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**THE EFFECT OF PLANTING DENSITY IN CROWN PROJECTION AREA  
FOR YOUNG POPULUS NIGRA L. STANDS**

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**Abstract**

The study aimed to know the effect of the difference in the initial density of a forestation on the coronary coverage area. One-year-old black gouache seedlings were planted with four densities (5000, 1666, 833, 416) trees/ha. The results showed that the cultivation of high densities gave a crown coverage area much larger than that given by low densities, at the ages of (2 and 3) years. It reached (3093.75 and 4104.58) m<sup>2</sup>/hectare at the ages of (2 and 3) years, respectively, for density (5000) trees/hectare, while it was (81.25) m<sup>2</sup>/hectare at both ages at the shoulder blades (416) trees/hectare. This value does not mean that no growth will occur, but rather the reason is that some trees perish, as the forest is a biological system that is affected by the external factors surrounding it. The values were calculated in two cases, namely, without and with dead trees. The percentage of the coronal coverage area for the four densities was also found.

The reason for this result is that the high density of cultivation in the early stages of life works to maintain soil moisture, reduce evaporation and make better use of nutrients.

**Keywords:** primary density, coronary coverage, Populus nigra.

**Introduction**

Poplar trees are among the species that have been given great importance in the field of studies, as they are woody species with short cutting cycles, which produce live mass that can be used in many fields, whether in the field of fiber, fuel, in addition to environmental benefits (Coleman and Stanturf 2006). The reason for its success in these uses is due to the ease of its propagation, its speed of installation, and growth (Zalesny et al. 2006). It is planted for different purposes and in groups of trees on the sides of rivers to protect them from erosion and erosion (Duggan 2005).

Trees need light, nutrients and water in order to grow normally. Evolution in trees such as changes in the size of the crown and branches and the growth of leaves and roots affect biological processes such as light absorption, rainwater retention,

evaporation, transpiration, photosynthesis and respiration to a large extent, and these affect the structure and growth of the tree.

The lengths, diameters and crowns of trees vary according to the density and time period of the tree itself, so these two variables are influential in the productivity of the living mass of trees, as it is in a continuous dynamic with time. (Gawy, 2009). The amount of light reaching the forest floor and rainwater retained by the tree crowns have a major role in determining the animal and plant species present in this site.

In other words, the area of coronary coverage is the influence that plays the largest role in the processes of natural renewal and the emergence of lower branches. Since the initial composition of the tree is of great importance to its growth and development, if the other conditions of the tree are similar between the different densities of the tree, the initial difference in the composition of the tree will be the important influence up to a certain age depends on the type of trees planted, growth increases and decreases according to the difference in the initial densities and age of the tree (Tom and Burkhart 1989). The aim of this study is to find out the differences in the area covered by trees planted with different densities in the first years of life, or in other words the effect of the initial density on the ratio of crown coverage to the forest floor, or in another way to know the extent of the effect of a forestation density on the area of crown coverage of the forest floor.

### Materials and Methods

The research was conducted on young black poplar trees, *Populus nigra* L., planted in the Nineveh Forest. The data were taken from trees planted with four different densities represented by four planting distances as follows: the first density with planting distances between trees (1X2) m<sup>2</sup>, the second density with planting distances (2X3) m<sup>2</sup>, the third density with planting distances (3X4) m<sup>2</sup>, and the fourth density with planting distances (4X6) m<sup>2</sup>, i.e. equivalent to (5000, 1666, 833, 416) trees/ha, respectively. The area of crown coverage of trees was measured at the beginning of afforestation as well as at the age of two and three years, depending on four samples for each density, meaning that the total number of samples was (16) samples, with an area of (20X30) m<sup>2</sup> per sample.

The crown coverage area was measured by measuring the width of the crown, which was measured directly from small trees and using a tape measure, and for large trees, it was based on the location of the crown, and in both cases, for the sake of accuracy, we took more than one reading, and then find an average. These readings are to obtain the width of the crown, which represents the diameter of the circle used to find the area of the circle, which in turn represents the area of the projection of the crown or the area of the coronal coverage.

