



Faculty of Resource Science and Technology

**EFFECTS OF NITROGENOUS FERTILIZER AND GROWING
MEDIA ON THE GROWTH OF *EUGENIA GRANDIS* WIGHT**

Mazia Ismail

Bachelor of Science With Honours
(Plant Resource Science and Management)
2004

QK
901
M475
2004

**EFFECTS OF NITROGENOUS FERTILIZER AND GROWING MEDIA ON THE
GROWTH OF *Eugenia grandis* WIGHT**

P. KHIDMAT MAKLUMAT AKADEMIK
UNIMAS



1000128254

MAZIA ISMAIL

This project is submitted in partial fulfilment of the requirements for the degree of
Bachelor of Science with Honours
(Plant Resource Science and Management)

Faculty of Resource Science and Technology
UNIVERSITY MALAYSIA SARAWAK
2004

ACKNOWLEDGEMENT

First and foremost, ALHAMDULILLAH, a highly gratitude especially for Allah SWT the almighty, as I had successfully completed my final year project.

I wish to express my deepest gratitude and sincere appreciation to my supervisor, Madam Dayang Awa Abang Lingkeu and my co-supervisor, Dr. Sim Soon Liang for their valuable advices and precious guidances during the completion of this project.

Million of thanks are extended to Dr. Sepiah Muid, Dr. Liew Kang Chiang, Dr. Ling Teck Yee, Dr. Chieng Tiong Chin and Plant Laboratory assistants for their help and support during the implementation of this project.

My furthest gratitude also dedicated to all my supportive friends for their companionship, understanding and willingness.

Lastly, my devoted appreciation and utmost thankfulness especially to my family for their never ending love, supports and prayers.

Thank you.

Effects of Nitrogenous Fertilizer and Growing Media on the Growth of *Eugenia grandis* Wight.

Mazia Ismail

Plant Resource Science and Management Programme
Faculty of Resource Science and Technology
University Malaysia Sarawak

ABSTRACT

Eugenia grandis Wight is a valuable roadside tree species in Myrtaceae family. In this growth study, a total of 240 of two months old seedlings of *Eugenia grandis* were potted into polythene bags containing three different types of growing media i.e. topsoil (a_1), mixture of topsoil and sand in ratio 2:1(a_2) and mixture of topsoil and peat soil in ratio 2:1(a_3). Seedlings growing in each of the growing media were treated with four levels of ammonium nitrate i.e. 0mg/l (b_1), 50mg/l (b_2), 100mg/l (b_3) and 150mg/l (b_4). The study indicated that types of growing media and different levels of ammonium nitrate showed significant effects on the seedlings growth and total biomass production. The seedlings grown in a_2 have the best growth and lowest biomass production while seedlings grown in a_1 showed the opposite. From the levels of ammonium nitrate aspect, the highest growth was achieved by b_4 and the lowest growth and biomass production was attained by b_1 . The study concluded that interaction between a_2 and b_4 is the suitable combination for the growth of *Eugenia grandis*.

Key words: *Eugenia grandis*, types of growing media, levels of ammonium nitrate, growth

ABSTRAK

Eugenia grandis Wight merupakan salah satu spesies tanaman hiasan jalan yang berharga dalam famili Myrtaceae. Dalam kajian tumbesaran ini, sebanyak 240 anak benih *Eugenia grandis* yang berumur dua bulan telah ditaburkan dalam polibeg dengan menggunakan 3 jenis media yang berbeza iaitu tanah sahaja (a_1), campuran tanah dan pasir dengan nisbah 2:1(a_2) dan campuran tanah dan tanah gambut dengan nisbah 2:1(a_3) serta diberi rawatan dengan 4 jenis ammonium nitrat yang berbeza iaitu 0mg/l(b_1), 50mg/l(b_2), 100mg/l(b_3) dan 150mg/l(b_4). Kajian ini menunjukkan bahawa jenis media dan jenis ammonium nitrat memberi kesan yang signifikan ke atas tumbesaran dan penghasilan biojisim anak benih *Eugenia grandis*. Anak benih yang ditanam dalam media a_2 menghasilkan tumbesaran tertinggi dan kandungan biojisim yang terendah manakala anak benih yang ditanam dalam media a_1 menunjukkan tumbesaran dan penghasilan biojisim yang sebaliknya. Dari aspek jenis ammonium nitrat, tumbesaran tertinggi diperolehi oleh b_4 dan tumbesaran serta penghasilan biomass paling rendah adalah daripada b_1 . Kajian mendapati bahawa kombinasi antara a_2 dan b_4 merupakan interaksi rawatan yang paling sesuai untuk tumbesaran anak benih *Eugenia grandis*.

Kata kunci: *Eugenia grandis*, jenis media, jenis ammonium nitrat, tumbesaran.

INTRODUCTION

Eugenia grandis locally known as *Jambu Laut*, *Ubah Laut* or Sea Apple is a big tropical tree plant of the Myrtaceae family. This plant is commonly distributed on rocky and sandy shores in Peninsular Malaysia, Borneo and Thailand.

E. grandis may reach up to 24 metres in the open or even 30 metres in the coastal forest, with tall obconic crown. The bark is grayish and the inner bark is pale pink to dark reddish and pale yellow near the surface. The leaf blades are large, broadly elliptic, shiny with down-turned tip and long stalk. Flowers are white and arranged in clusters. Fruits are oblong, with green leathery rind when ripe, dry and edible.

It has been reported (Corner, 1988) that *E. grandis* was planted as a roadside tree in Borneo and Thailand as well as in Peninsular Malaysia. Local people believe that the edible fruits of *E. grandis* are useful in treating hypertension, however there is no study on this.

Growing media especially soil plays an important role in growth of plants. Interaction of plants with soil contribute greatly to the success or failure of growth (Hanlon and Rhoads, 1988). Soils appear in different characteristics in terms of soil structure, texture, moisture, pH, salinity and compaction. These factors may affect the root penetration in the soil and the nutrient uptake by plants.

Nitrogen is one of the macronutrients required in plants. It is a component of proteins, nucleic acids, nucleotides, coenzymes and vitamins (Bannister, 1976). Requirement of minerals is different in different plant. Therefore, it is important to satisfy the need of minerals and nutrients to ensure the plant grows well. Insufficiency or excess of some elements leads to the disturbance of normal metabolism and showing symptom of nutritional disorder (Davidescu and Davidescu, 1982).

The objective of this study is to find out the effect of different levels of nitrogen and different types of growing media on the growth of *Eugenia grandis* and thus to seek for the best interaction between the two factors.

MATERIALS AND METHODS

Study Site

This study was conducted in the green house of Faculty of Resource Science and Technology, University Malaysia Sarawak with 50% of light intensity by using netting.

Resource of Study

Seeds from mature fruits of *Eugenia grandis* were obtained from along Bako Road, Petra Jaya, Kuching. The seeds were then germinated on seed bed. Two months old seedlings of *E. grandis* were potted in 15 x 22.5cm polybags filled with different growing media.

Experimental Design

It is a 3 x 4 factorial experiment with 20 replicates per treatment combination arranged in a Completely Randomized Design (CRD).

