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Growth Performance of *Eucalyptus Microtheca* Seedlings in Response to Different Levels of Organic and Inorganic Fertilizer

Dr. Sherzad Omar Hamad
Department of Forestry, College of Agricultural Engineering Sciences, Salahaddin University, Erbil, Kurdistan Region, Iraq.
Sherzad.hamad@su.edu.krd

Aisha Abdulla Shahin
Department of Forestry, College of Agricultural Engineering Sciences, Salahaddin University, Erbil, Kurdistan Region, Iraq.
ayshashan.shahen1997@gmail.com

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ABSTRACT

In nursery stage, some silvicultural treatments have been applied to produce high quality of forest seedlings. Fertilizer application is one of the most significant treatments that effects on the growth and development of the seedlings. This study was performed in early November 2019 to early April 2020.The paper evaluates the effects of organic and inorganic fertilizers on the growth of *Eucalyptus microtheca* seedling under nursery growing conditions. Organic fertilizer was used with three levels of animal manure, which are 0, 50 and 100 g/pot, and three levels of inorganic (compound chemical) fertilizer, which include 0, 1 and 2 g/pot of NPK (15:15:15), and each treatments were replicated three times due to availability limited numbers of *Eucalyptus microtheca* seedlings in the nursery. Vegetative growth parameters taken include, seedling height (cm), leaf number, stem diameter (mm) and biomass (g). The results obtained from the experiment showed that the effects of the treatments were significantly difference from the control for all the parameters accessed. Results of this research concluded that the best seedling growth performance and biomass allocation of *E. microtheca* were obtained from the seedlings that fertilized with 50 g organic matter and 2 g NPK fertilizer. The results will help nursery man to produce healthy and a high

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quality of *E. microtheca* seedlings to meet plantation program.

1. Introduction

Eucalyptus microtheca F. Muell belongs to Mytraceae Family. The natural habitats of *Eucalyptus microtheca* cover a large area in mid-northern and northern parts of Australia in arid and semi-arid growth areas. However, it has been successfully cultivated in Sudan, Iran, Iraq and Pakistan. *E. microtheca* is frequently planted in the driest habitats for industrial and non-industrial purposes (Susiluoto and Berninger, 2007). It is fast growing in favorable sites. It is about 25 meters tall and very durable and resistant to insect attacks (Al-Mousawi and Al-Naib, 1975). It used mainly for posts, poles, railway sleepers, and fuel; it is also used in the cellulose industry for textile pulp, and to some extent for paper pulp by mixing with better pulps. The species is commonly planted along roadsides, in shelterbelts, and in farm wood lots and is of importance as a honey and pollen producer (Goor and Barney, 1976).

In view of the potential of mentioned species, nursery men should multiply this species on a large scale for afforestation and reforestation programs. In the nursery stage, some silvicultural treatments have been applied to produce high quality and quantity of forest seedlings. Fertilizer application is one of the most significant treatments that effects on the growth and development of the seedlings (Driessche, 1988; Bhujbal, 2012). Seedling's quality can be enhanced by governing the type, amount, and timing of fertilization (Duryea and Landis, 2012). Nitrogen (N), phosphorus (P), and potassium (K) are three central macro-nutrients that are very important in the early development stage of seedlings (Pallardy, 2008). Availability of satisfactory N in leaves is essential for photosynthesis that finally boosts shoot and root development (Oliet *et al*. 2009). The seedlings treat with an adequate level of fertilizer usually have larger stems, and bigger root mass (Trieu, 2003). Phosphorus (P) plays an important role in plant growth and development specifically root and reproductive system. In photosynthesis process, P also plays the main role in storage and transfer of energy as ADP and ATP (adenosine di- and triphosphate). P also is the most important part of the RNA and DNA structures, which are the primary components of genetic information (Uchida, 2000). Potassium (k) has indirect role in

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plant growth and development. Potassium is essential for the activation of over 80 enzymes in the plant. It has significant role in plant's ability to resist stresses from extreme hot and cold temperatures, drought and pests. Potassium diminishes water loss from the leaves and rises drought tolerance due to regulating the stomatal conductance by potassium. Potassium also improves water use efficiency (Hopkins and Huner, 2009)

