N)	Phosphorus (P)	Interaction N*P
Survival percentage	NS	NS	NS
Height at different interval:			
0 week	NS	NS	NS
4.5 week	NS	NS	NS
9 week	NS	NS	NS
13 week	NS	NS	NS
17 week	NS	NS	NS
22 week	NS	NS	NS
Relative height growth rate			
4.5 week	NS	NS	NS
9 week	NS	NS	NS
13 week	NS	NS	NS
17 week	NS	NS	NS
22 week	NS	NS	NS
Collar dia at different interval:			
0 week	NS	NS	NS
9 week	***	NS	NS
22 week	***	NS	NS
Fresh leaf weight	**	NS	NS
Fresh root weight	***	NS	NS
Fresh stem weight	**	NS	NS
Oven dry wt. of root	**	NS	NS
Oven dry wt. of stem	**	NS	NS
Oven dry wt. of leaf	NS	NS	NS
Leaf area	NS	NS	NS
Total bioruass	**	NS	NS
Steru weight ratio	NS	NS	NS
Root weight ratio	NS	NS	NS
Fresh weight ratio	***	NS	***
Leaf area ratio	***	NS	NS
Leaf weight ratio	NS	NS	NS
Root shoot ratio	NS	NS	NS

: Significant at 5% level, * Significant at 1% level,
NS: Non-significant

Comparison of treatment means showed that collar dia. and total dry matter production is markedly better for those seedlings applied with fertilizers than those in the control. The differences were significant for collar diameter increment, fresh weight of root, stem and leaf, dry weight of stem, total biomass production, fresh weight ratio and leaf weight ratio according to Duncun's Mulitple Range Tests (Table 3-6). Following are some important growth response patterns:

Survival: Fertilizer dozes had not significant effect on survival percentage, i.e. there is no mortality rate.

Height and relative height growth rate: The seedlings used in the fertilizer experiment were not significantly different in their initial height. From Table 3 it is clear that there were no significant differences at any intervals on height growth due to fertilizer application. But data of 9 to 22 weeks indicate that N_2 P_2 yielded better at all stages. After 22 weeks (150 days) of fertilization highest (50.27 cm) shoot length was found with N_2P_2 where as the lowest (38.64 cm) was found with N_0P_0. Individually N_2 doze P_2 dozes have better effect on height growth. Relative height growth rate at different times were not also significant (Table 2).

Coller diameter increment: The seedlings used in the fertilizer experiment were not significantly different in their initial diameter growth (Table 2 and 4). Though the collar diameter was measured at three different intervals and presented in the Table for subsequent growth prediction. Finally data of 22 weeks were considered for describing the result. The highest (98.50 mm) collar diameter was found with N_2P_1 fertilizer application and lowest (79 mm) with N_0P_0. The best dia increment response was found with the level 2 of Nitrogen and the level 2 of phosphorus. Though there was no significant difference for phosphorus levels (Table 2).

Total leaf area (cm^2): Different combination had no significant effect on leaf area production (Table 2). Highest (762.10 cm^2) fertilizer leaf area was found with N_3P_1 were as the lowest (597.20 cm^2) with N_1P_3 (Table 4). It indicated a negative response of phosphorus doze to leaf area expansion.

Fresh weight of root, stem and leaf: The responses to different parameters (fresh wt. of leaf, stem, root) were significant due to fertilizer dozes (Table 2). Response on production of fresh root weight was significant at 1% level. Best production (20.87 g) achieved with N_1P_2 where the lowest 7.79 g) was with control (N_0P_0) treatment (Table 5). N_2 gave best yield. On the other hand, though effect of P was not significantly different but P_2 gave better yield. Response on production of fresh stem weight was significant at 1% level (Table 2). Here, the responses followed the same trend of the fresh root wt. (Table 5). N_2 and P_2 level of fertilizer individually gave best growth. There was no significant effect of P dose on fresh root weight. Production of fresh leaf weight was significant at 5% level (Table 2). On fertilizer application same trend of fresh root production was also found for the fresh leaf weight production (Table 5). Individually N_2 dose gave better result in combination with P_2 than others.

Dry weight of root, stem and leaf: Dry wt. of root and stem showed significant response to fertilizer dozes (Table 2), which was only due to nitrogen doze. Phosphorus has no significant effect on these parameters. Fertilizer application had no significant effect on dry wt. of leaf (Table 2), but total dry matter production is significantly effected by fertilizer application at 5% level (Table 2).