Factor a was types of growing media or substrate. There were three types, viz.

- a₁ - Topsoil
- a₂ - Mixture of topsoil and sand (2:1)
- a₃ - Mixture of topsoil and peat (2:1)

Factor b was level of ammonium nitrate (NH₄NO₃) applied. There were four levels, viz.

- b₁ - 0 mg/l NH₄NO₃
- b₂ - 50 mg/l NH₄NO₃
- b₃ - 100 mg/l NH₄NO₃
- b₄ - 150 mg/l NH₄NO₃

The ammonium nitrate (NH_4NO_3) was first applied when the seedlings are 3 months old at 100ml per polybag and subsequently at two weeks interval.

The total experimental units (polybags) were:

$$3 \times 4 \times 20 = \mathbf{240 \text{ polybags}}$$

Methodology

The three growing media used were topsoil (a_1) as control treatment, a mix of topsoil and sand with ratio 2:1(a_2) and a mix of topsoil and peat soil with ratio 2:1 (a_3).

The nitrogen treatments consisted of 4 levels, viz. 0 mg/l (b_1), 50 mg/l (b_2), 100 mg/l (b_3) and 150 mg/l (b_4) of ammonium nitrate (NH_4NO_3). The ammonium nitrate was applied in solution form. The ammonium nitrate (NH_4NO_3) was dissolved in distilled water and applied fortnightly. Seedlings in polybags were watered twice daily (morning and evening) except on rainy days.

Observations were made fortnightly starting from two weeks after potting and carried on for 14 weeks. Parameters measured were; height (measurement using 15cm ruler, starting from 1cm above the ground onto the highest shoot), diameter (measurement using digimatic caliper from 1 cm above the ground) and total numbers of leaf (only matured leaves were counted). After 14 weeks, seedlings were taken out carefully from the polybags. Shoots and roots were separated, cleaned and dried in the oven at 60°C for 3 days. Dry weights of shoots and roots were taking and the following were computed.

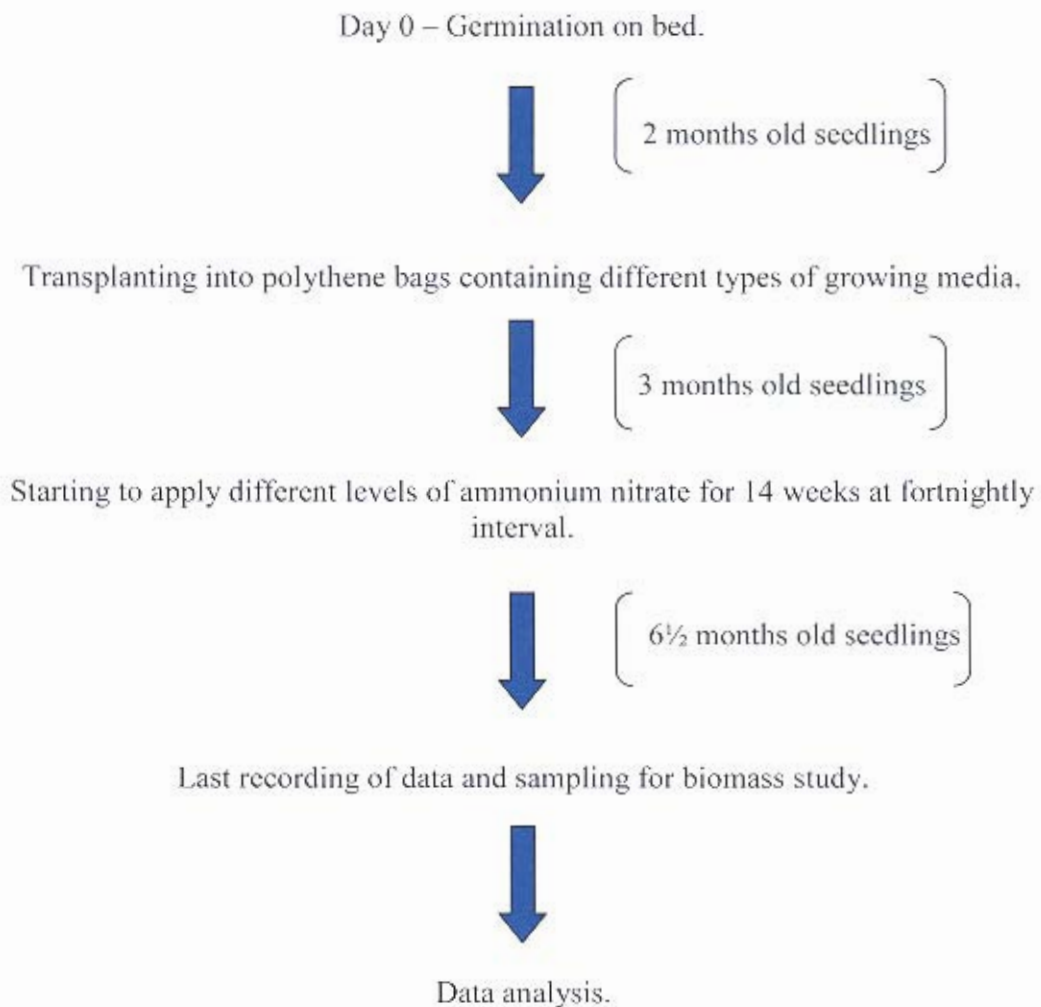
Total of biomass = dW* of roots + dW of shoots

Root / shoot ratio = dW of roots / dW of shoots

* dW refers to as dry weight

The results obtained were analyzed using the SPSS statistical package version 11.5.

Flow chart below showing the activities:



RESULTS

Table 1(a): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on plant height (cm) of *Eugenia grandis* seedlings at 2 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	5.87 ± 0.25*	6.47 ± 0.12	6.48 ± 0.20	6.27 ^b ± 0.20
50	5.84 ± 0.23	5.96 ± 0.13	6.42 ± 0.19	6.07 ^b ± 0.18
100	6.14 ± 0.21	5.82 ± 0.17	5.28 ± 0.17	5.75 ^a ± 0.25
150	5.58 ± 0.21	5.81 ± 0.12	6.59 ± 0.14	5.99 ^{ab} ± 0.31
Mean	5.86 ^a ± 0.12	6.01 ^{ab} ± 0.15	6.19 ^b ± 0.31	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