The appropriate application of organic and inorganic fertilizers to nursery soils is considered crucial because it may seriously influence the value of seedlings produced (Krishnan, 2014). Organic fertilizer (animal manure) has a significant role in improved seedling growth due to increased soil nutrient availability, increased soil microbial activity, decomposition of harmful elements, improvement soil structure, and increased soil water availability (Han *et al*., 2016). Inorganic fertilizers (NPK) are relatively have high nutrient content and are rapidly taken up by seedlings. The use of excess fertilizer can result in a number of problems such as nutrient loss, surface water and ground water contaminations, and increased sensitivity to harmful insects (Hoque *et al*, 2004). Adequate inorganic fertilizer application in the nursery stage is necessary to assure the production of high-quality and quantity seedlings (Hoque *et al*, 2004; Sherzad *et al*., 2015; Hamad et al., 2020). A vigorous seedling has to be well supplied with all the elements in suitable proportions for efficient growth (Craven *et al*., 2007; Gbadamosi, 2006). It is important to find a suitable amount of fertilizer to be used to different species, sizes, and ages of the seedlings for higher response to the use. Fertilizer gives various effects on plant growth based on the availability enough amount of nutrient in the soil (Barizan and Newbery, 2008).

The previous studies reported that the fertilizer (organic or/and inorganic) application has played a significant role in enhancing the growth of different forest tree seedlings. For instance, Stahl *et al*. (2013) reported that both shoot and root systems of *Eucalyptus benthamii*, and *Eucalyptus dunnii* were enhanced with nitrogen and Phosphor applications in the nursery. Farah Shahanim *et al*. (2014) displayed that *Neobalanocarpus heimii* seedlings fertilized with 10 g of NPK had significantly higher height increment, diameter increment, photosynthetic rate, and stomatal conductance than those fertilized with 10 g of goat dung. Sherzad *et al*. (2015) demonstrated that *Shorea materialis* seedlings fertilized with 2 g NPK monthly had

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significantly better growth variables than other fertilizer levels. Ashiono *et al*. (2017) showed that adding of Sawdust: Cow dung mixture (1:1) had the highest measurements for height, root collar diameter and biomass of *Eucalyptus saligna* when compared to the rest of growth mixtures. Rotowa *et al*. (2017) conducted a study to identify the effect of organic and mineral fertilizer treatments on the growth of *Moringa olifera* seedlings, and ultimately, they found that the highest value of growth traits recorded in poultry manure as followed by cow dung treatment. Hamad et al. (2020) found that *Brachychiton populneus* seedlings treated with 3 and/or 4 g NPK fertilizer every two months recorded higher growth characters, chlorophyll content and biomass allocation than application 0, 1, and 2 g NPK fertilizer. James (2020) displayed that the application of organic fertilizer had a positive effect on the growth parameters (seedling height, basal girth, number of leaves and leave area) of *Eucalyptus torelliana* F. Muell.

Although *Eucalyptus microtheca* is thought to be fast growing species, fertilizer application is required for full growth and improved seedling quality. Accordingly, and based on our knowledge that there is no study tested yet the influence of organic and inorganic fertilizers and their combination effects on the growth of *Eucalyptus microtheca* seedlings under nursery growing condition. Therefore, the object of the study is to identify the effect of different levels of organic and chemical fertilizers and their combinations on the early growth rate of *Eucalyptus microtheca* potted seedlings under the plastic-house.

2. Materials and Methods

2.1 The Study Location

This experiment was performed in early November 2019 to early April 2020 under a plastic house in Grdarasha field (Elevation 415 meters above Sea level, Latitude: 36°06'47.0"N and Longitude: 44°00'44.8"E) which belongs to the College of Agricultural Engineering Sciences, Salahaddin University-Erbil.

2.2 Species under Study

Eucalyptus microtheca potted seedlings at age five months were bought from a private nursery. The average height of the seedlings was about 12±2cm and the

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seedling grown in the pot that filled with 5 kg of sandy loamy soil. The seedlings were kept healthy by watering and weeding when needed.