Table 3: Height (cm) of Champa seedlings at different intervals (Values in the columns followed by the same letter(s) are not significantly different

H. 0 Week	H. 4.5 Week	H. 9 Week	H. 13 Week	H. 17 Week	H.22 Week
3.11a	5.15a	8.95a	17.66a	31.49a	50.27a
(N_1P_0)	(N_1P_0)	(N_3P_3)	(N_2P_2)	(N_2P_2)	(N_2P_2)
2.88a	4.99a	9.56a	17.37a	30.13a	48.13a
(N_1P_2)	(N_0P_2)	(N_3P_2)	(N_2P_3)	(N_2P_3)	(N_1P_2)
2.86a	4.69a	9.93a	14.89a	29.34a	47.72a
(N_1P_3)	(N_1P_2)	(N_3P_1)	(N_2P_1)	(N_2P_1)	(N_2P_3)
2.79a	4.66a	8.51a	14.76a	27.08a	47.61a
(N_2P_2)	(N_3P_3)	(N_3P_0)	(N_3P_1)	(N_1P_2)	(N_3P_1)
2.78a	4.66a	10.99a	14.27a	26.35a	46.96a
(N_2P_1)	(N_0P_0)	(N_2P_3)	(N_1P_2)	(N_3P_2)	(N_2P_1)
2.76a	4.61a	11.29a	14.15a	26.27a	46.47a
(N_2P_0)	(N_0P_3)	(N_2P_2)	(N_3P_2)	(N_3P_1)	(N_1P_3)
2.75a	4.60a	9.77a	13.73a	25.36a	44.58a
(N_3P_2)	(N_2P_0)	(N_2P_1)	(N_3P_3)	(N_1P_3)	(N_1P_1)
2.75a	4.60a	8.32a	12.72a	24.87a	44.25a
(N_0P_0)	(N_0P_1)	(N_2P_0)	(N_1P_1)	(N_3P_3)	(N_3P_2)
2.74a	4.58a	8.61a	12.43a	24.86a	42.64a
(N_3P_3)	(N_2P_1)	(N_1P_3)	(N_3P_0)	(N_1P_1)	(N_0P_3)
2.74a	4.56a	9.41a	12.40a	24.33a	42.49a
(N_0P_3)	(N_3P_2)	(N_1P_2)	(N_1P_3)	(N_3P_0)	(N_3P_0)
2.68a	4.52a	8.68a	12.13a	23.86a	42.45a
(N_2P_3)	(N_1P_3)	(N_1P_1)	(N_2P_0)	(N_2P_0)	(N_2P_0)
2.68a	4.51a	8.61a	11.00a	22.60a	41.60a
(N_1P_1)	(N_1P_1)	(N_1P_0)	(N_1P_0)	(N_1P_0)	(N_3P_3)
2.64a	4.50a	7.02a	10.91a	22.31a	41.00a
(N_0P_1)	(N_3P_1)	(N_0P_3)	(N_0P_2)	(N_0P_3)	(N_1P_0)
2.61a	4.34a	7.78a	10.33a	22.25a	39.72a
(N_0P_2)	(N_3P_0)	(N_0P_2)	(N_0P_1)	(N_0P_2)	(N_0P_2)
2.57a	4.30a	7.65a	9.77a	21.52a	39.45a
(N_3P_0)	(N_2P_2)	(N_0P_1)	(N_0P_0)	(N_0P_1)	(N_0P_1)
2.56a	4.29a	7.24a	9.32a	21.02a	38.64a
(N_0P_1)	(N_2P_3)	(N_0P_0)	(N_0P_3)	(N_0P_0)	(N_0P_0)

Table 4: Collar dia (mm) at different intervals, leaf area (cm^2)

