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Cultivation of Chinese chestnut *Castanea mollissima* in natural forests in Shaqlawah-Erbil.

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ABSTRACT

Mixed forests have the potential to improve soil fertility, nutrient cycling, carbon storage and ultimately biomass production, and they have other benefits, such as improved risk management and protection against pests and diseases. In addition, they can serve as a silvicultural system for growing high-quality wood. This study aimed to check the comparable effect between Organic and chemical fertilizer NPK on growth traits of *Castanea mollissima &* to check the habitat growth of the *Castanea* seedlings in Shaqlawah Erbil treated with NPK & Irrigation in compare with control under local climate. the first experiment production of seedlings conducted in Agriculture college forestry department in greenhouse during May to September 2022 and the second experiment planting of seedlings in permanent field done in Shaqlawah /Erbil from October 2022 October 2023. RCBD factorial design used, two fertilizers used Peatmoss , silt+ 500ppmNPK and Sand as control .in September the seedlings harvested, the biometric traits height and diameter & biomass traits shoot and root measured. The results show highly significancy about effect of fertilizers on height of seedlings p value ≤0.05 during the 6 months of experiment So, the means of height of seedlings in NPK were 54 cm were the mean of peatmoss were 65 cm and 26 cm in sand control, sig. found in diameter trait the mean diameter for peatmoss were 2.8 mm ,2.3mm in NPK and 1.1 mm for control. And the results show significance between fertilizers effect on biomass growth traits (shoot, root) So the means of shott biomass of seedlings in NPK were 3.9 g. were and 6.7 g. in peatmoss were 1.5g. in control. about root biomass trait significant p value≤0.05 found between all treat medias if the mean root biomass 1.1g.for control were 3.7 g. for NPK and 6.6g. for peatmoss. Even sig. differences found in chemical leaf nutrient conc. So, the means of Nitrogen content of seedlings in control were 87.5 ppm were the mean of NPK were 439.5ppm and 532.3ppm in peatmoss. results for the field experiment, the data value for the growth trait Height for the seedlings showed significant P value ≤0.05 during the experiment duration between NPK and control. So, the means of height of seedlings in NPK were 69.7 cm were the mean of control were 62.3cm, and the p value of ANOVA table were ≤0.05 for the diameter trait, significant differences found between control and NPK mean≤0.05 if the mean diameter for control were2.1 mm and 2.8 mm for NPK. About the irrigation treatment, the data value for the growth trait Height for the seedlings showed significant P value ≤0.05 between control and Irrigation treatment. So the means of height of seedlings in control without irrigation were 62.3 cm were the mean of irrigation were 68.3cm. for the diameter trait, significant p value found between control and irrigation mean≤0.05 if the mean diameter for control were 2.1 mm and 2.8 mm for irrigation. the data value for the growth trait (chemical content nutrients) for the seedlings in the field showed significant P value ≤0.05 between NPK and control. So, the means of Nitrogen content of seedlings in control were 132.66 ppm were the mean of NPK were 524.25ppm. generally, the species of *Castanea mollissima* can be plant in our mountain forestry areas in north of Iraq with treat with NPK fertilizer and Irrigation during first years of planting till the seedlings produce good amount of root systems to utilize and exploit more depth horizons of soil for water and nutrients. To gain this goal we recommend to have a mixed forest than pure, so it is better to plant *Castanea mollissima* with oak tree species *Quercus aegilops*, *Quercus infectoria* and *Quercus libani* which found in the mountain forests in Safeen mountain in Shaqlawah Erbil, to have facilitation between tree species..

***Keywords*:** Forest Ecophysiology, Organic and NPK fertilizers, *Castanea mollissima*

INTRODUCTION

The Chinese chestnut *Castanea mollissima* Blume is a deciduous tree belongs to the Fagaceae family, is one of the most anciently (3500 years) domesticated tree species, is a dominant ecological and economic tree which typically grows and flourishes in mountainous regions with poor soil. [1]. Medium-large dimensions, reaching a height of 30-35 m, which may present great longevity (up to 1000 years). It is considered a species of fast growth until the 80 or 90 years, stabilizing the growth at these ages [2]. In relation to precipitation, it requires a minimum rainfall between 600 - 800 mm [3]. is a woody plant widely cultivated in Europe, North American and Asia as an economic crop, cultivated and used as food and timber production [4]. China has the highest production of chestnuts worldwide and in many hilly areas, In addition to its ecological value, the nuts produced by *C. mollissima* are very delicious and contain many nutrients, including starch, protein, fat, fiber, calcium, phosphorus, and iron. Due to the high starch content and high nutritional value of the nuts, *C. mollissima* is categorized as a woody grain and oil plant [5]. Its sweet kernels are edible and have been used in traditional Chinese medicine for treatment of gastroenteritis, bronchitis, and regurgitation [6]. More recently, there has been an increase in the demand for chestnut wood, leading to an increase of plantation of new stands managed for timber

production. Wood production at national level accounts for about 167 million m3, with an average of 8.97 million m3 of wood harvested per year, A significant part of this wood is exported [7]. Many researchers have confirmed the physiological role of NPK and humic acid in increasing the leaves content of mineral and chlorophyll, the leaves content of nitrogen, phosphorous, and potassium [8]. The most important major nutrient is Nitrogen (N) which partakes in many compounds in the plant such as amino acids, proteins, chlorophylls, hormones, alkaloids and enzymes. Phosphorus (P) partakes in phospholipids, DNA, RNA and metabolism of fats. Potassium (K) regulates water condition within the plant cell and water loss by transpiration as a catalyst and condensing agent of complex substances through its active properties, and potassium has a main role in plant metabolism such as photosynthesis, translocation of photosynthates, water relation as well as enzyme activation. As to the nonconventional sources of organic matter suitable for soil amendments, different humic acid- derived materials have improved soil characteristics and plant growth [9]. Humic acid is complex substances derived from organic matter decomposition. Agricultural humic acid are reputed to enhance nutrient uptake, drought tolerance, seed germination and overall plants performance [10]. They can survive in soils with low fertility. However, the growth is slow and wood production is irregular. When installed in more fertile soils, the species can present high increments and, therefore, high yields [11]. In poorly fertile soils, a balanced fertilization with the main macronutrients, Nitrogen (N), phosphorus (P), and potassium (K), is positively influence tree growth, increasing the ability of young plants to form new roots, which increases competition for water, light, nutrients, and increases their resistance to pests and diseases [12]. there are no published results about the effects of the fertilization with the main nutrients N, P and K on the chestnut trees forest systems managed for wood production. The objective of this research was, therefore, to evaluate the effects of nitrogen, phosphorus, and potassium fertilizers with Irrigation on the growth of young chestnut trees.