2.3 Experimental Design

A factorial CRD was used with three levels of organic fertilizer (A), which are 0, 50 and 100 g/pot of well decomposed animal manure, and three levels of inorganic (compound chemical) fertilizer (B), which include 0, 1 and 2 g/pot of NPK (15 : 15 : 15) and their interactions (0g of organic fertilizer + 0g of inorganic fertilizer (A0B0), 0g of organic fertilizer + 1g of inorganic fertilizer (A0B1), 0g of organic fertilizer + 2g of inorganic fertilizer (A0B2), 50g of organic fertilizer + 0g of inorganic fertilizer (A50B0), 50g of organic fertilizer + 1g of inorganic fertilizer (A50B1), 50g of organic fertilizer + 2g of inorganic fertilizer (A50B2), 100g of organic fertilizer + 0g of inorganic fertilizer (A100B0), 100g of organic fertilizer + 1g of inorganic fertilizer (A100B1), 100g of organic fertilizer + 2g of inorganic fertilizer (A100B2) /seedling), then each level had three replications. Thus, the total number of the experimental units was 27. Statistically, the minimum replication numbers in any experiment are three replications. However, using more than three replications are better to increase accuracy of results. In the current study only three replications were used due to availability limited numbers of *Eucalyptus microtheca* seedlings compared with *Eucalyptus camaldulensis* in the nursery. Moreover, both organic and inorganic fertilizer were added to the seedlings in early November.

2.4 The Studied Parameters

At the start of the study (November), growth parameters viz seedling height (cm), stem diameter (mm) and leaf numbers were measured. The seedling height measured from the pot edge to the highest living apical shoot using a measuring tape in centime meter unites. Stem diameter was measured at pot edge level by using a digital Vernier caliper in millimeter units (Digimatic caliper Mitutoyo-Japan). Meanwhile; leaf number for each seedling counted manually. In addition, the mentioned parameters re-measured at the end of the experiment (April) to record seedling height increment (cm), stem diameter increment (mm) and leaf numbers increment. Moreover, the seedlings were harvested in April and separated into their components (shoot (stem, leaf), and root) and oven dried at 80 C° for 72 hours until constant dry weight (Sherzad

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et al., 2017) to calculate biomass of the seedlings, which are shoot dry weight (g), root dry weight (g) and total seedling dry weight (g). In addition, Dickson Quality Index (DQI) was measured to assess seedling quality as a function of total dry weight (TDW), shoot height (SH), stem diameter (SD), shoot dry weight (SDW) and root dry weight (RDW), and is given as follows (eq 1) (Dickson *et al.*, 1960):

$$DQI = \frac{TDW\ (g)}{\frac{SH(cm)}{SD(cm)} + \frac{SDW(g)}{RDW(g)}} \qquad \text{(eq 1)}$$

2.5 Data analysis

Data of the growth and biomass parameters were subjected separately to the Analysis of Variance (ANOVA) using SPSS Statistics 25. The significant differences among treatment means were compared by Duncan Test at p≤ 0.05.

3. Results

Results of analysis of variance showed that organic fertilizer, inorganic fertilizer and their interactions had significant effects on height increment and leaf number increment of *Eucalyptus microtheca* seedlings. However, stem diameter increment of the seedlings was not significantly affected by the organic fertilizer, inorganic fertilizer and their interactions (Table 1).

Comparison means among different levels of organic manure in table (2) demonstrated that the seedlings of *Eucalyptus microtheca* were fertilized with 50 g of organic fertilizer had significantly the highest height increment (24.90 cm). In addition, the seedlings were fertilized with 50 and 100 g of organic manure were significantly recorded higher leaf number increment (24.22 and 21.78/seedling respectively) than those unfertilized seedlings (13.44/seedling). Even though stem diameter increment of the seedlings was not significantly influenced by application of different organic manure amounts, the maximum diameter increment was obtained from the seedlings were treated with 50 g of animal manure (2.21 mm).

Results of inorganic fertilizer application in table (3) illustrated that *E. microtheca* seedlings were treated with 2 g of inorganic fertilizer NPK had significantly better height increment (25.53 cm) and leaf number increment (24.89/seedling) compared with those fertilized with 0 and 1 g of NPK. In addition, stem diameter increment of

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the seedlings was not significantly affected by different levels of NPK fertilizer applications. However, the highest diameter increment was also gained from the seedlings were fertilized with 2 g of NPK (2.21 mm).

Table (1): Analysis of variance of the effect of organic, inorganic fertilizer and their interactions on height increment, leaf number increment and stem diameter increment of *E. microtheca* seedlings.

Source of Variation	DF	P-Value		
		Height increment	Leaf number increment	Stem diameter increment
Organic Fertilizer (A)	2	0.026	0.004	0.360
Inorganic Fertilizer (B)	2	0.010	0.017	0.292
A * B	4	0.035	0.000	0.327

Significant occurs when P- value is ≤ 0.05. DF = degree of freedom.