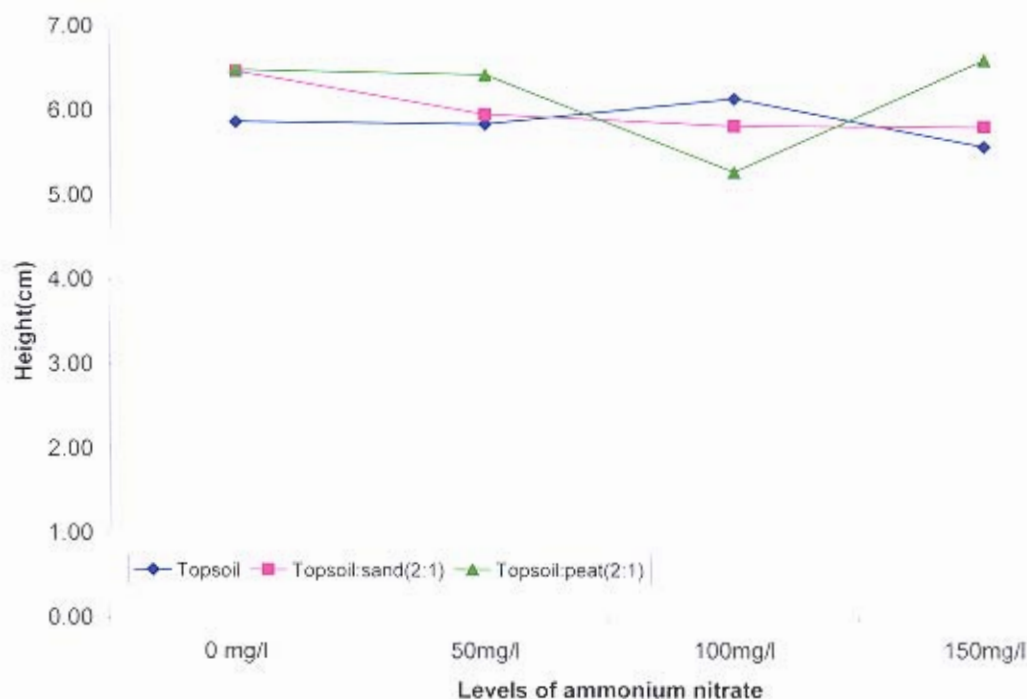


Figure 1(a): Mean height of *Eugenia grandis* seedlings grown in 3 different types of growing media at 2 weeks after application of 4 different levels of ammonium nitrate.

Table 1(b): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH₄NO₃) on plant height (cm) of *Eugenia grandis* seedlings at 4 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	6.15 ± 0.24*	7.02 ± 0.12	6.71 ± 0.19	6.63 ^a ± 0.26
50	6.33 ± 0.26	6.42 ± 0.15	6.65 ± 0.19	6.46 ^a ± 0.10
100	6.57 ± 0.27	6.64 ± 0.17	5.86 ± 0.17	6.36 ^a ± 0.25
150	5.99 ± 0.24	6.66 ± 0.17	6.80 ± 0.16	6.48 ^a ± 0.25
Mean	6.26 ^a ± 0.12	6.68 ^b ± 0.13	6.50 ^{ab} ± 0.22	

*refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

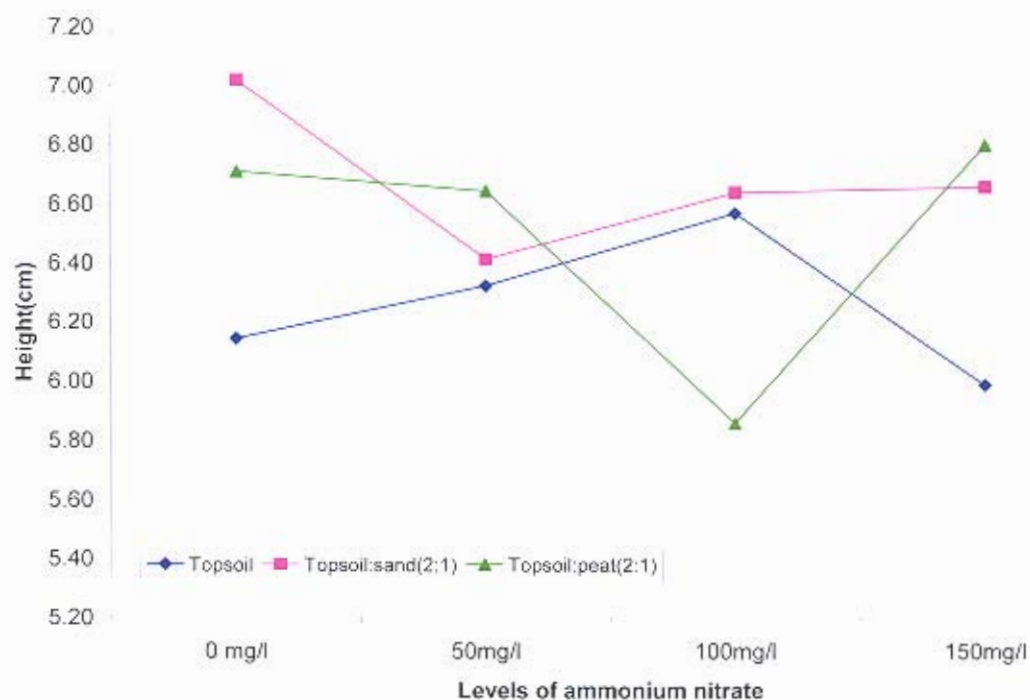


Figure 1(b): Mean height of *Eugenia grandis* seedlings grown in 3 different types of growing media at 4 weeks after application of 4 different levels of ammonium nitrate.

Table 1(c): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH₄NO₃) on plant height (cm) of *Eugenia grandis* seedlings at 8 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	7.06 ± 0.25*	7.81 ± 0.14	7.14 ± 0.19	7.34 ^a ± 0.24
50	7.38 ± 0.32	7.39 ± 0.19	7.10 ± 0.19	7.29 ^a ± 0.10
100	6.98 ± 0.27	8.13 ± 0.19	7.07 ± 0.19	7.39 ^a ± 0.37
150	6.68 ± 0.22	8.74 ± 0.28	7.18 ± 0.17	7.53 ^a ± 0.62
Mean	7.02 ^a ± 0.14	8.02 ^b ± 0.28	7.12 ^a ± 0.02	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

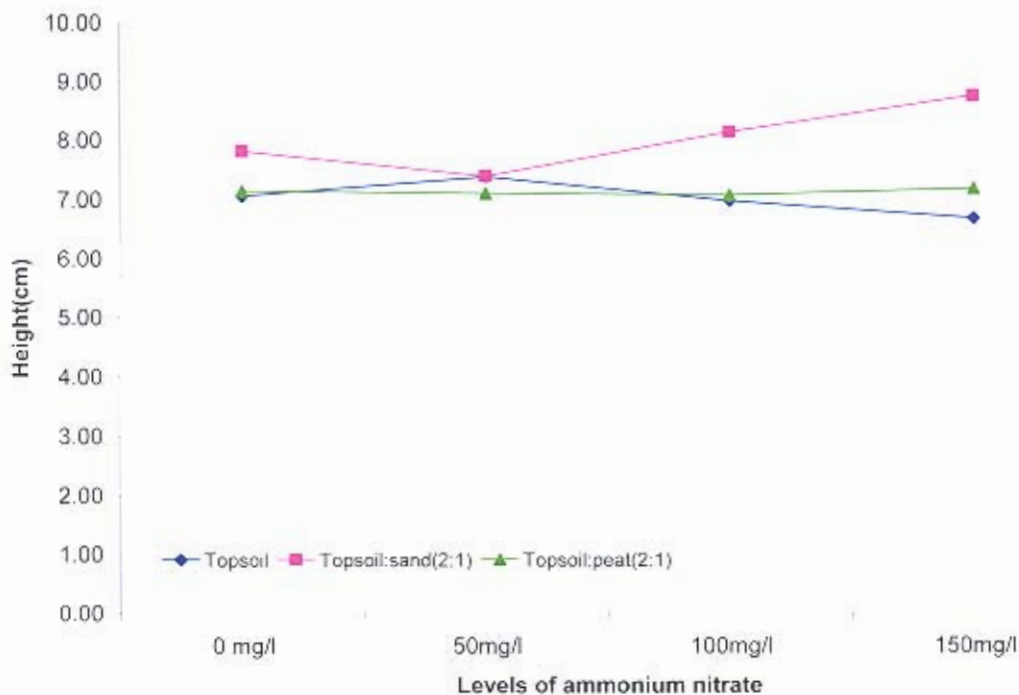


Figure 1(c): Mean height of *Eugenia grandis* seedlings grown in 3 different types of growing media at 8 weeks after application of 4 different levels of ammonium nitrate.