Material and methods

1- Experiment set up

The first part of this study (seedling production) conducted in Agricultural college Gerdarasha/Erbil field during April to October 2022 inside the green house, the seeds beringed from the market. One species used Chinese chestnut *Castanea mollissima*, the experiment designed as RCBD one factor to check the effect of different fertilizer types organic peat moss and chemical NPK in comparable with Sand control on growth traits of seedlings. The second part of this study (Seedling planting) establishment in permanent field in Shaqlawa town in north face of Safeen mountain 900 m elevation, the experiment designed as RCBD factorial to check the effect of Irrigation and NPK fertilizer in comparable with control on growth traits of seedlings.

2- Seeds planting

The seeds stored in refrigerator in 5°C for two months to break down the internal dormancy of embryo, in April the seeds planted in polyethylene bags in dimension 30*15 cm, three Agri. Media used silt+NPK 500 ppm, Sand control, peat moss. The bags filled up with Agri. medias, ten bags used per media treatment, the total number of seedlings were 30. the bags irrigated weekly 2 liters. Per week, the climate inside greenhouse is less near 5 °C degree plus in comparable with outside and light intensity are 50% outside, the seedlings stayed inside the green house six months treated with silvicultural treat Irrigation for all treatments and fertilization NPK 500 ppm just for silt media, about 50 ml NPK solution per week diluted by 0.5 g of NPK in 1 liter of deionized water till the harvest in middle of September.

3- seedling harvest treatments

in the middle September the seedling harvest started, the seedlings isolated from the bags and washed with nozzle spray water to remove the Agri medias particles from the roots and putted inside cartoon bags and transported to the labs to measure the biometric and biomass traits.

4-Biometric measuring

The height of seedling measured with tape measure in dimension 0-200cm, the diameter measured with caliper 0-150 mm, the height measured from the base of seedling to the highest tip and the diameter measured in the middle of seedling to get the real value. The height and diameter measured at the day of harvesting in the middle of September 2022 inside greenhouse.

5-Biomass measuring

The biomass measured in the Lab. the seedlings cut in the root and stem connecting area and each part putted in cartoon bags and labeled, the samples putted in oven in 60 °C for 48 hours to drying the samples, the biomass measured as dry matter in gm ±0.1. the samples weighted and the data recorded.

6-Leaf chemical analysis

The leaf chemical analysis of leaf samples measured in the lab one times, after 12 months of planting for the greenhouse and Permanent field samples, the leaf of seedlings cut and putted in cartoon bags and labeled, the samples putted in oven in 60 °C for 48 hours to drying the samples, For determination of leaf N,P,K concentrations, dried until constant mass, fine leafs were ground to powder (Pulverisette 5; Fritsch, Idar-Oberstein, Germany) the biomass measured as dry matter in (gm ±0.1). the samples weighted and the data recorded. The total percentage of nitrogen was estimated using the Macro Kjeldahl device, potassium were measured according to [13],The amount of phosphorus was estimated calorimetrically using the method [14].

7- Seedlings planting

After the seedlings production finished, the seedlings transferred to permanent field in Shaqlawah town in October 2022. Shaqlawah town is located to the north of Erbil city about 50 km in the north face of Safeen mountain. The experiment designed as RCBD factorial to check the effect of Irrigation and fertilization with NPK on growth traits of the seedlings in comparable with control (no Irrigation, no fertilization) treatments.in October 2022 the Seedlings of Chinese chestnut *Castanea mollissima* planted in permanent field, 10 replication seedlings used per treatment, control no irrigation no fertilization and NPK irrigation treatments, the total number of seedlings used were (20) seedlings.

The seedlings planted and irrigated and rested one week to aclimate with field condition. In the second week the treatments done on seedlings ,one type of fertilizers used to fertilize the seedlings in comparable with control treatment , NPK 20g. used per seedlings with irrigation 7 liter per week, the seedling irrigated and fertilized for 12 months till the harvest in next year October 2023.

8-Biometric measuring of seedlings in the field

The height of seedling measured with tape measure in dimension (0-200)cm, the diameter measured with caliper (0-150) mm, the height measured from the base of seedling to the highest tip and the diameter measured in the middle of seedling to get the real value .the height and diameter of seedlings were measured three times during the 12 months of field experiment at the day of planting, after 6 months, after 12 months.

9-Data management and statistic analysis

The data transported to excel file Microsoft program and SPSS program used for statistical analysis. The data analyzed with GLM linear model ANOVA two way full factorial multi variable . first the data checked with Shapiro to check the normality of data, then descriptive statistic calculated to get the means of variable with standard error value. ANOVA two way used to measure the p value. Even the graphs made with SPSS .