Table (2): Effect of organic fertilizer on means of height increment, leaf number increment and stem diameter increment of *E. microtheca* seedlings.

Organic Fertilizer (g)	Height increment (cm)	Leaf number increment	Stem diameter increment (mm)
0	18.56 b	13.44 b	2.09 a
50	24.90 a	24.22 a	2.21 a
100	18.28 b	21.78 a	1.86 a

Means with the same letter in a column are not significantly different by Duncan at p ≤ 0.05.

Table (3): Effect of inorganic fertilizer on means of height increment, leaf number increment and stem diameter increment of *Eucalyptus microtheca* seedlings.

Inorganic Fertilizer (g)	Height increment (cm)	Leaf number increment	Stem diameter increment (mm)
0	17.86 b	15.89 b	2.10 a
1	18.34 b	18.67 b	1.84 a
2	25.53 a	24.89 a	2.22 a

Means with the same letter in a column are not significantly different by Duncan at p ≤ 0.05.

Interaction effects of organic and chemical fertilizer on the growth of seedling height (Figure 1) displayed that the seedlings were fertilized with A50B0, which are 50 g organic manure and 0 g of inorganic fertilizer NPK, recorded higher seedling height increment (28.17 cm) followed by A100B2, A50B2, A0B2, A0B1 and A50B1, while the lowest value of seedling height increment (12.67 cm) was found in the seedlings were not treated by organic and inorganic fertilizer (A0B0). In addition, figure (2) showed

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that leaf number increment significantly increased when the seedlings treated with combination of 50 g animal manure and 2 g of NPK (A50B2), followed by 100 g animal manure and 1 g of NPK (A100B1), whereas the lowest numbers of leaf increment was also achieved in A0B0 treatment.

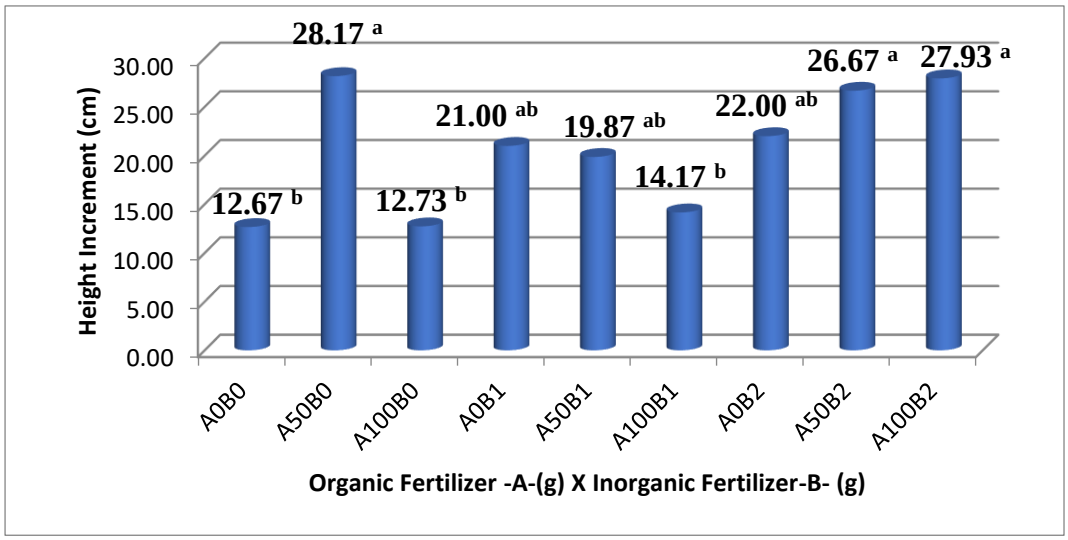

Figure (1): Interactive effect of organic and inorganic fertilizer on mean height increment (cm) of *E. microtheca*. Means with the same letter are not significantly different by Duncan at $p \leq 0.05$.