### Results and Dissection

The results showed that cultivation with high densities gave a crown coverage area much larger than that given by low densities, at the ages of (2 and 3) years. The density

was (185.13 and 246.28) m<sup>2</sup> at ages (2 and 3) years , respectively, for density (5000) trees/ha, while it was (4.875) m<sup>2</sup> at both ages at the sapling (416) trees/ha . As shown in Table (1). This is consistent with what was reached by (David et al., 2002) when they studied the effect of different densities of young Douglas-fir trees on growth. The result differed when the trees reached the age of (8) years.

Table (1) shows the total coronary coverage area totals for samples at two and three years of age for the four densities

Density	Total coronary coverage area at the age of (2) years (m <sup>2</sup> )	Total coronary coverage area at the age of (3) years (m <sup>2</sup> )	Increase in coronary coverage area within one year (m <sup>2</sup> )
1	185.13	246.28	61.15
2	34.35	44.45	10.15
3	13.42	18.15	4.725
4	4.875	4.875	0

We see from the above table that the total crown coverage area increases with increasing a forestation intensity (decreasing planting distances between trees). It prompts us not to leave large distances between the trees in order to make optimal use of the land without negatively affecting the output. On the contrary, the high density at young ages has a positive effect in terms of reducing water evaporation from the surface of the earth and increasing growth as we note that in the fourth density remained The area of coronary coverage is the same at the age of three years, and this does not mean that there was no increase, but the reason for this is the death of a large number of trees at this density and thus did not show a clear increase on the final output.

The table has been converted into a graphic form, as shown in Figure (1) as follows:

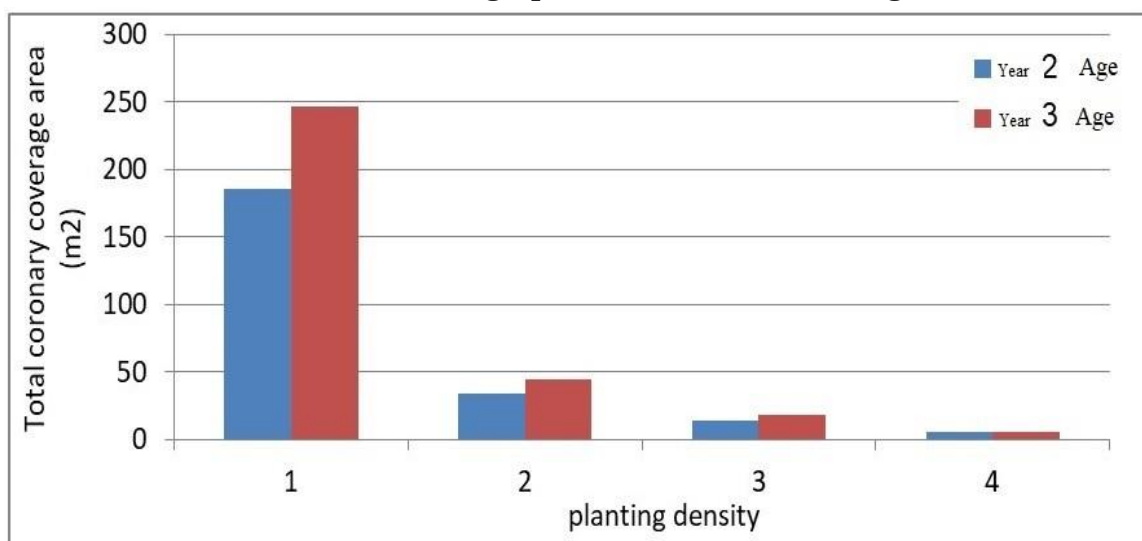


Figure (1) shows the total coronary coverage area totals for the study samples at 2 and 3 years of age for the four densities

Since the basic unit used in measuring the area is hectares, the total coronary coverage for the unit area (ha) was found, and it was as in Table (2).

Table (2) shows the total coronal coverage area totals per unit area at 2 and 3 years of age for the four densities.