CO.DI.0 Week	CO. DI. 9 Week	CO.DI. 22 Week	Leaf area
26.00a	61.25a	98.50a	762.10a
(N_1P_3)	(N_2P_1)	(N_2P_1)	(N_3P_1)
26.00a	56.50ab	95.50ab	748.60a
(N_3P_0)	(N_2P_2)	(N_2P_2)	(N_1P_2)
25.75a	56.00b	95.25a-c	742.70a
(N_0P_3)	(N_1P_2)	(N_2P_3)	(N_0P_2)
25.75a	55.75b	94.75a-d	724.50a
(N_3P_3)	(N_3P_0)	(N_1P_2)	(N_2P_2)
25.00a	55.50b	94.00a-d	713.80a
(N_2P_0)	(N_2P_0)	(N_3P_0)	(N_3P_2)
24.75a	55.00b	93.00a-d	706.70a
(N_1P_0)	(N_2P_3)	(N_3P_1)	(N_2P_3)
24.75a	54.50b	92.50a-e	702.70a
(N_2P_2)	(N_3P_1)	(N_1P_1)	(N_1P_1)
24.50a	54.00bc	92.00a-e	698.00a
(N_1P_2)	(N_3P_3)	(N_3P_2)	(N_2P_1)
24.00a	53.00bc	90.00a-f	691.20a
(N_3P_2)	(N_3P_2)	(N_3P_3)	(N_1P_0)
23.75a	52.50bc	89.75a-f	682.80a
(N_2P_3)	(N_1P_3)	(N_2P_0)	(N_0P_1)
23.75a	52.00bc	86.75b-f	666.10a
(N_3P_1)	(N_1P_1)	(N_1P_3)	(N_0P_3)
23.50a	49.00c	85.25c-f	665.60a
(N_0P_2)	(N_1P_0)	(N_0P_2)	(N_3P_3)
23.25a	48.75c	84.75d-f	646.80a
(N_0P_1)	(N_0P_2)	(N_1P_0)	(N_2P_0)
23.25a	48.75c	81.75ef	632.00a
(N_1P_1)	(N_0P_3)	(N_0P_1)	(N_0P_0)
22.50a	47.00cd	79.75f	599.80a
(N_0P_0)	(N_0P_1)	(N_0P_3)	(N_3P_0)
22.25a	42.50d	79.00f	597.20a
(N_2P_1)	(N_0P_0)	(N_0P_0)	(N_1P_3)

Values in the columns followed by the same letter(s) are not significantly different

N_1P_2 yielded best (13.47 g) total dry matter where as control yielded the lowest (9.13 g) (Table 5). N_2 and P_2 had highest response to total biomass production.

Different growth variables: Fertilizer treatment had significant effect (at 1% level) on fresh weight ratio and leaf ratio. Interaction effect was also found significant (at 1% level) on fresh weight ratio (Table 2). Table 6 presents the response of seedlings to different fertilizer combination on different growth variables. Fresh wt ratio was highest at N_1P_o and lowest with No P_1. Similarly, leaf area ratio was highest with N_1P_o and lowest at N_3P_o. However, on other growth variables there are no significant effect of fertilizer treatments. Both the nitrogen and phosphorus doze has positive effect on root/shoot ratio but not significant. Though there was no significant effect N_3 and P_2 has highest response in comparison to other dozes.

DISCUSSION

Morphological characteristics are the physical or visually determinable attributes of a tree seedling. The major morphological criteria used to describe seedling quality are shoot height, stem diameter, root mass and shoot/root ratio. These are the basis for grading seedlings at the nursery. The results of this fertilizer study conform

Table 5: Fresh and dry matter production (g) of champa seedlings. (Values in the columns followed by the same letter(s) are not significantly different