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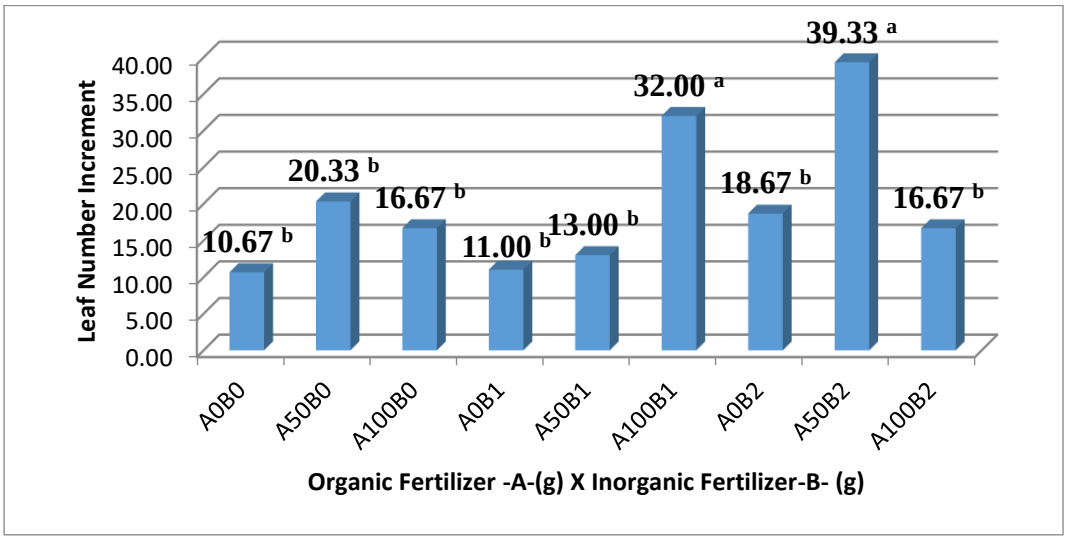

Figure (2): Interactive effect of organic and inorganic fertilizer on leaf number mean increment of *Eucalyptus microtheca*. Means with the same letter are not significantly different by Duncan at $p \leq 0.05$.

Table (4) showed that shoot dry weight was significantly affected only by organic fertilizer factor. However, root dry weight and total seedling dry weight were significantly influenced by both the organic and inorganic fertilizer factors. On the other hand, Dickson quality index was significantly affected only by inorganic fertilizer factor. Furthermore, there were not significant interaction effect of the organic and inorganic fertilizer found on the seedling biomass parameters and Dickson quality index.

Table (4): Analysis of variance of the effect of organic, inorganic fertilizer and their interactions on shoot dry weight, root dry weight, total dry weight and Dickson quality index of *E. microtheca* seedlings.

Source of Variation	DF	P-Value			
		Shoot dry weight	Root dry weight	Total dry weight	Dickson quality index
Organic Fertilizer (A)	2	0.040	0.024	0.024	0.390
Inorganic Fertilizer (B)	2	0.113	0.000	0.004	0.012

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A * B	4	0.402	0.442	0.920	0.152

Significant occurs when P- value is ≤ 0.05. DF = degree of freedom.

Table (5) demonstrated that shoot dry weight, root dry weight and total seedling dry weight of the seedlings were treated by 50 g and 100 g of organic fertilizer were significantly greater than the control. However, there was not significant differences between application of 50 g and 100 g of organic fertilizer. Thus, economically better to use 50 g of organic fertilizer to enhance seedling biomass of the species. Moreover, even though application of different organic fertilizer amounts did not have significant effect on Dickson quality index of the seedlings, it was improved by increasing organic fertilizer amounts.

Table (5): Effect of organic fertilizer on means of shoot, root and total dry weights of *E. microtheca* seedlings.

Organic Fertilizer (g)	Shoot dry weight (g)	Root dry weight (g)	Total dry weight (g)	Dickson quality index
0	2.63 [b]	2.68 [b]	5.31 [b]	0.08 [a]
50	3.71 [a]	3.29 [a]	7.00 [a]	0.09 [a]
100	3.97 [a]	3.54 [a]	7.51 [a]	0.10 [a]

Means with the same letter in a column are not significantly different by Duncan at p ≤ 0.05.