Density	Total coronary coverage area per unit area at the age of (2) years (m <sup>2</sup> )	Total coronary coverage area per unit area at the age of (3) years (m <sup>2</sup> )
1	3093.75	4104.583
2	571.6667	740.8333
3	223.75	302.5
4	81.25	81.25

This was represented graphically in Figure (2) as follows:

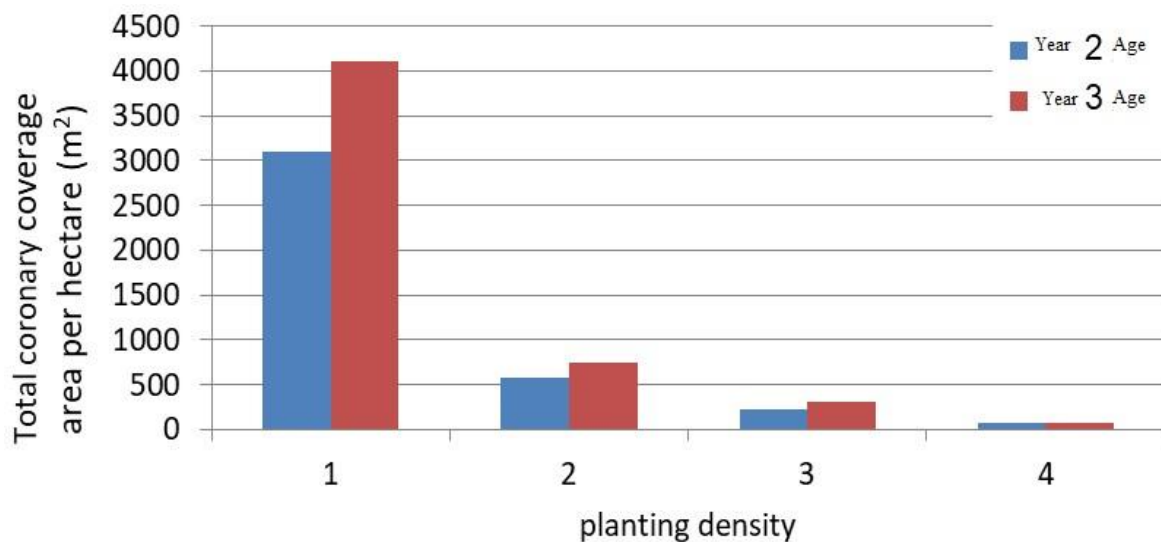


Figure (2) shows the relationship between planting density and total coronary coverage area per hectare for ages 2 and 3 years

The percentage of the total crown coverage area was also found (if the a forestation area is 100 square meters, what is the area that the crowns will cover?). The results were as in the following table (3):

Table (3) shows the percentage of total coronary coverage area totals at the age of two and three years for the four densities.

Density	% Of total coronary coverage area at the age of (2) years (m <sup>2</sup> )	% Of total coronary coverage area at the age of (3) years (m <sup>2</sup> )
1	30.9383	41.04667
2	5.716667	7.408333
3	2.2375	3.025
4	0.8125	0.8125

Table (3) has been represented in Figure (3) as follows:

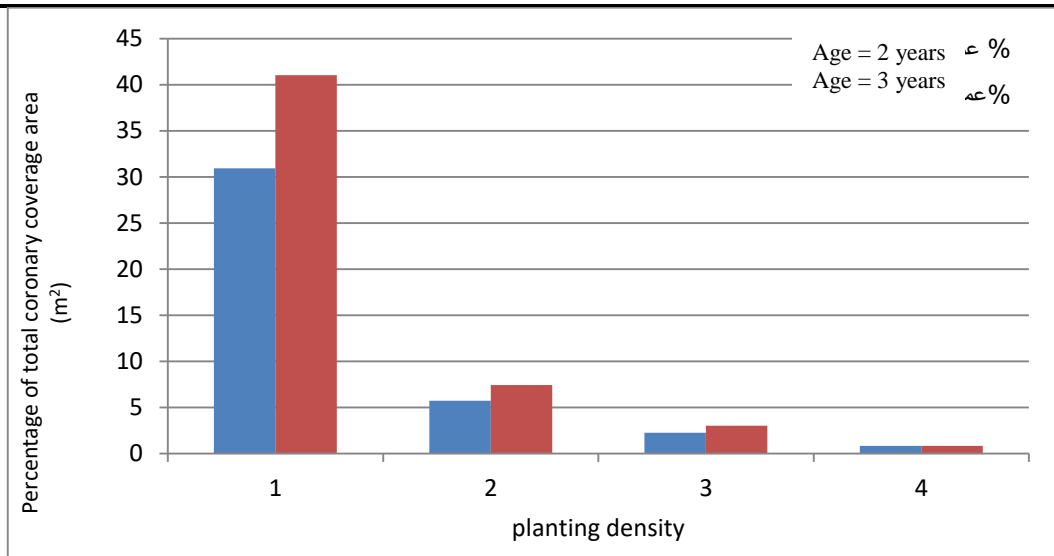


Figure 3 shows the percentage of total coronary coverage area totals at two and three years of age for the four densities

Since the forest is a dynamic biological system, that is, it is in a state of constant change and it is affected and affected by the ecosystem and the ocean, including the phenomenon of competition, so we find the emergence of deaths in the number of trees over time, and this phenomenon has been taken into account and then On its basis, the area of coronal coverage with and without deaths (dead trees) and their percentages was found and tabulated by finding the corona coverage rate, since in the first case the dead trees were considered with a diameter of zero, and it was calculated when finding the rate by dividing the total area of the total coronary coverage For the sample by the total number of trees (including dead trees), but in the second case, the average was found by dividing the total coronary coverage area by the total of the sample by the number of live trees only (without dead trees). As shown in table (4). Table (4) shows the average coverage area for one tree with dead trees at the age of two and three years for the four densities

Density	Average coronary coverage area at the age of (2) years (m <sup>2</sup> )	Average coronary coverage area at the age of (3) years (m <sup>2</sup> )
1	0.697838	0.925847
2	0.423457	0.548765
3	0.372917	0.504167
4	0.304693	0.304693

The Table (4) has been represented in Figure (4) as follows:

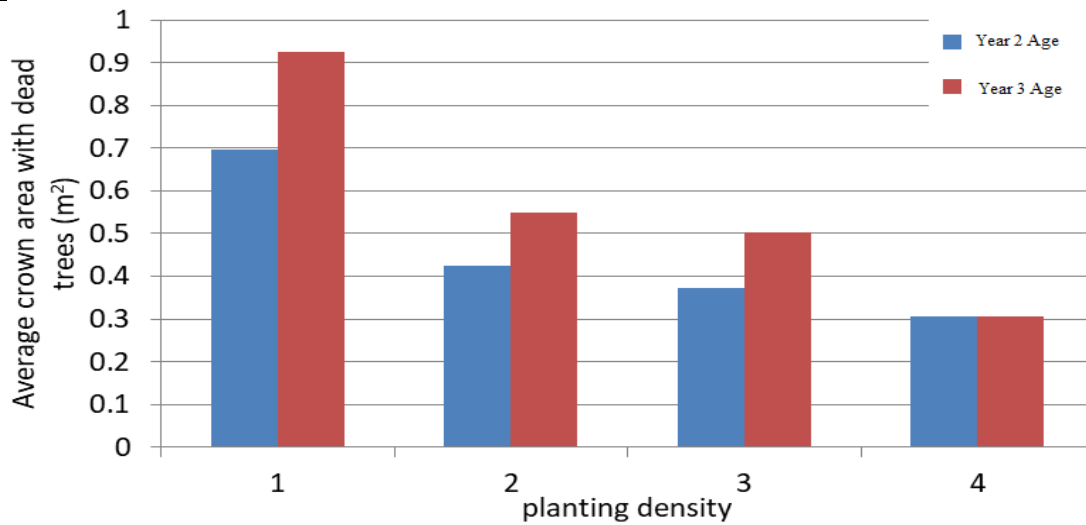


Figure (4) shows the average crown coverage area for a single tree with dead trees at two and three years of age for the four densities

The percentage of the average crown area for all trees, including dead trees, was also found by using proportion and proportion. The results were as in the following table (5).

Table (5) shows the percentage of the average crown drop area for all trees , including dead trees.