Results and Discussions

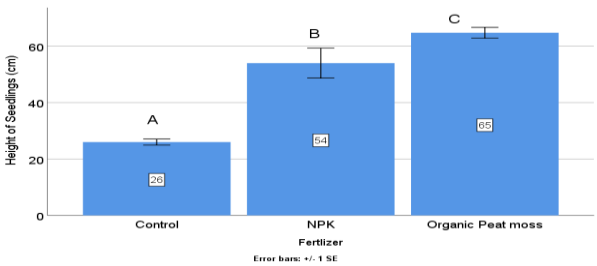
1- Biometric, Biomass and Leaf chemical content data according to fertilizers type (Organic and chemical) in green house experiment

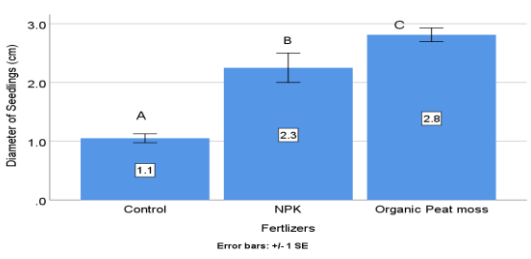
According to statistical analysis results, the data value for the growth trait (Height) for the seedlings showed significant P value ≤0.05 during the experiment duration between NPK and organic peat moss and control. So, the means of height of seedlings in NPK were 54 cm were the mean of peat moss were 65cm and 26cm in control, so significant differences were found between the fertilizer type with control and with each other A, B, C Fig. (1). and the p value of ANOVA table were ≤0.05 for the diameter trait significant p value found between control and peatmoss mean≤0.05 if the mean diameter for peatmoss were 2.8 mm and 1.1 mm for control. significant found between control 1.1 mm and NPK 2.3mm and NPK 2.3mm with peatmoss 2.8 mm, (A, B, C) if P value were ≤0.05 fig (2). About the root length trait according to statistical analysis results, the data value for the growth trait (root length) for the seedlings showed significant P value ≤0.05 between NPK and organic peat moss and control. So, the means of root length of seedlings in NPK were 25 cm were the mean of peat moss were 42.3 cm and 10.7 cm in control, so significant differences were found between the fertilizer type with control and with each other (A, B, C) Fig. (3). About the biomass production results, according to statistical analysis results, the data p value for the growth trait (Shoot biomass) for the seedlings showed significant P value ≤0.05 and ≤0.001 during the experiment duration between control and NPK and between control and peat moss. So the means of shoot biomass of seedlings in NPK were 3.9g. were the mean of control were 1.5g. and sig. differences found between control and peat moss if p value of ANOVA table were ≤0.001 between peat moss and Control ,the means were 6.7g. significant found between all treat continuously A,B,C fig.4. for the root biomass trait significant p value found between all treat medias, control with NPK and peat moss mean≤0.05 if the mean root biomass 1.1g for control were 3.7 g for NPK and 6.6g. for peat moss. Fig 5**.** while about chemical conc. Nutrients in leaves results, according to statistical analysis results, the data value for the growth trait (chemical content nutrients) for the seedlings showed significant P value ≤0.05 during the experiment duration between NPK and organic peat moss and control. So, the means of Nitrogen content of seedlings in control were 87.5 ppm were the mean of NPK were 439.5ppm and 532.3ppm in peat moss. About phosphor (P) showed significant P value ≤0.05 between NPK and organic peat moss and control. So, the means of phosphor content of seedlings in control were 4.75ppm and 36.50ppm in NPK and 64.33ppm in peat moss. About potassium (K) the results showed significant P value ≤0.05 between NPK and organic peat moss and control So the means of potassium content of seedlings in control were 17.33 ppm were the mean of NPK were 98.50ppm and 115ppm in peat moss. differences were found between the fertilizer type with control and with each other A, B, C table 2**.**

during first to end of experiment significant differences between means of trait growth found, which refers to the differences according to fertilizer type for availability of macro nutrients which are very important for the growth of seedlings physiologically and producing of biomass [15]. Nitrogen plays an important role in seedling growth It also regulates the plant's absorption of potassium In addition, phosphorus is included in the composition of many Proteins that act as enzymes for many activities It is vital to the plant and is also involved in the synthesis of acids Amino, nuclear, and chlorophyll molecules. This is consistent with the results [16] in addition to Nitrogen, phosphorus and potassium improve seedling growth Acacia. So the peat moss fertilizer treatment get the higher Biometric data (height) and (diameter) then NPK treatment while Control get the lowest value fig.(1,2). even peat moss treatment were higher leaf chemical concentration on macro nutrients than NPK and control table(2).the results of this research were compatible with the results of [10] when they fertilize olive seedlings with humic acid and NPK in compare with control and they found that The obtained results revealed that treatment 4ml. humic substance was the most effective one compared with the other treatments. Since this treatment gave the best results concerning percentage of plant height increment, lateral shoot number per plant, leaves number per plant, stem diameter, also it increased leaves dry weight percentage comparing with the control. On the other hand, the highest root number was recorded from Egazy olive seedlings not fertilized with NPK