FR.RT.WT.	FR.ST.WT.	FR.LF.WT.	DR.WT.RT.	DR.WT.ST.	ODR.LF	W (G)
20.86a	15.25a	17.63a	4.62a	4.23a	4.62a	13.47a
(N_1P_2)	(N_1P_2)	(N_1P_2)	(N_1P_2)	(N_1P_2)	(N_1P_2)	(N_1P_2)
19.78a	15.09a	15.99ab	4.38ab	4.22a	4.40a	12.45ab
(N_2P_1)	(N_2P_1)	(N_2P_1)	(N_2P_2)	(N_2P_1)	(N_0P_1)	(N_2P_2)
18.39a	14.65ab	15.57a-c	4.25a-c	4.19ab	4.17a	12.30ab
(N_1P_0)	(N_2P_2)	(N_2P_3)	(N_3P_1)	(N_2P_2)	(N_3P_3)	(N_2P_1)
17.84ab	14.32ab	15.31a-c	4.19a-c	4.03a-c	4.09a	12.17a-c
(N_2P_3)	(N_2P_3)	(N_2P_2)	(N_3P_2)	(N_2P_3)	(N_2P_0)	(N_2P_3)
17.77a-c	13.42ab	15.28a-c	4.11a-d	3.68a-c	4.04a	11.75a-d
(N_1P_1)	(N_1P_1)	(N_2P_0)	(N_2P_3)	(N_1P_1)	(N_2P_3)	(N_3P_1)
17.49a-c	12.47ab	15.02a-c	4.05a-d	3.61a-c	4.03a	11.38a-d
(N_3P_2)	(N_2P_0)	(N_1P_1)	(N_2P_1)	(N_3P_1)	(N_2P_1)	(N_3P_3)
17.37a-c	12.11ab	14.63a-c	4.01a-d	3.49a-c	3.90a	11.27a-d
(N_2P_0)	(N_3P_2)	(N_1P_3)	(N_3P_0)	(N_2P_0)	(N_3P_1)	(N_3P_0)
16.68a-c	12.04ab	14.61a-c	3.97a-e	3.40a-c	3.88a	11.16a-d
(N_2P_2)	(N_3P_1)	(N_3P_1)	(N_3P_3)	(N_3P_0)	(N_2P_2)	(N_3P_2)
16.31a-c	11.87ab	14.57a-c	3.81a-e	3.31a-c	3.86a	11.14a-d
(N_3P_1)	(N_3P_0)	(N_3P_3)	(N_1P_1)	(N_3P_2)	(N_3P_0)	(N_1P_1)
16.02a-c	11.80ab	14.52a-c	3.79a-e	3.25a-c	3.81a	11.07a-d
(N_1P_3)	(N_1P_3)	(N_3P_2)	(N_0P_2)	(N_1P_3)	(N_1P_3)	(N_2P_0)
15.23bc	11.18ab	13.90a-c	3.49b-e	3.24a-c	3.67a	10.50a-d
(N_0P_3)	(N_1P_0)	(N_3P_0)	(N_2P_0)	(N_3P_3)	(N_3P_2)	(N_0P_1)
14.35b-d	11.16ab	13.89a-c	3.39b-e	2.98a-c	3.65a	10.45b-d
(N_3P_3)	(N_3P_3)	(N_1P_0)	(N_1P_3)	(N_0P_2)	(N_1P_1)	(N_1P_3)
14.24b-d	10.75ab	13.36bc	3.29c-e	2.83bc	3.65a	10.40b-d
(N_0P_2)	(N_0P_2)	(N_0P_2)	(N_0P_1)	(N_1P_0)	(N_0P_2)	(N_0P_2)
12.77cd	10.34ab	12.35bc	3.08de	2.82c	3.47a	9.27cd
(N_3P_0)	(N_0P_1)	(N_0P_3)	(N_0P_3)	(N_0P_1)	(N_1P_0)	(N_0P_3)
9.93de	10.30ab	12.29bc	3.06de	2.81c	3.38a	9.23d
(N_0P_1)	(N_0P_3)	(N_0P_1)	(N_0P_0)	(N_0P_3)	(N_0P_3)	(N_1P_0)
7.79e	9.97b	11.91c	2.93e	2.81c	3.27a	9.13d
(N_0P_0)	(N_0P_0)	(N_0P_0)	(N_1P_0)	(N_0P_0)	(N_0P_0)	(N_0P_0)

FR.RT.WT = Fresh wt. of root. FR.ST.WT = Fresh wt. of stem. FR.LF.WT = Fresh wt. of leaf.
DR. WT.RT = Dry wt. of root. DR. WT.ST = Dry wt. of stem. ODR.LF = Dry wt. of leaf.
W(G) = Total biomass.

with the general expected response, where application of fertilizers yielded better growth and seedlings quality. This is also in agreement with earlier reports on other plantation species, e.g. *Pinus caribaea*[13-15], *Tectona grandis*[16], *Dryobalanops aromatica* and *D. oblongifolia*[16]. Positive effects of fertilization were also reported on Lobolly pine[17-19], white spruce[20] and Douglas-fir[21-23] while negative effect for sitka spruce[24] and white- spruce[25] was also recorded.

In the present experiment no toxic effect of nitrogen and phosphorus doze. This agrees with the finding of Hartley[26] and Kadeba[27] Where addition of excess fertilizer on *pinus caribaea* depressed growth and increased mortality on Nigexian Savannah sites.

Applying too high a doze, young trees may severely damaged[28]. Similarly Kadeba[27], Ojo and Jackson[29] reported that urea caused 50% mortality of seedlings if applied wrongly. Though little is known about the effects of nursery fertilization on seedling performance in the field, studies have been found positive effects of fertilization on either height growth or survival. Seedling height at the time of outplanting can greatly influence the growth rate in the field. The response of several major timber species to N fertilization have been evaluated, including loblolly pine[17], lodgepole pine[30] and white spruce[3]. Positive responses of fertilization also reported by Wilde *et al.*[31], Jung and Richle[32], Switzer and Nelson[17], Smith *et al.*[33], Sudvitsyna[34], Karami[35], Onuwaje and Ozu[36], Van Den Driessche[23], Zwierink[37], Awang and katim[38].