Comparison means of seedling biomass traits among different inorganic fertilizer levels in table (6) investigated that even though different levels of chemical fertilizer had not significant result on the shoot dry weight of *E. microtheca* seedlings, application of 2 g fertilizer NPK gave the best result of the mentioned biomass parameter. On the other hand, root dry weight was significantly enhanced with increasing inorganic fertilizer levels as the maximum root dry weight was 4.02 g after application 2 g of NPK, while the minimum result of it was 2.20 g in the control level. In addition, used 1g and 2 g fertilizer NPK dramatically increased total seedling dry weight compared with the control treatment. In other word, the greatest value of total seedling dry weight was 8.01 g after applied 2 g NPK followed 6.73 g in 1 g NPK,

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whereas the smallest result which was 5.07 g in the control treatment. Based on Dickson quality index the best significant amounts of inorganic fertilizer application was 2g/seedling in order to improve quality of *E. microtheca* seedlings.

Table (6): Effect of inorganic fertilizer on means of shoot, root and total dry weights of *E. microtheca* seedlings.

Inorganic Fertilizer (g)	Shoot dry weight (g)	Root dry weight (g)	Total dry weight (g)	Dickson quality index
0	2.86 [a]	2.20 [c]	5.07 [b]	0.09 [b]
1	3.44 [a]	3.29 [b]	6.73 [a]	0.07 [c]
2	3.99 [a]	4.02 [a]	8.01 [a]	0.10 [a]

Means with the same letter in a column are not significantly different by Duncan at $p \leq 0.05$.

4. Discussion

Seedlings grown in containers face several restrictions, including the scarcity of growing area, which offer the essential nutrients. Therefore, organic and mineral fertilizers are used to provide sufficient nutrients to the seedlings in nursery. The seedlings supported with adequate amount of fertilizer usually have bigger stems and root mass (Trieu, 2003).

This study exhibited that fertilizer application either organic or inorganic or combination of them with adequate level has played critical role in enhancing some growth parameters of *E. microtheca* seedling under nursery growing condition. The best usage amount of animal manure and chemical fertilizer NPK were 50 g and 2 g respectively or both amounts together to improve most growth parameters of the studied species since organic manure increases soil nutrient availability, soil microbial activity, decomposition of harmful elements, improvement soil structure, and soil water availability (Han *et al*., 2016), and mineral fertilizers (NPK) are also relatively have high nutrient content and are rapidly taken up by seedlings (Hoque *et al*, 2004). Results of growth performance of *E. microtheca* seedlings in the present study in line with those reported by the prior studies on the other forest seedlings species. For example, Trubat *et al*. (2010) explored that fertilization influenced growth and morphology of *Quercus suber* L. seedlings at nursery stage. Aminah *et al*. (2013)

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displayed that stem height increment and basal stem diameter increment of *Neobalanocarpus heimii* seedlings received 1 and 2 g NPK were significantly increased compared with those unfertilized. Stahl *et al*. (2013) investigated that shoot and root growth of *Eucalyptus benthamii*, and *Eucalyptus dunnii* seedlings were boosted with nitrogen and Phosphor applications. Sherzad *et al*. (2015) demonstrated that application of 2 g NPK.pot^{-1} significantly increased the height increment, leaf number increment in *shorea materialis* seedlings compared with unfertilized seedlings. Han *et al.* (2016) informed that the application of a mixed of animal manures (1000 g.m^{-2}; mixture of poultry manure, cattle manure, swine manure, and sawdust) or NPK fertilizer (urea, 30 g.m^{-2}; fused superphosphate, 70 g.m^{-2}; potassium chloride, 15 g.m^{-2}) increased the seedling height and root collar diameter of yellow poplar (*Liriodendron tulipifera* L.). Ashiono *et al*. (2017) showed that adding of Sawdust: Cow dung mixture (1:1) had the highest measurements for height, root collar diameter and biomass of *Eucalyptus saligna* when compared to the rest of growth mixtures. Egbewole (2017) showed that the maximum growth rate of *Araucaria heterophylla* seedlings were recorded in soil treated with poultry droppings. Rotowa *et al*. (2017) conducted a study to identify the effect of organic and mineral fertilizer treatments on the growth of *Moringa olifera* seedlings, and ultimately, they found that the highest growth traits of *Moringa olifera* seedlings recorded in poultry manure and then cow dung treatment. Awosan and Morakinyo (2020) demonstrated that the highest significant value for seedling height, leaves number and branches number of *Deinbollia pinnata* were achieved when the species was manured by organic fertilizer (cow dung), while the control had the highest mean value in collar diameter. James, (2020) demonstrated that organic fertilizer application had a positive effect on the seedling height, basal diameter, leaf number and leaf area of *Eucalyptus torelliana* seedlings. Hamad et al. (2020) reported that the highest increment in stem height, stem diameter and leaf number of *Brachychiton populneus* seedlings obtained when the seedlings fertilized with 3 and 4 g of NPK fertilizer.