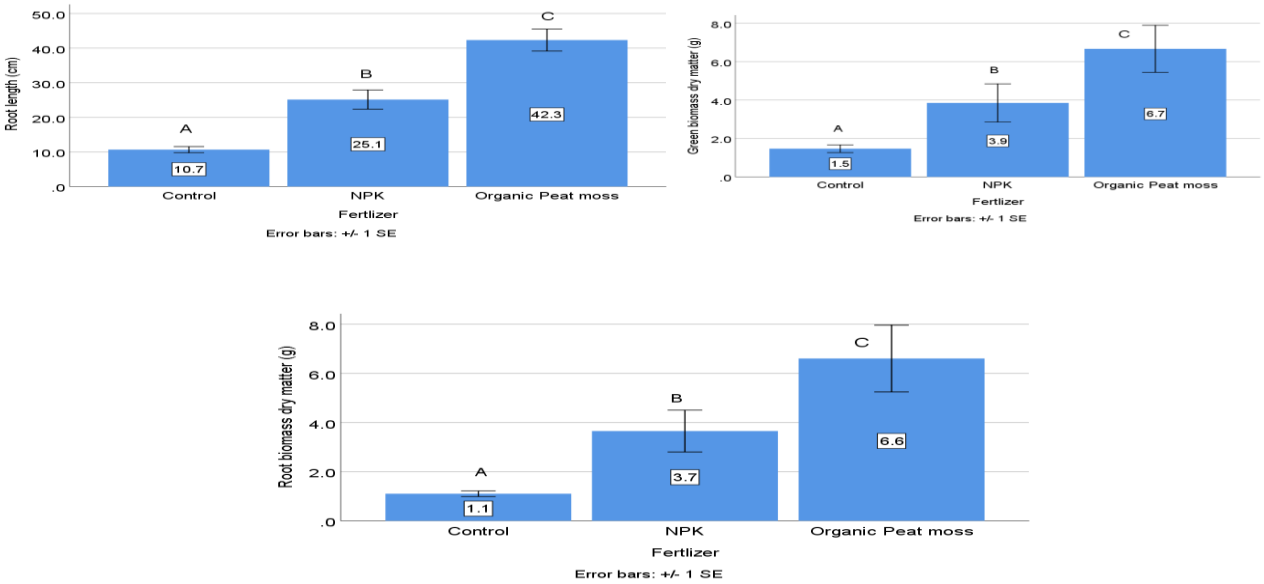
and or humic substance. While, the highest root length value was obtained by using 2ml humic substances without NPK. However [17] find the same results when they fertilize *Stranvaesia davidiana* L. and they find that organic fertilizer increased the plant height by 0.42 cm to 9.59 cm and basal diameter by 0.01 cm to 0.05 cm, compared with the control group. Organic fertilizer had the maximum effect on seedling growth. The total growth of basal diameter and chlorophyll content was 1.58 cm and 39.53, respectively. Basal diameter were the most critical index in seedling reproduction. Even our results are agreement with [18]when they fertilized *pawlownia tomentosa* seedlings with humic acid and NPK in comparable with control, the application of NPK fertilizer caused a significant increase in the most important studied characteristics such as morphological and physiological properties of *Paulownia tomentosa* seedlings. The production of *Castanea mollissima* seedlings can be improved by adding the adequate levels of NPK fertilizer. And even compatible with [8] when they found that chemical fertilization with compound fertilizers NPK especially at a concentration of 250 mg NPK.L^{-1} achieved a significant increase in the percentage of nitrogen, phosphorous, and potassium in the petioles of the leaves, the concentration of chlorophyll and the percentage of protein in the leaves. the results certificate that peat moss was increase the growth traits of seedlings because the role of peat moss in improving the soil fertility nutrients and increasing the availability of nutrient elements and continuously availability in soil and in result increased the growth of seedlings [19]. The presence and nature of organic matter in a mineral soil adds unique physical and chemical properties, making such soils apparently more fertile, Organic matter associated with the cells of living microorganisms, Organic matter associated with living soil fauna, Organic fragments with recognizable cellular structure derived particulate organic matter from any source but usually dominated by plant-derived materials, Organic materials with chemical structures that do not allow them to be placed into the category of non-humic biomolecules, Organic materials that are soluble in alkaline solution but precipitate on acidification of the alkaline extract [20]. And our result was compatible with the results of [21] when they fertilized *Paulownia tomentosa* and the results show that the urea treatment with a concentration of 3.2 g per plant increased significantly in plant height, the number of leaves, leaf area and percentage of dry matter in the total vegetative, where urea treatment at a concentration of 1.6 g.$plant^{-1}$ led to a significant increase in stem diameter and dry weight of roots. Nitrogen increases cytokinin production, which subsequently affects cell wall elasticity, the number of meristematic cells, and cell growth [22] Nitrogen promotes the formation of active photosynthetic pigments by increasing the amounts of stromal and thylakoid proteins in leaves and by increasing the formation of chloroplasts during leaf growth [23] even the results show that all growth traits(Height , Diameter, shoot biomass, root biomass and root length have a significant correlation with Nitrogen conc. In roots were p value were ≤ 0.05 fig.(6,7,8,9,10). Therefore, fertilization usually enhances root respiration, and the root tissue nitrogen concentration increases with the addition of nitrogen fertilizer, which may be the underlying reason for the observed increase in root respiration with fertilization [24]. So it is better to use chemical fertilizer for producing seedlings programmes especially organic fertilizer peat moss and NPK fertilizer which enhance the growth of seedlings significantly. However the temperature and moisture had a influence on seedling production inside greenhouses the significant growth traits for treatments means high significantly of growth traits per time duration first to end of experiment and this is due to its suitability climatic conditions in terms of average temperatures and humidity for growing *Castanea* seedlings and this is consistent with the results of and [25] when they produce three sp. of Acacia seedlings by seed inside green house in compare with outside open area and they find highly significant in growth traits of seedlings height, diameter ,shoot biomass and root biomass was higher inside greenhouse then outside open area. And our results were compatible with [26] when they produce American chestnut *Castanea denata* in light shade in compare with no shade full sun areas, and the results were higher height and diameter and less mortality of seedlings in light shade treatment than fully open area. It was stated that the appropriate temperature range is between 15–28 °C inside the greenhouse so the optimum temperature inside the greenhouse enhancement the growth of seedlings because it has a role in increasing photosynthesis which the optimum temp degree are between 20-25°C [27] and the suitable temperature increased the activity of root and stomatal conductivity to increase the uptake of water and nutrient from the soil [20] and increase the gas exchange CO_2 and O_2 assimilation to produce glucose sugar which then convert to biomass and these compatible with [28] for growth of plant in optimum environment in correlations with cell physiology and biology. Accordingly we recommend to produce seedling of *Castanea mollissima* inside greenhouse to protect them from harsh ecosystem outside high temperature and wind even it must to use peat moss agri. media which is full decomposed plant material very rich in macro nutrient and it can continuously provide the plant with nutrients and can hold water for more time even more microbe activity even it can use NPK to fertilize seedlings with other agri. Medias like Silt to enhance the growth of seedlings and can get good biometric and biomass results but less than peat moss or should be increase the conc. to more than 500 ppm ,(800 -1000) ppm which is more chipper than peat moss price in market.