Table 1(d): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on plant height (cm) of *Eugenia grandis* seedlings at 10 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	7.65 ± 0.23*	8.08 ± 0.14	7.42 ± 0.17	7.71 ^a ± 0.19
50	7.74 ± 0.29	7.79 ± 0.19	7.36 ± 0.16	7.63 ^a ± 0.14
100	6.84 ± 0.42	9.00 ± 0.23	7.36 ± 0.20	7.73 ^a ± 0.65
150	7.15 ± 0.22	10.13 ± 0.41	7.47 ± 0.20	8.25 ^b ± 0.94
Mean	7.34 ^a ± 0.21	8.75 ^b ± 0.53	7.40 ^a ± 0.03	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

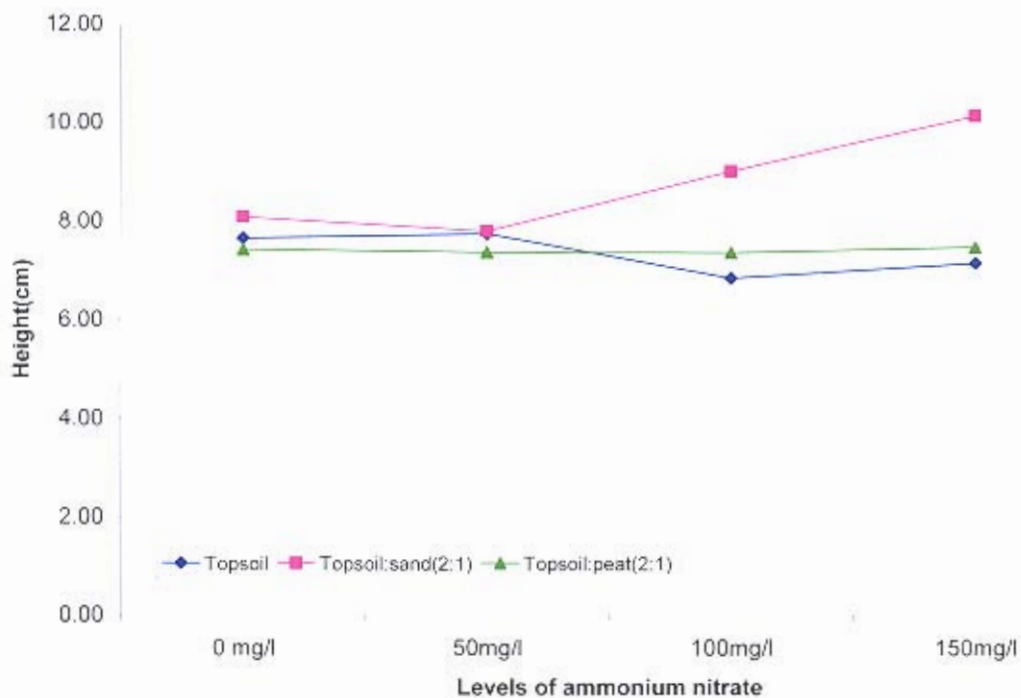


Figure 1(d): Mean height of *Eugenia grandis* seedlings grown in 3 different types of growing media at 10 weeks after application of 4 different levels of ammonium nitrate.

Table 1(e): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on plant height (cm) of *Eugenia grandis* seedlings at 14 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	8.23 ± 0.24*	8.78 ± 0.18	7.98 ± 0.18	8.33 ^a ± 0.23
50	8.39 ± 0.32	8.64 ± 0.22	7.91 ± 0.18	8.31 ^a ± 0.21
100	7.29 ± 0.46	10.50 ± 0.28	8.26 ± 0.21	8.68 ^{ab} ± 0.95
150	7.86 ± 0.20	10.96 ± 0.39	7.84 ± 0.24	8.88 ^b ± 1.04
Mean	7.94 ^a ± 0.24	9.72 ^b ± 0.59	8.00 ^a ± 0.09	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

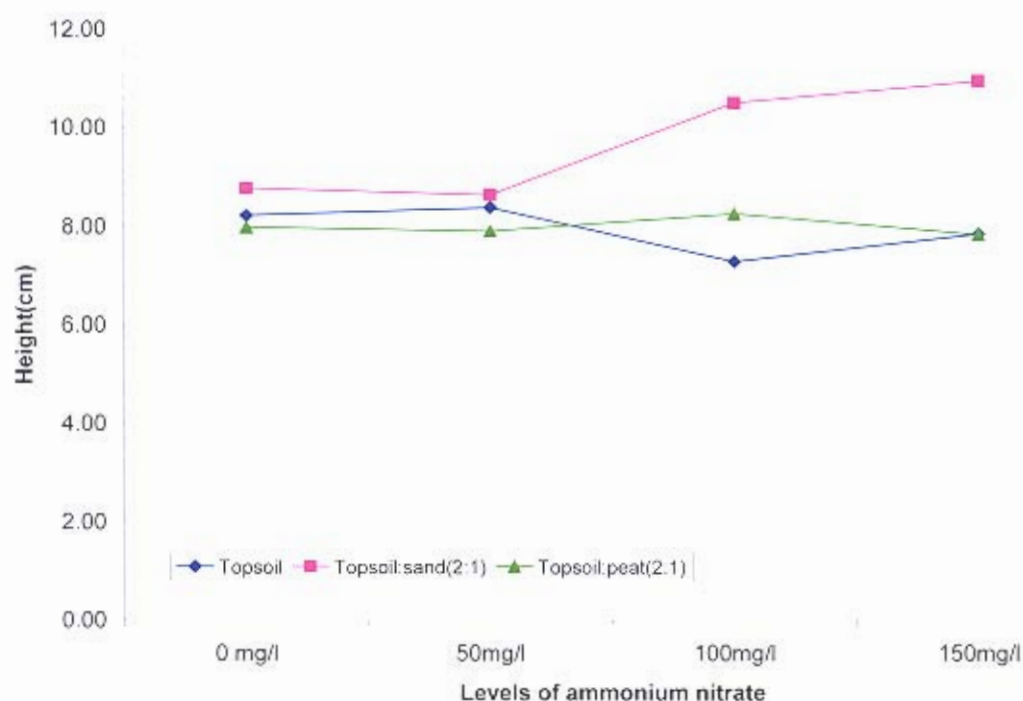


Figure 1(e): Mean height of *Eugenia grandis* seedlings grown in 3 different types of growing media at 14 weeks after application of 4 different levels of ammonium nitrate.

