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Carbon storage by *Atriplex lentiformis*

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Abstract

Increasing level of carbon dioxide CO_2 due to industrial activity is primarily cause of global warming. Planting *Artoplex lentiformis* can help to reduce atmospheric CO_2 buildup partly replacing use of fuels and by carbon storage. The objective of this study was to determine the effects of row spacing on carbon storage. A split- plot design with three replications included three row spacing **(**2×2, 4×4, and 6×6m) was applied. Some laboratory samples were taken from aerial and root biomass of *Artoplex*, and soil for determination of carbon storage. Results showed the values of carbon storage of aerial and root biomass among row spacing was significant different (p=0/o5%). The highest carbon storage was related to 2×2 m row spacing, reached 74583.6 and 6862.5 kg/ha in aerial and root biomass respectively. The carbon amount of soil had no significant differences (p=0/o5%) between treatments. The ranking of the plantation carbon storage by row spacing was 2×2 m > 4×4 m > and 6×6m and by components was aerial carbon> root carbon > soil carbon.

Keywords: Atriplex lentiformis; Aerial and root biomass; Carbon storage; Carbon dioxide; Row spacing

1. Introduction

Public concern over global climate change and the "greenhouse effect" has become obvious and powerful. The concentration of CO_2 in the earth's atmosphere has increased by about 30% since 1850 that has emerged as the most significant international environmental issue (UNEP, 1999). Additionally, if the present trends in the increase of atmospheric CO_2 continue, the preindustrial CO_2 level will increase another 30% in 50 years and then will be double about the year 2100 (Abrahamson, 1989). CO_2 is the most abundant greenhouse gas and is case of more than half of the radioactive forcing associated with the greenhouse effect (Dixon *et al.*, 1993, Moura-Costa, 1996). Today's urgent need for substantive CO_2 emission reductions could be satisfied more cheaply through available sequestration technologies than by an immediate transition to nuclear, wind or solar energy (Lackner, 2003). Vegetation plays two basic roles in this case. First, by increasing biomass and photosynthesis decreases the volume of carbon dioxide. This will be achieved by planting shrubs in rangelands of arid and semi arid areas and afforestreation. The second role is to supply energy and fuel as alternatives for fossil fuels (Van Kooten, 2000). Reclamation of eroded land generally involves increases in plant cover that result in accumulation of carbon stocks in biomass and soils. Degraded land has the potential to be a substantial carbon sink because of low initial carbon levels (Del Moral and Bliss, 1993; Magn-ússon, 1994; Whisenant, 1999). *Atriplex lentiformis* is an important shrub species for improvement and restoration in some parts of arid and semi arid Iranian rangelands, according to Atriplex species are characterized such as: forage production,

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desertification, especially in arid areas, restoration of rangelands, preventing erosion and protecting wildlife, fuel usage, tolerance to salinity and harsh environmental conditions (Mousavi Aghdam, 1986). At the end of 2007 about 833×10^{6} seedling were planted in rangeland areas of Iran which was most of then A*triplex* species (Eskandari, *et al*., 2008). Iran is one of the countries that obliged decreasing greenhouse gases and one of the solutions is carbon sequestration. According to the role of this plant the objectives of this research was to investigation spacing row on carbon storage capacity.

2. Materials and methods

Study area

The study area, called as Emamzadeh Eshagh station is located about 40 km away from northwest of Ardestan in Esfahan province. It is located between longitudes of 52° 23 to 51° 27 E and latitudes of 33° 23 to 33° 59N. The average of annual rainfall is 111 mm. The area has a dry climate with mean annual air temperature of 20.2^{oC}. Halophytes species made the vegetation of the area including *Seidlitzia rosmarinus*, *Haloxylon ammodendrom* and *Salsola sp*. The sandy loam soil is highly saline.

2.2. Sampling procedures

Vegetation sampling

The aerial fresh weight of plant was determined using cutting and weight method in all treatments. Plants were cut on ground level and weighed in the field. Then, 200 g of the samples were transferred to lab for dry weight and organic carbon percentage determination (McDicken, 1997).