Green house Experiment Results

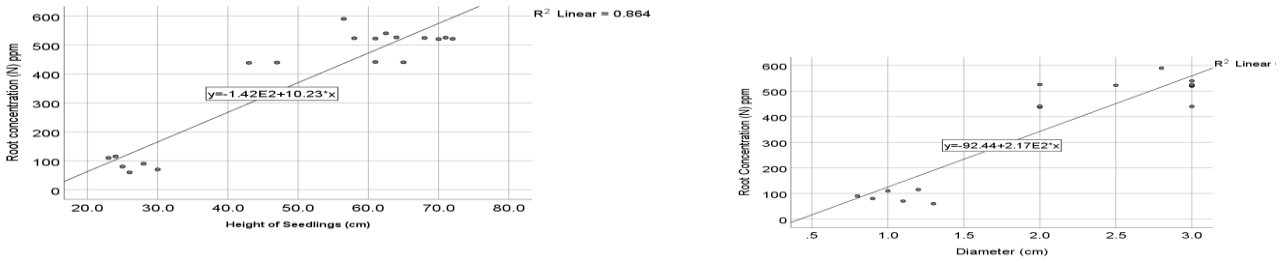




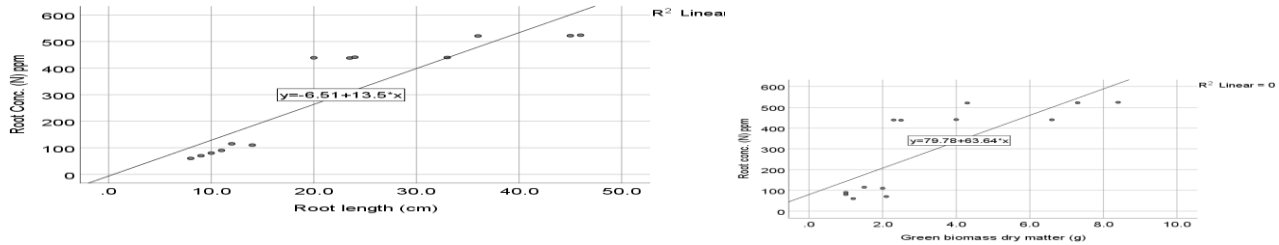
Figure(1,2) mean height and diameter of seedling of Castanea mollissima under three different Agri. Media (control,NPK,peatmoss) Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).



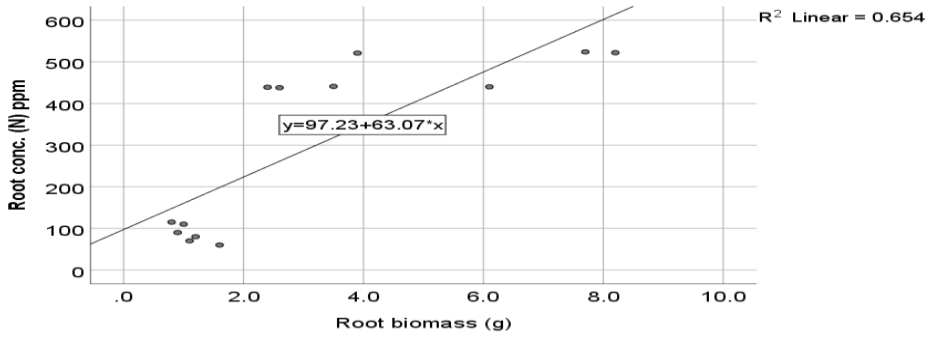
Figures(3,4,5) mean root length and shoot biomass and root biomass of seedling of Castanea mollissima under three different Agri. Media (control,NPK,peatmoss) Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).



Figure(6,7) *pearson corelation between mean height and diameter of seedling and nitrogen conc. In root of Castanea mollissima Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).*



Figure(8,9) *pearson corelation between mean root length and green biomass of seedling with nitrogen conc. In root of Castanea mollissima, Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10*



Figure(10) *pearson corelation between mean root biomass of seedling with nitrogen conc. In root of Castanea mollissima, Significant differences between treatments are indicated by different letters (t-test, p<*

Table (1) peat moss , chemical traits are total

sample	pH	EC (Ds/m)	% total (N)	(P) % P_2O_5	(K) % K_2O	O.M %
Peat moss	6.4	0.4	0.75	0.13	0.14	40.32

nitrogen (N) , Phosphor (P) and Potassium
(K) concentrations, pH, EC (Ds/m).
0.05, mean+SE, n=10).

Table 2 Leaf chemical traits of the species *Castanea mollimmosa* in the green house, leaf chemical traits are total nitrogen , Phosphor and Potassium in ppm. Significant are indicated by different capital letters (mean±SE; Tukey test, p<0.05 .

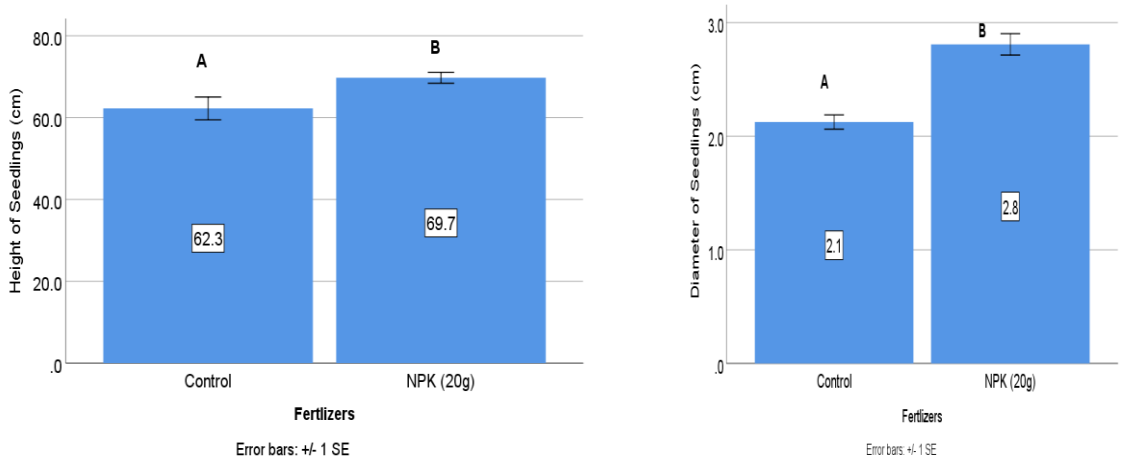
Species	date	Fertilizer	Nitrogen (N) ppm	Phosphor (P) ppm	Potassium (K)ppm
Castanea mollissima	30 /9/2022	Control	87.5±8.17 A	4.75±2.41 A	17.33±1.84 A
		NPK	439.5±10.01 B	36.50.49±2.96 B	98.50±2.26 B
		Organic Peat moss	532.33±6.67 C	64.33±1.97 C	115.00±1.51C