Effects of types of growing media and nitrogenous fertilizer on plant height of *Eugenia grandis* seedlings at 2, 4, 8, 10 and 14 weeks are presented in Figure 1(a), 1(b), 1(c), 1(d) and 1(e) respectively.

No clear and consistent trend was detected in younger seedlings i.e. three to four months old (2 and 4 weeks after treatment). During the early growth it appeared that there are no beneficial effects of the nitrogenous fertilizer on plant height for *E. grandis* seedlings growing on the three different media. However, older seedlings exhibited clear trend of response to the different levels of ammonium nitrate. Higher levels of this fertilizer have beneficial effects on plant height of seedlings grown in the mixture of topsoil and sand. For those seedlings growing on topsoil and mixture of topsoil and peat, the effects are negligible. It is quite clear that plant growth in terms of height increase is affected by the level of ammonium nitrate on *E. grandis* seedlings grown on topsoil and sand mixture.

Table 2(a): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on plant diameter (mm) of *Eugenia grandis* seedlings at 2 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	1.23 ± 0.03*	1.22 ± 0.02	1.27 ± 0.03	1.24 ^b ± 0.02
50	1.31 ± 0.03	1.17 ± 0.03	1.29 ± 0.03	1.26 ^b ± 0.04
100	1.17 ± 0.02	1.12 ± 0.02	1.19 ± 0.03	1.16 ^a ± 0.02
150	1.26 ± 0.03	1.16 ± 0.02	1.27 ± 0.02	1.23 ^b ± 0.04
Mean	1.24 ^b ± 0.03	1.17 ^a ± 0.02	1.25 ^b ± 0.02	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

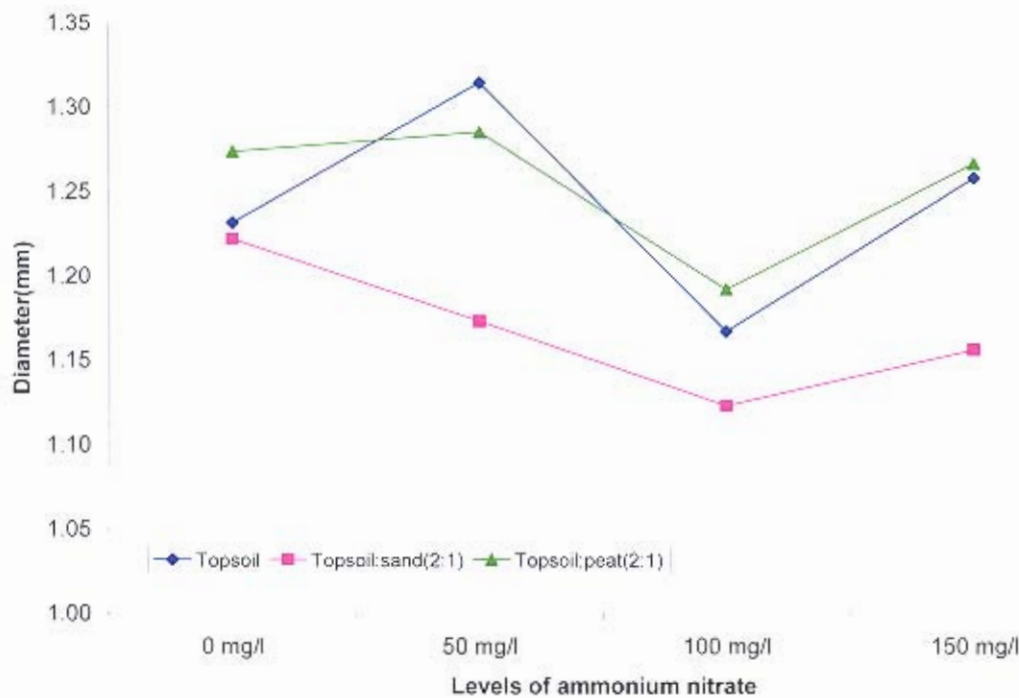


Figure 2(a): Mean diameter of *Eugenia grandis* seedlings grown in 3 different types of growing media at 2 weeks after application of 4 different levels of ammonium nitrate.

Table 2(b): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on plant diameter (mm) of *Eugenia grandis* seedlings at 4 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	1.15 ± 0.02*	1.23 ± 0.02	1.22 ± 0.03	1.20 ^a ± 0.02
50	1.21 ± 0.03	1.18 ± 0.02	1.21 ± 0.03	1.20 ^a ± 0.01
100	1.13 ± 0.03	1.17 ± 0.02	1.30 ± 0.03	1.20 ^a ± 0.05
150	1.29 ± 0.04	1.34 ± 0.03	1.26 ± 0.02	1.30 ^b ± 0.02
Mean	1.20 ^a ± 0.04	1.23 ^{ab} ± 0.04	1.25 ^b ± 0.02	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

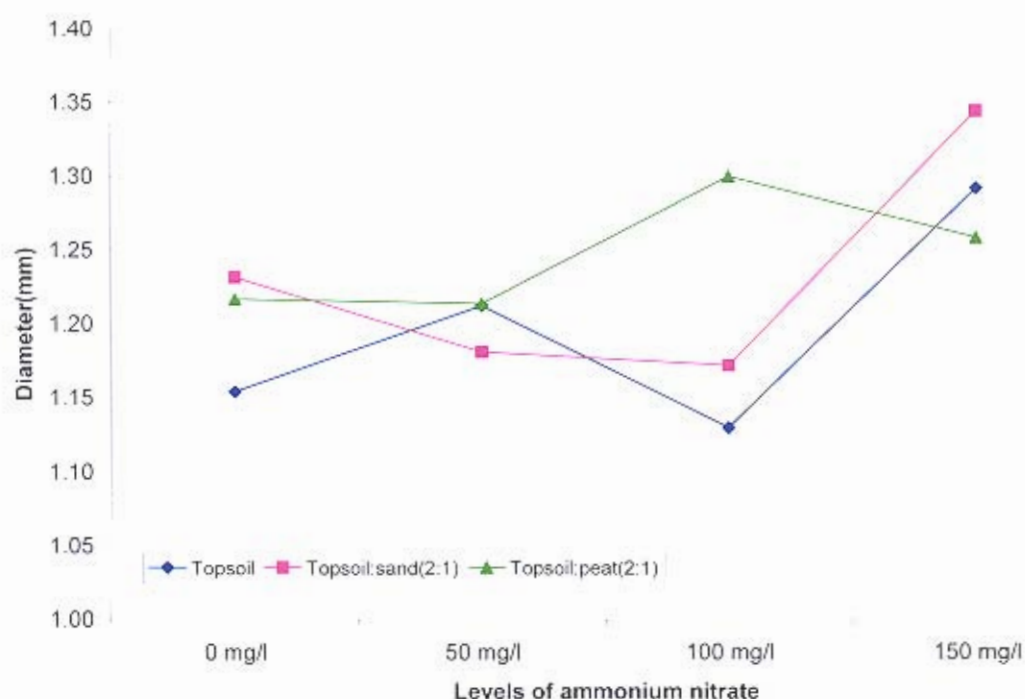


Figure 2(b): Mean diameter of *Eugenia grandis* seedlings grown in 3 different types of growing media at 4 weeks after application of 4 different levels of ammonium nitrate.