In terms of the seedling biomass of *E. microtheca,* results of the present study showed that the shoot dry weight, root dry weight and total dry weight of the seedlings treated with 50 g and 100 g organic fertilizer were significantly greater than the control. However, there was not significant differences between application of 50 g

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and 100 g of organic fertilizer. Thus, economically better to use 50 g of organic fertilizer to enhance seedling biomass of the species. Moreover, the shoot dry weight of the seedlings was not significantly differencing among NPK fertilizer amounts, while the root dry weight with 2 g NPK were significantly greater than the control and 1 g NPK. Furthermore, the total dry weight with 1 g and 2 g NPK were significantly superior than the control. So, these results confirmed the previous studies as application an adequate of fertilizer (organic or inorganic) played important role in raising seedling biomass of various forest tree seedlings. For example, Tripathi and Raghubanshi (2013) exposed that the total seedling biomass of *Acacia catechu*, *Bridelia retusa*, *Dalbergia sissoo*, *Lagerstroemia parviflora* and *Terminalia arjuna* were enhanced with the increasing amount of nitrogen from 0, to 120 kg. ha^{-1}. Han et al. (2016) reported that the mean dry weight of the stems and leaves of yellow poplar (*Liriodendron tulipifera* L.) were significantly enhanced after application of a mixed of animal manures (1000 $g.m^{-2}$; mixture of poultry manure, cattle manure, swine manure, and sawdust) or NPK fertilizer (urea, 30 $g.m^{-2}$; fused superphosphate, 70 $g.m^{-2}$; potassium chloride, 15 $g.m^{-2}$), compared with the control. Awosan and Morakinyo (2020) demonstrated that organic fertilizer (cow dung) gave the highest significant value for stem, leaf and root dry weight of *Deinbollia pinnata* seedlings. Hamad et al. (2020) informed that the highest significant value of stem and leaf dry weight of *Brachychiton populneus* seedlings were achieved when the seedlings treated with 4 g NPK fertilizer. However, the highest significant value of root dry weight was attained when the seedlings treated with 3 g NPK fertilizer.

Although several parameters can be used to estimate quality of seedling, for instance, seedling height, stem diameter, shoot and root dry weight, combination of these morphological properties through the Dickson Quality Index becomes an approach to avoid the risk of selecting higher, yet weaker seedlings. The DQI was a good pointer of seedling quality, sturdiness, and biomass balance distribution (Johnson and Cline, 1991). This index takes in consideration important ratios that measure the sturdiness (SH/SD) and biomass balance distribution (SDW/RDW), and ranges from 0 to 1. The greater this value the better the quality of the seedling (Caldeira *et al.*, 2005). In present study, Dickson Quality Index ranged from 0.07 to 0.10. There were no significant differences among the organic fertilizer amounts, but the index improved

by increasing the organic fertilizer amounts. On the other hand, the index value enhanced significantly with 2g/ seedling of NPK fertilizer compared with 1g/seedling and control treatments. Thus, results of Dickson Quality Index confirmed the beneficial effects of the organic and chemical compound fertilizers for the growth and enhancing quality of *E. microtheca* seedlings.

5. Conclusion

Results of this research concluded that adding a suitable amount of organic manure and chemical fertilizer had played significant role in improving growth and biomass for *E. microtheca* seedlings. Therefore, to produce healthy and a high-quality seedlings of *E. microtheca* the study suggests that the seedlings should be treated with 50 g well decomposed animal manure and/or 2 g NPK fertilizer. For future studies, researchers should use more than three replications for each treatment in order to confirm the accuracy and stability of the results.