2- **Biometric and Leaf chemical content data according to fertilizers type (Organic and chemical) in permanent field experiment**

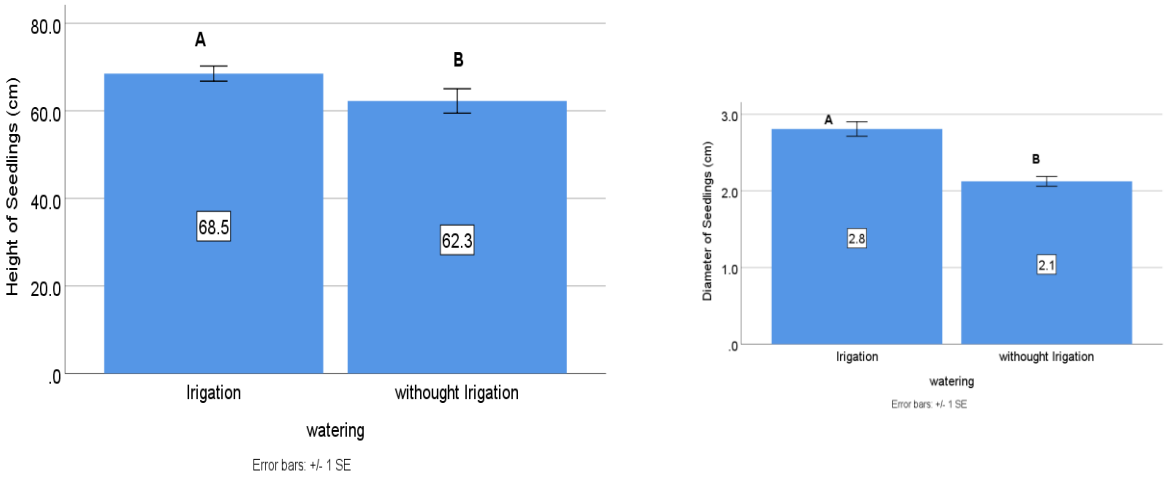
According to statistical analysis results for the field experiment, the data value for the growth trait (Height) for the seedlings showed significant P value ≤0.05 during the experiment duration between NPK and control. So, the means of height of seedlings in NPK were 69.7 cm were the mean of control were 62.3cm, So significant differences were found between control and the fertilizer Fig. (11). and the p value of ANOVA table were ≤0.05 for the diameter trait, significant p value found between control and NPK mean≤0.05 if the mean diameter for control were 2.1 mm and 2.8 mm for NPK. fig (12). About the irrigation treatment, according to statistical analysis results for the field experiment, the data value for the growth trait (Height) for the seedlings showed significant P value ≤0.05 during the experiment duration between control and Irrigation treatment. So the means of height of seedlings in control with ought irrigation were 62.3 cm were the mean of irrigation were 68.3cm, So significant differences were found between control and the irrigation Fig. (13). and the p value of ANOVA table were ≤0.05 for the diameter trait, significant p value found between control and irrigation mean≤0.05 if the mean diameter for control were 2.1 mm and 2.8 mm for irrigation. fig (14). According to statistical analysis results, the data value for the growth trait (chemical content nutrients) for the seedlings showed significant P value ≤0.05 during the experiment duration between NPK and control. So, the means of Nitrogen content of seedlings in control were 132.66 ppm were the mean of NPK were 524.25ppm. About phosphor (P) showed significant P value ≤0.05 between NPK and control. So, the means of phosphor content of seedlings in control were 8.76 ppm were the mean of NPK were (56.49) ppm . About potassium (K) the results showed significant P value ≤0.05 between NPK and control. So, the means of potassium content of seedlings in control were 67.0 ppm were the mean of NPK were 116.86ppm. So significant differences were found in leaf chemical nutrient content between the fertilizer with control (A, B) table 3. The results in our research show significant differences were found between NPK 20g. treatment and control for growth traits of seedlings height and diameter fig. (11,12) and even the seedlings content on macro nutrients nitrogen, phosphor and potassium were higher and significant than control table(3) refers to the differences according to fertilizer availability of macro nutrients which are very important for the growth of seedlings physiologically and producing of biomass [15]. Nitrogen plays an important role in seedling growth It also regulates the plants absorption of potassium in addition, phosphorus is included in the composition of many Proteins that act as enzymes for many activities It is vital to the plant