Table 2(c): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on plant diameter (mm) of *Eugenia grandis* seedlings at 8 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	1.28 ± 0.02*	1.30 ± 0.03	1.31 ± 0.05	1.30 ^a ± 0.01
50	1.41 ± 0.05	1.25 ± 0.03	1.24 ± 0.03	1.30 ^a ± 0.06
100	1.19 ± 0.02	1.34 ± 0.03	1.51 ± 0.04	1.35 ^a ± 0.09
150	1.35 ± 0.04	1.41 ± 0.04	1.28 ± 0.03	1.35 ^a ± 0.04
Mean	1.31 ^a ± 0.05	1.32 ^a ± 0.03	1.33 ^a ± 0.06	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

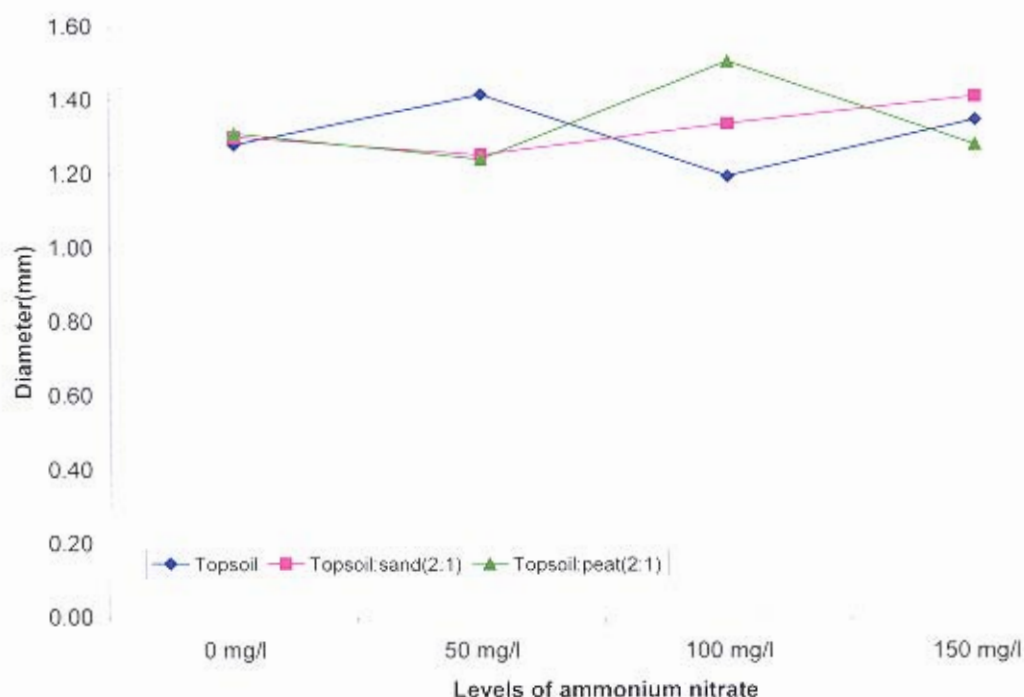


Figure 2(c): Mean diameter of *Eugenia grandis* seedlings grown in 3 different types of growing media at 8 weeks after application of 4 different levels of ammonium nitrate.

Table 2(d): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on plant diameter (mm) of *Eugenia grandis* seedlings at 10 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	1.37 ± 0.05*	1.39 ± 0.03	1.31 ± 0.05	1.35 ^{ab} ± 0.03
50	1.44 ± 0.05	1.29 ± 0.04	1.24 ± 0.03	1.32 ^a ± 0.06
100	1.08 ± 0.07	1.51 ± 0.04	1.60 ± 0.03	1.40 ^{bc} ± 0.16
150	1.47 ± 0.04	1.61 ± 0.05	1.30 ± 0.03	1.46 ^c ± 0.09
Mean	1.34 ^a ± 0.09	1.45 ^b ± 0.07	1.36 ^a ± 0.08	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

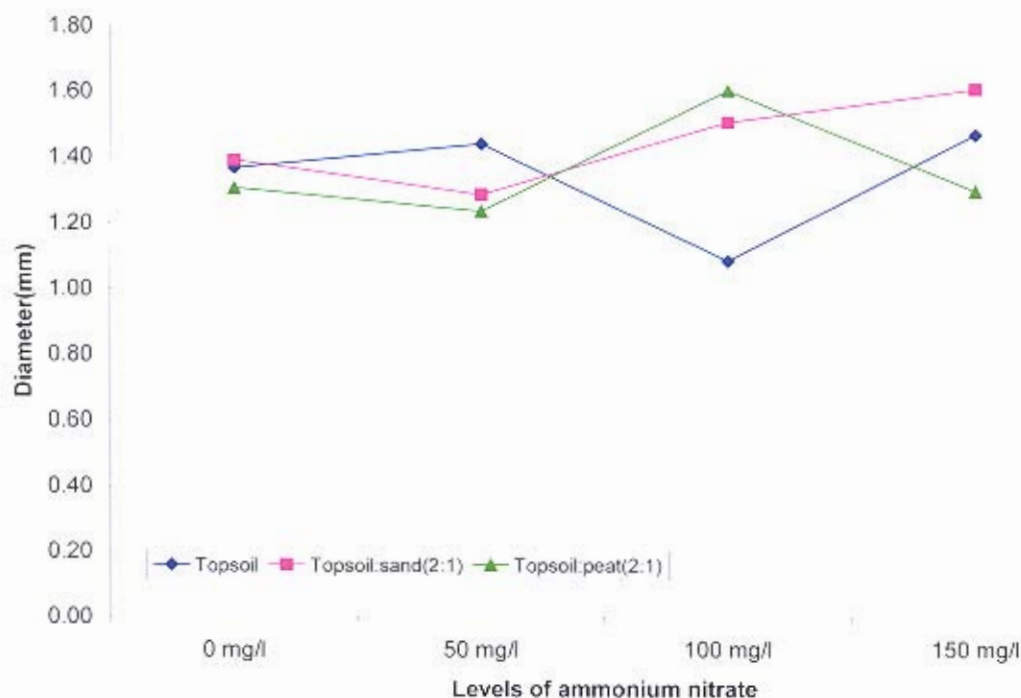


Figure 2(d): Mean diameter of *Eugenia grandis* seedlings grown in 3 different types of growing media at 10 weeks after application of 4 different levels of ammonium nitrate.