Density	% of the average coronary coverage area at the age of (2) years (m²)	% of the average coronary coverage area at the age of (3) years (m²)
1	34.89191	46.29233
2	7.057613	9.146091
3	3.107639	4.201389
4	1.269552	1.269552

This was represented graphically in the following figure (5):

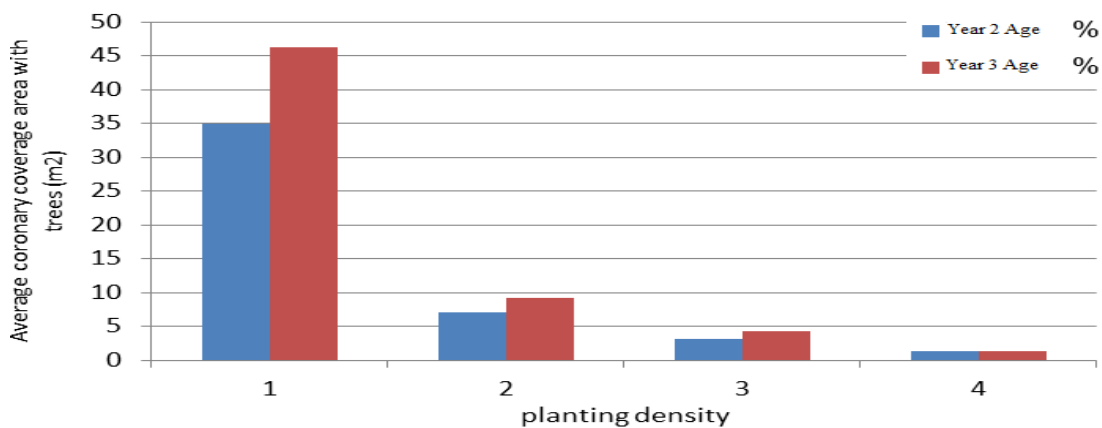


Figure (5) shows the percentage of the average crown drop area for all trees, including dead trees

The average crown drop per tree was also found without including dead trees in the calculation, for the four densities and for ages 2 and 3 years, as shown in Table (6).

Table (6) shows the average coverage area for a single tree without dead trees at the age of two and three years for the four densities

Density	Average coronary coverage area at the age of (2) years (m <sup>2</sup> )	Average coronary coverage area at the age of (3) years (m <sup>2</sup> )
1	0.7189	0.992875
2	0.46455	0.654714
3	0.44583	0.720442
4	0.34125	0.521266

This was represented graphically in the following figure (6):