and is also involved in the synthesis of acids Amino, nuclear, and chlorophyll molecules. And these results were compatible with [29] when they fertilize *Punica granatum* seedlings with NPK in compare with control and they find high growth of seedling traits for the number of leaves, height of plant, and area of leaves parameters studied. It is clear to us that there are differences in the proportion of nutrients in the soil of the regions table 4, but the main factor influencing the process of forest growth is the nitrogen element, which is considered one of the most important problems of plant nutrition in arid and semi-arid areas [30]. The total nitrogen content in our field study in Shaqlawah is within the limits of the proportions represented in semi-arid areas. However, it is It represents the state of availability of the element nitrogen in forest soils, and this is consistent with what was confirmed by [31]. Even our results show significant differences between Irrigation and control refers to influence of watering in increase growth traits of seedlings in the permanent field, Even the precipitation amount in the area were good for growing the trees which were near 900 mm per year distributed among the months from January to December unless from July to September few 5-15 mm of rain precipitate [25]. Rain amounts and temporal patterns are a key driver of forest dynamics, because annual net primary production (NPP) generally positively correlates with the annual amount of precipitation [32]. While water uptake occurs primarily belowground, the root system has to serve several functions simultaneously. It has to provide a stable platform for the shoot so that the photosynthetic organs can intercept sunlight, and it has to provide a network that can exploit the water and nutrient resources of the soil [33]. About the growth traits of seedlings during one year of experiment, according to statistical analysis results for the field experiment, the data value for the growth trait height for the seedlings showed significant P value ≤0.05 during the experiment duration between D1 and D3. So, the means of height of seedlings in D1 were 64.1 cm were the mean of D3 were 73cm, So significant differences were found per time Fig. (15). And about the growth traits diameter of seedlings during one year of experiment, according to statistical analysis results for the field experiment, the data value for the growth trait Diameter for the seedlings showed significant P value ≤0.05 during the experiment duration between D1 and D3. So, the means of diameter of seedlings in D1 were 2.6 mm were the mean of D3 were 3.0mm, So significant differences were found per time Fig. (16). The results show growth of seedlings per year with increment in height of seedlings 8.9 cm and 0.4 mm in diameter, generally the species of *Castanea mollissima* can be plant in our mountain forestry areas in north of Iraq with treat with NPK fertilizer and Irrigation during first years of planting till the seedlings produce good amount of root systems to utilize and exploit more depth horizons of soil for water and nutrients. A concept for designing highly productive mixed-species stands is the need to combine species that differ in characteristics such as shade tolerance, height growth rate, and crown structure [34] & [35]. Mixed-species plantations are designed to produce more facilitative interactions than those designed solely for the complementarity of resource use in forest plantations The complementarity effect is characterized by trait variation, which enables a permanent association of species that enhances collective performance, resource partitioning and positive interactions between species, leading to a more complete capture of resources and resulting in higher productivity [36]. To gain this goal we recommend to have a mixed forest than pure, So it is better to plant *Castanea mollissima* With oak tree species *Quercus aegilops*, *Quercus infectoria*, *Quercus libani* which found in the mountain forest in Safeen mountain in Shaqlawah Erbil, to have facilitation between tree species share the soil resources water and nutrients especially the species were different in root system and morphology and the oak trees were make as a nursery trees to the *castanea* species protect them from high temperature and wind and these results are compatible with [37] & [38].

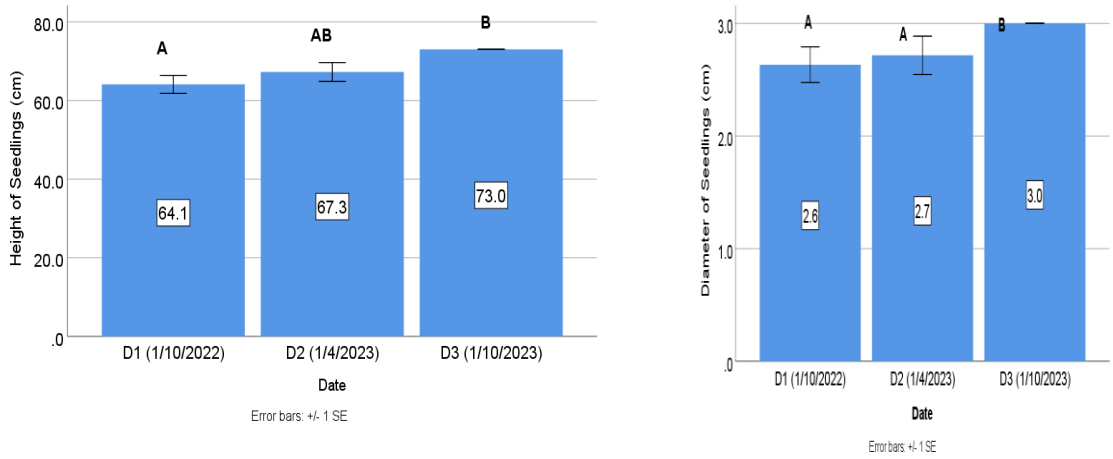
Field Experiment Results



Figure(11,12) mean height and diameter of seedling of Castanea mollissima under (control,NPK,) treatments Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).



Figure(13,14) mean height and diameter of seedling of Castanea mollissima under (control,and irrigation) treatments Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).



Figure(15,16) mean height and diameter of seedling of Castanea mollissima under (d) treatments Significant differences between treatments are indicated by different letters (t-test, p<0.05, mean+SE, n=10).

Table 3 Leaf chemical traits of the species Castanea mollimmosa in the field Shaqlawah, root chemical traits are total nitrogen (N) , Phosphor (P) and Potassium (K) ppm concentrations. Significant are indicated by different capital letters (mean±SE; Tukey test, p<0.05 .

Species	date	Fertilizer	Nitrogen (N) ppm	Phosphor (P) ppm	Potassium (K)ppm
Castanea mollissima	30 /10/2022	Control	132.66±10.93 A	8.76±2.53 A	67.0±3.02 A
		NPK	524.25±7.73 B	56.49±1.79 B	116.86±2.15 B

Table 4 (Fine) Soil chemical traits of the field, chemical traits are total nitrogen (N) , Phosphor (P) and Potassium (K) concentrations, pH, EC (Ds/m), organic matter % and soil texture.

sample	pH	EC (Ds/m)	% N	(P) ppm	(K) ppm	O.M %	% Sand	% Silt	% Clay	Soil texture
Soil field	7.85	0.2	0.21	8.6	78.2	2.1	65.6	10.7	23.7	Sandy clay loam

Table 5 Climatic factors of in Shaqlawah -Erbil from October 2022 to September 2023