Results of the present study revealed that N and P fertilization (upon the dozes used) have no effect on the mortality of seedlings. Total height and relative height growth rate of the species is not significantly effected by the N and P applications. However N has significant effect in collar dia. increment but P has no significant effect in the same parameter (Table 2). Considering the case of fresh and dry weight of root, shoot and leaf for the seedlings of Kadam 77 kg N ha^{-1} and 77 kg P ha^{-1} had gave the best responses, These findings are in support of the earlier findings in other species[16,39-43] where the same interesting differences were also found.

Different growth variables such as total biomass for Champa 77 Kg N ha^{-1} in addition to 77 kg P ha^{-1} gave the best response. There were significant decreases in fresh weight ratio as the nitrogen doze increases. No significant differences were found in stem weight ratio, leaf area ratio,

Table 6: Different growth variables of Champa seedlings (Values in the columns followed by the same letter(s) are not significantly different

F.W.R	LAR	S.W.R	R.W.R	L.W.R	R/S
4.734a	75.023a	0.531a	3.500a	0.413a	0.656a
(N_1P_0)	(N_1P_0)	(N_2P_0)	(N_3P_3)	(N_0P_1)	(N_0P_0)
4.147ab	71.805ab	0.344a	3.322 a	0.377a	0.617a
(N_1P_1)	(N_0P_3)	(N_2P_1)	(N_1P_3)	(N_1P_0)	(N_3P_2)
4.137b	71.103a-c	0.337a	0.380a	0.374a	0.598a
(N_2P_1)	(N_0P_2)	(N_2P_2)	(N_3P_2)	(N_2P_0)	(N_3P_0)
4.130b	67.289a-d	0.331a	0.368a	0.368a	0.584a
(N_2P_0)	(N_0P_0)	(N_2P_3)	(N_3P_0)	(N_3P_3)	(N_0P_2)
4.108b	64.893a-d	0.328a	0.366a	0.366a	0.572a
(N_1P_3)	(N_3P_1)	(N_1P_1)	(N_0P_2)	(N_0P_3)	(N_3P_1)
4.075bc	64.841a-d	0.317a	0.360a	0.363a	0.546a
(N_0P_3)	(N_0P_1)	(N_1P_2)	(N_3P_1)	(N_1P_3)	(N_2P_2)
4.013bc	64.605a-d	0.316a	0.355a	0.352a	0.543a
(N_1P_2)	(N_3P_2)	(N_1P_3)	(N_0P_0)	(N_0P_0)	(N_3P_3)
3.994b-d	63.211a-d	0.308a	0.352a	0.350a	0.527a
(N_3P_2)	(N_1P_1)	(N_3P_1)	(N_2P_2)	(N_0P_2)	(N_1P_1)
3.921b-e	59.430b-d	0.302a	0.343a	0.344a	0.523a
(N_2P_3)	(N_2P_0)	(N_1P_0)	(N_1P_1)	(N_3P_0)	(N_1P_2)
3.755b-e	58.617b-d	0.297a	0.343a	0.340a	0.519a
(N_2P_2)	(N_2P_2)	(N_0P_3)	(N_1P_2)	(N_1P_2)	(N_0P_3)
3.702b-e	58.045cd	0.296a	0.338a	0.332a	0.514a
(N_0P_2)	(N_1P_3)	(N_3P_2)	(N_0P_3)	(N_3P_1)	(N_2P_3)
3.660b-f	57.822cd	0.294a	0.338a	0.331a	0.490a
(N_3P_1)	(N_2P_3)	(N_0P_0)	(N_2P_3)	(N_2P_3)	(N_0P_1)
3.513c-f	57.763cd	0.288a	0.328a	0.329a	0.490a
(N_3P_3)	(N_3P_3)	(N_3P_0)	(N_2P_1)	(N_1P_1)	(N_2P_1)
3.422d-f	57.001cd	0.284a	0.324a	0.327a	0.483a
(N_3P_0)	(N_2P_1)	(N_0P_2)	(N_0P_1)	(N_2P_1)	(N_1P_0)
3.234ef	56.251d	0.282a	0.321a	0.324a	0.476a
(N_0P_0)	(N_1P_2)	(N_3P_3)	(N_1P_0)	(N_3P_2)	(N_1P_3)
3.126f	54.156d	0.263a	0.314a	0.311a	0.460a
(N_0P_1)	(N_3P_0)	(N_0P_1)	(N_2P_0)	(N_2P_2)	(N_2P_0)