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کاردانەوەی گەشەی نەمامی یوکالیپتۆس بۆ بڕی جیاواز لە پەینی ئەندامی و نا ئەندامی

پـوخـتـه:

لە نەمامگە چەند کردارێك ئەنجام دەدرێت بە مەبەستی گەشە پێدان و بەرهەم هێنانی نەمامی داری دارستان بە کوالیتی بەرز. یەکێك لە گرینگترین ئەو کردارانە بریتیە لە بەکارهێنانی پەین کە کاریگەریەکی بەرچاوی هەیە لەسەر گەشە و بەرەوپێشچوونی نەمامەکان. ئەم توێژینەوە ئەنجامدرا لە سەرەتای مانگی تشرینی یەکەمی 2019 تا سەرەتای مانگی ئایاری 2020 ، کە تێیدا هەڵسەنگاندن کراوە بۆ کاریگەری بەکارهێنانی پەینی ئەندامی(ئاژەڵی) و پەینی نائەندامی (کیمیایی) لەسەر گەشەی نەمامی داری یوکالیپتۆس. پەینە ئەندامییەکە بە سێ بڕی جیاواز بەکارهێنرا لە پاشماوەی تەواو شی بووەی ئاژەڵ کە بریتی بوون لە 0، 50 ، 100 گرام/مەرکان. پەینە نائەندامیەکەش بریتی بوو لە سێ بڕی جیاواز لە پەیی ئاوێتەی کیمیایی (نایترۆجین، فۆسفۆر، پۆتاسیۆم)، بڕەکانیش بریتی بوون لە 0،

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1، 2 گرام/مەرکان. بە مەبەستی هەڵسەنگاندنی کاریگەری بڕەجیاوازەکانی ئەم دوو جۆر پەیینە لەسەر گەشەی نەمامەکان چەند خەسلەتێکی گەشە لە نەمامەکان پێوانەکرا، خەسلەتەکانیش بریتی بوون لە بەرزی قەد(سم)، ژمارەی گەڵا، تیرەی قەد(ملم)، کێشی ووشکی بەشە جیاوازەکانی نەمام(گرام). ئەنجامی توێژینەوەکە دەریخست کە بەکارهێنانی هەر دوو جۆر پەینەکە کاریگەری بەرچاوی هەبووە لەسەر باشتر کردنی گەشە و بەرەوپێشچوونی نەمامەکان بە بەراورد لەگەڵ ئەو نەمامانەی کە پەینیان پێنەدراوە. دەرئەنجامی توێژینەوەکەش نیشانی دا کە باشترین بڕی پەینە ئەندامیەکە 50 گرام بووە و هەروەها باشترین بڕی پینە نائەندامیەکەش 2 گرام بووە. ئەنجامەکانی ئەم توێژینەوە سود بەخش دەبێت بۆ خاوەنی نەمامگەکان کە نەمامی یوکالیپتۆس بە کوالیتی بەرز وتەندروست بەرهەم بێنن بۆ پڕۆژەکانی دار چاندن وزیادکردنی ڕێژەی دارستان لە کوردستان.

استجابة أداء نمو شتلات اليوكالبتوس (*Eucalyptus microtheca*) لكميات مختلفة من الأسمدة العضوية وغير العضوية.

الملخص:

تم تطبيق بعض العمليات التنموية في المشتل لإنتاج شتلات الغابات ذات الجودة عالية ، و يعتبر استخدام السماد احدى أهم العمليات التنموية التي تؤثر على نمو وتطور الشتلات، يتناول البحث تأثير سماد عضوي وسماد غير عضو على نمو شتلة اليوكالبتوس (*Eucalyptus microtheca*) ، و قد تم اجراء الدراسة من بداية شهر تشرين الثاني 2019 الى بداية شهر أيار 2020 باستخدام السماد العضوي(السماد الحيواني) بثلاثة مستويات وهي 0 و 50 و 100 غم / وعاء ، وايضا استخدمت في التجربة ثلاثة مستويات من السماد غير العضوي (مركب كيميائيNPK) والتي تشمل 0 ، 1 و 2 غم / وعاء، وتم أخذ صفات النمو الخضري التي تشمل ارتفاع النبات (سم) ، عدد الورقة ، قطر الساق (ملم) والكتلة الحيوية (وزن جاف لأجزاء الشتلة) ، وقد أظهرت النتائج المتحصلة عليها من التجربة أن تأثير المعاملتين(السماد العضوي و الكيميائي) كان ملحوظا عن المقارنة لجميع الصفات المدروسة، و خلصت نتائج هذا البحث إلى أنه تم الحصول على أفضل صفات نمو و وزن جاف لشتلات اليوكالبتوس التي تمت معالجتها بـ 50 غم سماد عضوية و 2 غم سماد مركب NPK، النتائج التي تم التوصل اليها قد تساعد اصحاب المشاتل لإنتاج شتلات اليوكالبتوس ذات جودة عالية لتلبية برامج التشجير المختلفة.