Soil temperature°C		Wind speed m/sec	Sun shine hrs/day	Precipitation (mm)	% Air moisture			Temperature °C			factors \months
100 cm	50 cm				Avg.	max	min	Avg	max	min	
15.8	17.9	1.8	8.9	31.5	52.4	58.7	46.2	21.2	26.0	16.5	May
21.1	23.6	1.2	11.4	2.0	41.2	48.8	3.7	27.5	33.4	21.6	June
24.8	27.9	1.2	11.3	5.0	42.7	50.1	35.3	31.9	39.9	23.9	July
25.3	28.5	1.0	10.4	10.1	43.1	52.4	33.9	28.5	37.8	19.2	August
23.4	25.0	0.8	9.5	9.0	36.8	47.5	26.1	24.0	34.2	13.8	September
19.3	19.1	1.9	6.4	7.5	45.1	57.3	32.9	18.1	26.2	9.9	October
15.2	13.1	1.4	6.1	36.5	36.3	65.3	47.4	9.3	15.7	2.9	November
13.4	11.2	3.0	5.3	91.1	56.7	65	48.5	9.6	16.2	2.4	December
6.8	4.6	2.5	2.6	173.5	78.4	88.6	68.2	4.8	8.7	-0.1	January
5.2	3.6	5.8	3.1	265.2	75.7	87.5	64	6.7	10.8	1.6	February
7.1	7.0	2.2	6.1	148.3	58.1	70.1	46.1	11.8	18.5	5.1	March
6.4	7.2	2.3	6.4	147.4	73	86.9	59.2	14.7	18.9	10.2	April

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أدخال شجرة الكستناء الصيني Castanea mollissimaالى الغابات الطبيعية في شقلاوة – أربيل.

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الخلاصة

تمتلك الغابات المختلطة القدرة على تحسين خصوبة التربة ودورة المغذيات وتخزين الكربون وفي إنتاج الكتلة الحيوية، ولها فوائد أخرى، مثل تحسين إدارة المخاطر والحماية من الآفات والأمراض. بالإضافة إلى ذلك، يمكن أن تعمل كنظام زراعي حرجية لزراعة الأخشاب عالية الجودة. هدفت هذه الدراسة الى التحقق من التأثير المقارن بين الأسمدة العضوية والكيميائية والري على صفات النمو لشتلات شجرة الكستناء الصيني تحت تأثير المناخ المحلي في شقلاوة– أربيل. تم اجراء التجربة الاولى لانتاج الشتلات في كلية الزراعة قسم الغابات في البيوت البلاستيكية خلال شهر ايار الى شهر ايلول 2022 والتجربة الثانية لزراعة الشتلات في الحقل الدائم في شقلاوة اربيل خلال شهر تشرين الاول 2022 تشرين الاول 2023. تم استخدام تصميم عاملي. تم استخدام نوعين من السماد البيتموس و والطمي + 500 جزء في المليون سماد مركب و المشاهدة، في شهر أيلول تم حصاد الشتلات وتم قياس الصفات البايومترية مثل طول الشتلة وقطر الشتلة والبايوماس للنمو الخضري والجذر. تظهر النتائج دلالة عالية حول تأثير الاسمدة على ارتفاع الشتلات حيث كان طول الشتلات في معاملة المشاهدة 26 سم و54سم في السماد المركب والأكثر ارتفاعا كان لمعاملة البيتموس العضوي 65 سم، ولصفة قطر الشتلات كانت 1.1ملم للمشاهدة و 2.3 للسماد المركب و2.8 ملم للبيتموس العضوي. وتظهر النتائج دلالة بين تأثير الأسمدة على صفات نمو الكتلة الحيوية (البراعم والجذور) لذا فإن متوسط الكتلة الحيوية للشتلات في السماد المركب 3.9 غم و 6.7 للبيتموس العضوي و 1.5 للمشاهدة. بالنسبة للكتلة الحيوية للجذر كان 1.1 غم للمشاهدة و 3.7 غم للسماد المركب و 6.6 غم للبيتموس. لفروقات الدالّة وجدت في تركيز المغذيات الكيميائية للأوراق. وبذلك فإن متوسط محتوى النيتروجين في الشتلات في البيتموس 532.3 و(87.5) في المشاهدة و439.5 للسماد المركب جزء في المليون. وبالنسبة للنتائج الخاصة بالتجربة الحقلية فإن قيمة البيانات لصفة النمو (الارتفاع) للشتلات أظهرت قيمة 62.3سم للمشاهدة و 69.7 سم للسماد المركب ولصفة القطر 2.1 ملم للمشاهدة و2.8 ملم للسماد المركب. وبخصوص معاملة الري فقد أظهرت قيمة البيانات لصفة النمو (الارتفاع) للشتلات قيمة معنوية وكانت 62.3 سم للمشاهدة و 68.3 سم لمعاملة الري ولصفة قطر الشتلات كانت 2.1 للمشاهدة و 2.8 لمعاملة الري . أظهرت قيمة البيانات لصفة النمو (المحتوى الكيميائي للعناصر الغذائية) للشتلات في الحقل قيمة معنوية وكانت متوسط تركيز النتروجين في المشاهدة 132.66 جزء بالمليون و 524.25 للسماد المركب. بشكل عام يمكن زراعة شجرة الكستناء الصيني في مناطق الغابات الجبلية في شمال العراق مع استخدام السماد المركب والري خلال السنة الأولى من الزراعة حتى تنتج الشتلات كمية كبيرة من الكتلة الجذرية للاستفادة من عناصر الغذائية والرطوبة الموجودة في التربة . ولتحقيق هذا الهدف نوصي بأنشاء غابة مختلطة بدلاً من الغابة النقية، لذا من الأفضل زراعة شتلات شجرة الكستناء الصيني داخل غابات البلوط الطبيعية في جبل سفين في شقلاوة أربيل لزيادة التعاون بين الأشجار حيث ان أشجار البلوط تمثل أشجار حاضنة للكستناء الصيني تحميها من درجات الحرارة العالية والرياح

الكلمات المفتاحية: بيئة وفسيولوجيا ألاشجار، الاسمدة العضوية والكيميائية ، صفات نمو الاشجار.