FWR = Fresh wt./dry wt. ratio. LAR = Leaf area ratio. SWR = Stem wt. ratio.
RWR = Root wt. ratio. LWR = Leaf wt. ratio. R/S = Root/shoot ratio.

leaf weight ratio, root weight ratio. Hence no significant differences in these growth attributes and no drastic impact on photosynthetic activities of the plant were noticed. However reports on these growth variables are not available.

There was no significant difference in leaf area production were not significantly different. Many workers have reported the effect of root: short ratio on the subsequent growth and survival[44-56]. It is often assumed that nitrogen fertilization increases shoot weight proportionately more than root weight. Thus the root: shoot ratio will decrease with increasing fertilization. This imbalance could adversely effects field performance. However, data of loblolly pine[17], Douglasfir, Sitka spruce and lodgepole pine[23] indicated fertilization have little or at worst minimal negative impact on root shoot ratio. Seedlings usually have been reared with the view that growth and survival will be best when the shoot/root ratio is between 1 and 3[57,58]. Works by Walker and Johnson[59] with northern species of spruce (*Picea* sp) and pine shows that much higher shoot : root ratios may be better for container grown seedlings. In the present study no significant difference found for shoot/root ratio as well as root/shoot ratio due to N and P fertilization. However, the present findings are closely similar to the result of Rowan[60] and Wells[61]. The significant effect of N fertilization may indicate that the Chittagong University campus soils used for nursery grown media are deficient in nitrogen but there is no deficiency of phosphorus for champa seedlings.

The use of fertilizers discriminately to promote early growth of forest plantations is already an accepted policy. In Peninsular Malaysia, Yong[62] recommended the application of 120 g of rock phosphate into each planting hole at the time of planting, boosted by another 120 g of rock phosphate and 60 g of triple super phosphate one year after planting. These in total equivalent to 300 kg P ha^{-1}. However, the application of N and P at the rate of 77 kg N ha^{-1} + 77 kg P ha^{-1} for champa may be needed to Chittagong University campus soil to boost the initial diameter, leaf area and dry matter production. However these levels may have to varied depending on different soil types as already been reported for *Casuarina equisitfolia*[63] and for *Gmelina arborea* and *Swietenia mahagoni*[64].

However the results obtained from pot trials cannot be extrapolated to the field due to differences in soil volume, presence of impeding hogizons or moisture stress[38,65]. Instead these pot trials shold serve as a guidance for field application or further field studies into the effects of these nutrients on the growth of *Michelia champaca*.

Considering the findings of the experiment the following conclusions may be drawn:

- The total height and relative height growth rate of champa seedlings are not significantly influenced by different dozes used in these experiments. But the level N_2 and P_2 have shown better result for the species (77 kg ha^{-1}) for Champa.
- The collar diameter growth of the seedlings are effected by the nitrogen doze but not effected by phosphorus doze. Here N_2 and P_2 level for Champa 77 kg ha^{-1} best result.
- Total fresh weight, dry weight and total biomass are increased due to Nitrogen addition but here also (in most of the cases) N_2 and P_2 dozes had shown better performance.
- In case of leaf area N_2 and P_2 level (both separately 77 kg ha^{-1}) had shown better performance.
- Form over all aspects, it is found that, Nitrogen fertilizers obviously have beneficial effect increase the diameter, total biomass, leaf area of champa in the present potting media used for nursery raising.

It is also found that in respects of the seedlings of the control treatment, all the seedlings of the other treatment differ in their performance of collar dia. growth, total biomass and leaf area but beyond (above) the level 2 very few positive responses have found.

Of coarse, fertilizers accelerate the growth of seedlings in the nursery. But in fact fertilizers also may destroy whole the nursery by toxic effect. Here it is found that treatment N_2P_2 showed the best performance. On the other hand from the study it is clear that up to level 2 fertilizer dozes should there be fixed to avoid the toxic effect of and to augment the best results. Another thing is that the use of nitrogen and phosphorus fertilizers should there be in carefully in this study as it has itself toxic effects seriously.

Finally it may be recommended that in the nursery practice of *M. champaca* seedlings, the combination of fertilizers belonging the treatment N_2P_2 should be applied.

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