Table 2(e): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on plant diameter (mm) of *Eugenia grandis* seedlings at 14 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	1.42 ± 0.04*	1.57 ± 0.05	1.34 ± 0.04	1.44 ^a ± 0.07
50	1.63 ± 0.06	1.53 ± 0.05	1.39 ± 0.03	1.51 ^a ± 0.07
100	1.17 ± 0.07	1.81 ± 0.04	1.82 ± 0.03	1.60 ^b ± 0.21
150	1.51 ± 0.05	1.96 ± 0.06	1.37 ± 0.03	1.61 ^b ± 0.18
Mean	1.43 ^a ± 0.10	1.71 ^b ± 0.10	1.48 ^a ± 0.11	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

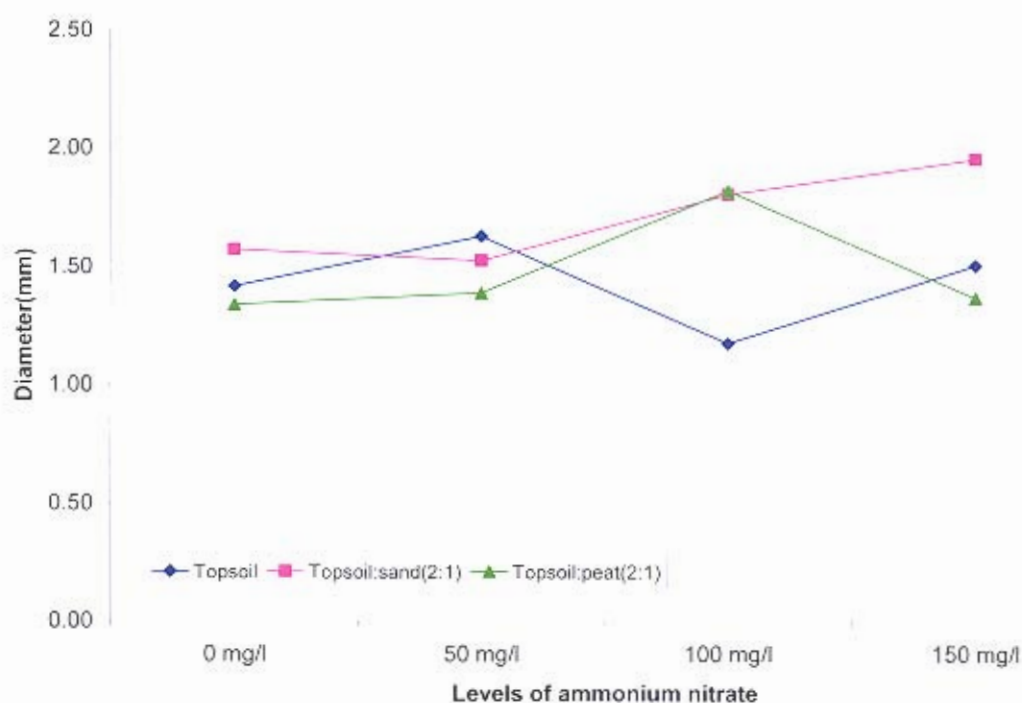


Figure 2(e): Mean diameter of *Eugenia grandis* seedlings grown in 3 different types of growing media at 14 weeks after application of 4 different levels of ammonium nitrate.

The influence of three levels of ammonium nitrate fertilizer on the diameter of *Eugenia grandis* seedlings grown on different media at 2, 4, 8, 10 and 14 weeks are shown in Figure 2(a), 2(b), 2(c), 2(d) and 2(e) respectively.

Referring to figures 2(a) and 2(b), there appeared to be no clear trend of the levels of fertilizer applied on the growth in term of plant diameter of younger seedlings. This result is the same as the plant height. In older seedlings, the response of seedlings grown on topsoil is inconsistent whereas for seedlings grown on topsoil and peat mixture, 100mg/l seemed to be the optimal level of ammonium nitrate for diameter increase. For seedlings grown on topsoil and sand mixture, the diameter increased as the level of ammonium nitrate increased.

Table 3(a): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on leaf numbers of *Eugenia grandis* seedlings at 2 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	9.20 ± 0.28*	9.75 ± 0.31	9.20 ± 0.37	9.38 ^{ab} ± 0.18
50	9.50 ± 0.36	9.20 ± 0.36	9.55 ± 0.26	9.42 ^{ah} ± 0.11
100	8.50 ± 0.33	9.40 ± 0.27	9.40 ± 0.26	9.10 ^a ± 0.30
150	9.05 ± 0.39	10.95 ± 0.37	9.55 ± 0.47	9.85 ^b ± 0.57
Mean	9.06 ^a ± 0.21	9.83 ^b ± 0.39	9.43 ^{ah} ± 0.08	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

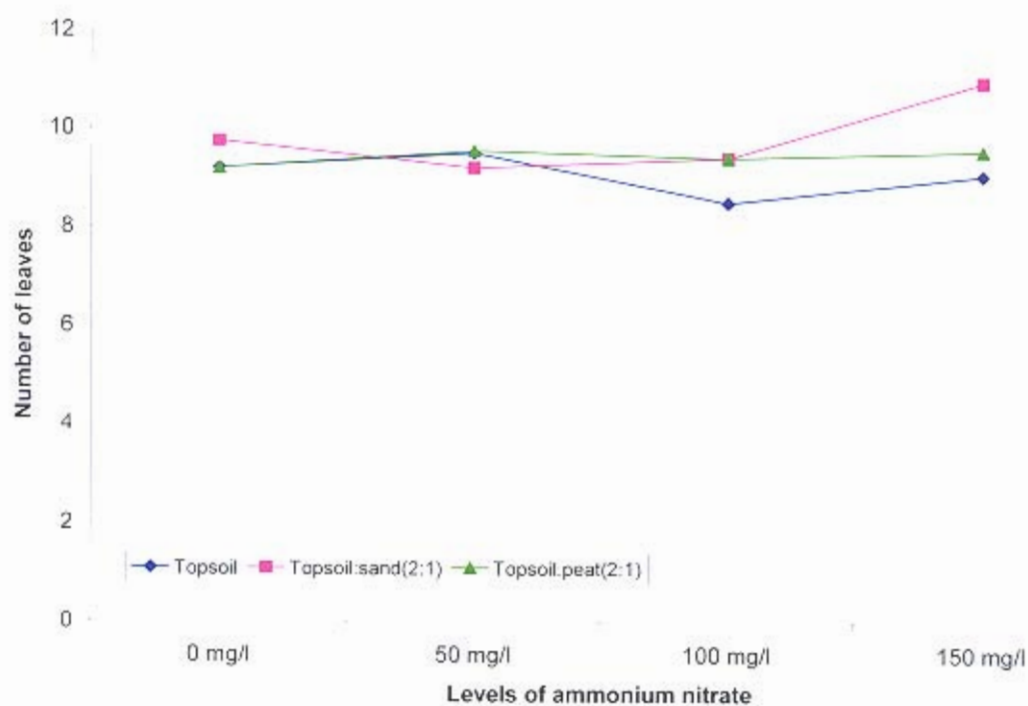


Figure 3(a): Mean leaf numbers of *Eugenia grandis* seedlings grown in 3 different types of growing media at 2 weeks after application of 4 different levels of ammonium nitrate.