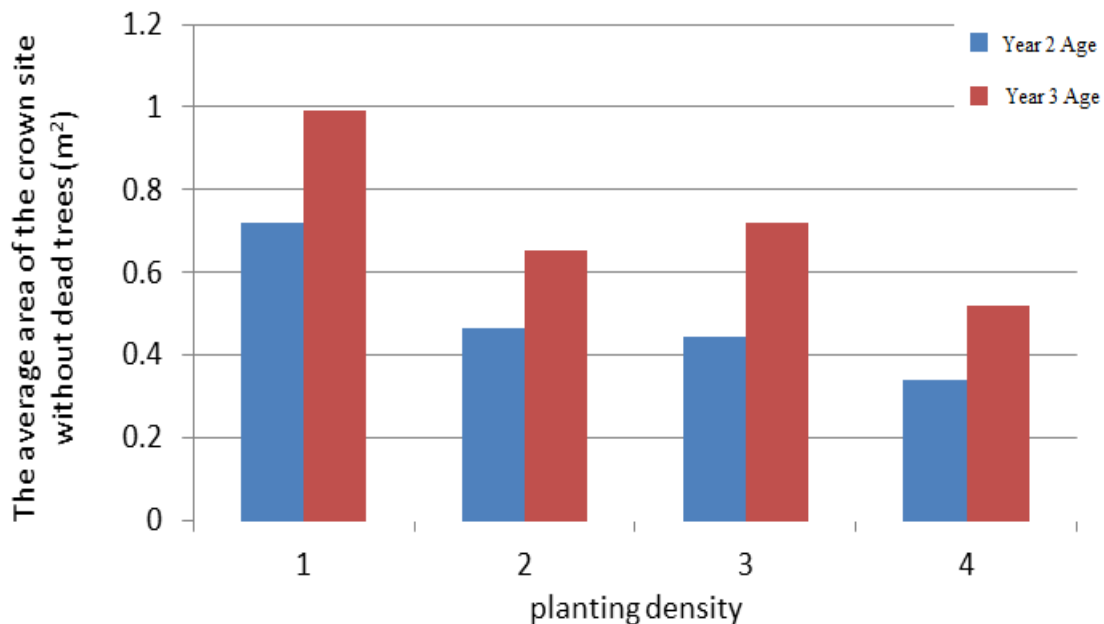


Figure (6) shows the average crown coverage area for a single tree without dead trees at two and three years of age for the four densities

The percentage of crown drop rate per tree was also found without including dead trees in the calculation, for the four densities and for ages 2 and 3 years, as shown in the following table (7):

Table (7) shows the percentage of the average crown drop per tree without including dead trees in the calculation, for the four densities and for ages 2 and 3 years

Density	% of the average coronary coverage area at the age of (2) years (m <sup>2</sup> )	% of the average coronary coverage area at the age of (3) years (m <sup>2</sup> )
1	35.945	49.64375
2	7.74255	10.91190
3	3.715307	6.003681
4	1.421864	2.171942

This was represented graphically in the form (7):

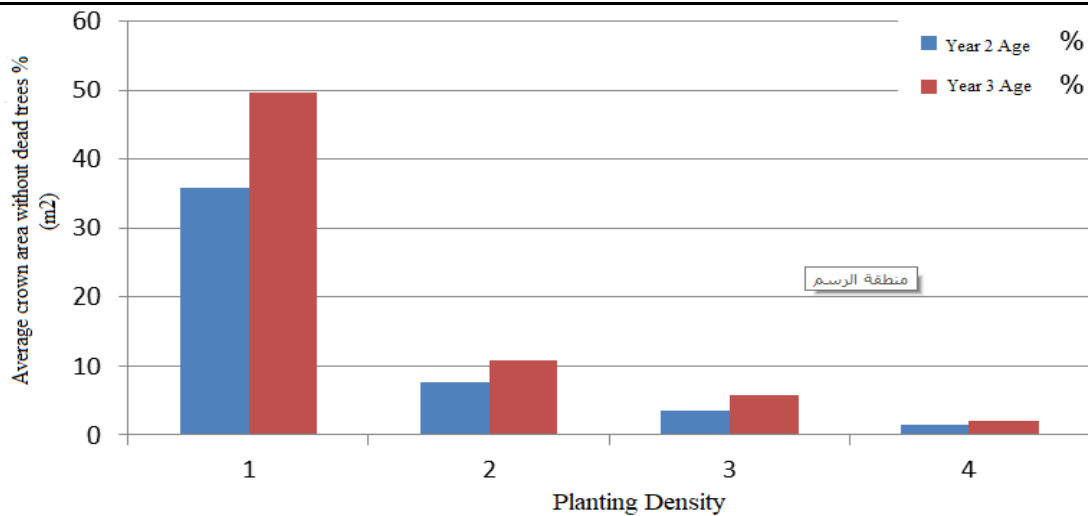


Figure (7) shows the percentage of average crown drop per tree without including dead trees in the calculation, for the four densities and for ages 2 and 3 years

### Recommendation and Conclusions

It is clear from the study that the high planting densities gave the highest values of the crown coverage area, and this is reflected on both the longitudinal and radial growth of the tree and thus the size of the tree, also the same effect will be on the tree as an integrated unit, (Ze-Hui Jiang et al. 2006). , and this is the result of the trees exploiting the site perfectly without leaving unused areas, as the small trees have relatively few requirements of materials, nutrients and water, which leads us not to leave large distances between the trees in order to make optimal use of the land without negatively affecting the output, but rather On the contrary, the high density at young ages has a positive effect in terms of reducing water evaporation from the surface of the earth. . Therefore, we recommend planting at close distances in the initial stages of a forestation, and then gradually reducing processes with age and increasing competition. therefore, we recommend planting at close distances in the initial stages of a forestation, and then gradually reducing processes with age and increasing competition.

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