Table 3(b): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH_4NO_3) on leaf numbers of *Eugenia grandis* seedlings at 4 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	9.80 ± 0.39*	10.90 ± 0.29	9.50 ± 0.39	10.07 ^a ± 0.43
50	10.15 ± 0.41	10.55 ± 0.39	10.20 ± 0.26	10.30 ^{ab} ± 0.13
100	9.10 ± 0.38	11.15 ± 0.23	10.40 ± 0.52	10.22 ^{ab} ± 0.60
150	10.00 ± 0.46	12.10 ± 0.31	10.35 ± 0.26	10.82 ^b ± 0.65
Mean	9.76 ^a ± 0.23	11.18 ^b ± 0.33	10.11 ^a ± 0.21	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

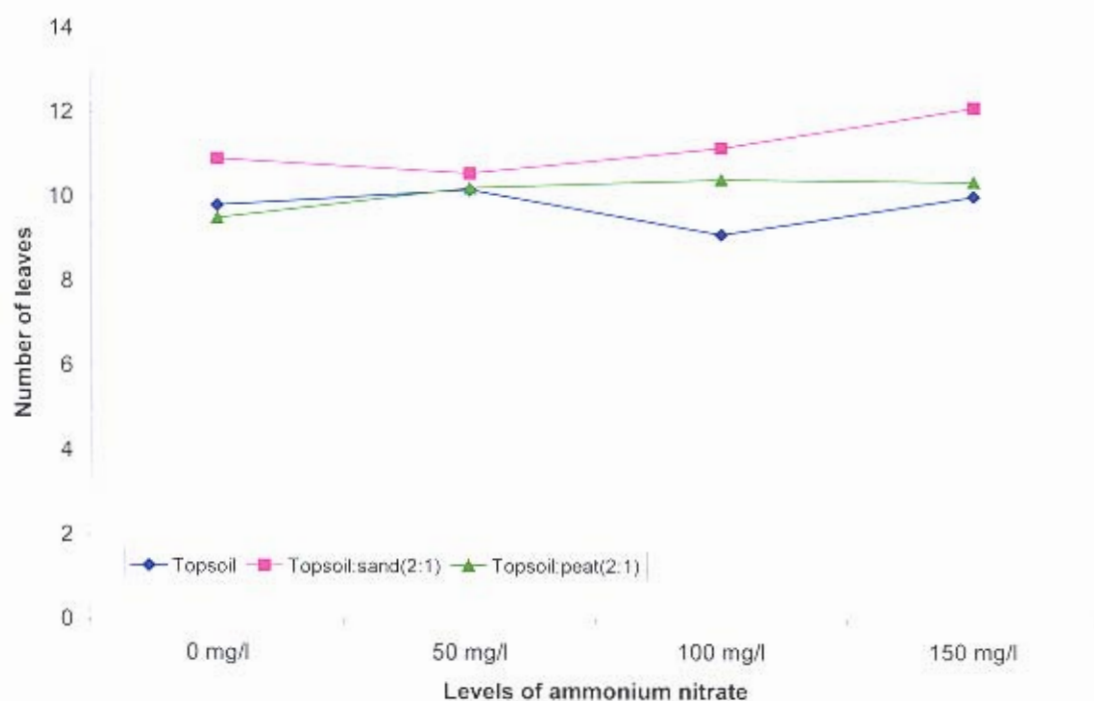


Figure 3(b): Mean leaf numbers of *Eugenia grandis* seedlings grown in 3 different types of growing media at 4 weeks after application of 4 different levels of ammonium nitrate.

Table 3(c): Effects of 3 types of growing media and 4 levels of ammonium nitrate (NH₄NO₃) on leaf numbers of *Eugenia grandis* seedlings at 8 weeks after treatment.

Ammonium nitrate (mg/l)	Growing medium			Mean
	Topsoil	Topsoil : sand (2:1)	Topsoil : peat (2:1)	
0	10.75 ± 0.42*	12.45 ± 0.39	10.35 ± 0.49	11.18 ^a ± 0.64
50	10.80 ± 0.50	12.65 ± 0.60	10.15 ± 0.36	11.20 ^a ± 0.75
100	9.80 ± 0.43	14.05 ± 0.28	13.10 ± 0.41	12.32 ^b ± 1.29
150	11.60 ± 0.43	15.70 ± 0.61	10.55 ± 0.38	12.62 ^b ± 1.57
Mean	10.74 ^a ± 0.37	13.71 ^b ± 0.75	11.04 ^a ± 0.69	

* refers as standard error of the mean.

Means that shared the same letter are not statistically significant at 5% level.

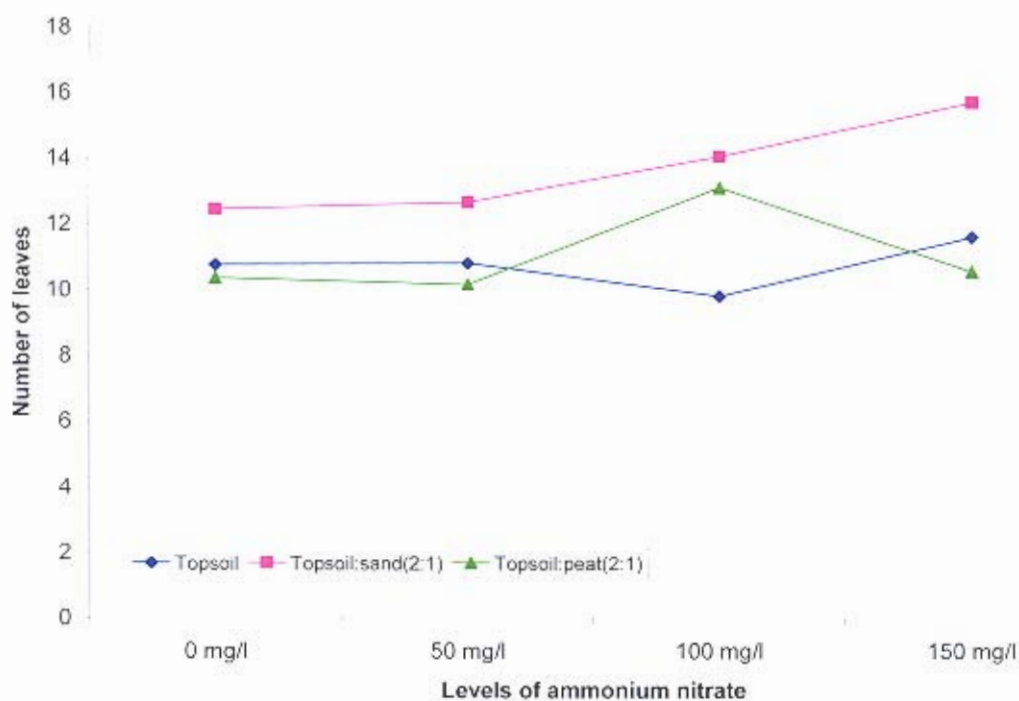


Figure 3(c): Mean leaf numbers of *Eugenia grandis* seedlings grown in 3 different types of growing media at 8 weeks after application of 4 different levels of ammonium nitrate.