Root sampling

Samples were taken from of 0-30 cm depth (the depth of root penetration according to MacDicken, 1997 methods.

Soil sampling

Soil samples were taken from of 0-30 cm depth (up to the root depth). One sample of about 1 kg of each treatment delivered to the lab according to MacDicken, 1997 method.

Root and aerial biomass carbon estimation:

The first, samples were dried in open air condition in order to determine the moisture percentage and then carbon content determined burning at 375^{oC} in an electric ovens. The Walky & Black method was used to determine the percentage of soil carbon. All samples collection was taken according to MacDicken's (1997) methods.

Statistical analysis

For data analysis SPSS software was used. Actually the data were normalized before the analysis by the one-Sample Kolmogorov-Smirnov Test. The Duncan's comparative test was applied to indicate the difference between treatment averages.

3. Results

Carbon of Soil

According to the results, different row spacing have no significant differences on average of carbon in the soil ($P<0.05$%).

Root carbon storage (Kg/ha)

Significant differences of 5% confidence level observed in root and aerial biomass carbon storage of different treatments, so that the maximum and minimum values were observed in the row spacing of 2×2 and 6×6 m respectively (Table 1).

Carbon distribution

In this research, in all treatments the carbon storage in aerial biomass was more than root and soil. (Fig. 1).

4. Discussion

Effects of row spacing on aerial and root biomass carbon storage

Based on the results, the maximum amount of carbon sequestration was found in the least row spacing. (Table1). Fang *et al*.(2007) also studied the biomass production and carbon storage in *Populus* species and concluded that the amount of carbon storage in row spacing of 3×3 m was higher than 3×4, 4×4 and 4×5m. The increase of plant biomass per unit area was considered as the reason of. Park and Ohga (2004) concluded that maximum amount of carbon of *willow sp* species was related to the row spacing of 0.3×0.9 m in comparison with those of 0.3×0.3, 0.6×1.1 m. Moghanizade, (2007) concluded that maximum amount of carbon in *Atriplex Canescens* was related to the row spacing of 2×2 m in comparison with those of 4×4 m . As the carbon amount of biomass is indicator of biomass per unit area, then was related dense vegetation cover supports canopy caver and the content of aerial biomass carbon. Dugas, (1999) resulted that the most amount carbon storage when occurred Leaf area index and aerial biomass height increasing.

Effects of row spacing on soil carbon storage

As the results indicated, the row spacing had no meaningful effect on soil carbon storage. Rennin, (1974) showed that there is a small difference between soil carbon of plants with shorter row spacing and those with farther row spacing. Steinbeck and Nwoboshi(1980) declared that were no significant difference on amount of carbon in the soil underneath the *Platorus occidentalis*, between three row spacing of 1.2×0.3, 0.6×1.2 and 1.1×1.2 m. Gilmore and Rolfe, (1980) explained that row spacing of 1.2×1.2, 3×3 m had a little effect on soil carbon and organic material in a 25 year old pine tree. They also declared that row spacing did not have a significant effect on soil carbon of the all sampling plot.

5. Conclusion

In this research, in all treatments the carbon storage in aerial biomass was higher than root and soil carbon. Abdi(2005) reported that estimation of carbon sequestration capacity by *Astragalus Tragacantha* , showed that the carbon content in aerial biomass was higher than root biomass carbon. Based on the results of this research it is recommended to decrease the spacing row to increase carbon storage.

Table 1. Root, aerial biomass carbon and soil carbon in row spacing treatments

Row spacing	2×2 m	4×4 m	6×6 m
Root carbon (Kg/ha)	6862.5±1316 a	1207.7±600 b	811.2±347 c
Aerial biomass carbon (Kg/ha)	74583.6±6967 a	34642.8±7638 b	20284.6±7688 c
Soil carbon (Kg/ha)	216±62 a	243±69 a	229±67 a

Different letters indicated the meaningful difference of 5% confidence level

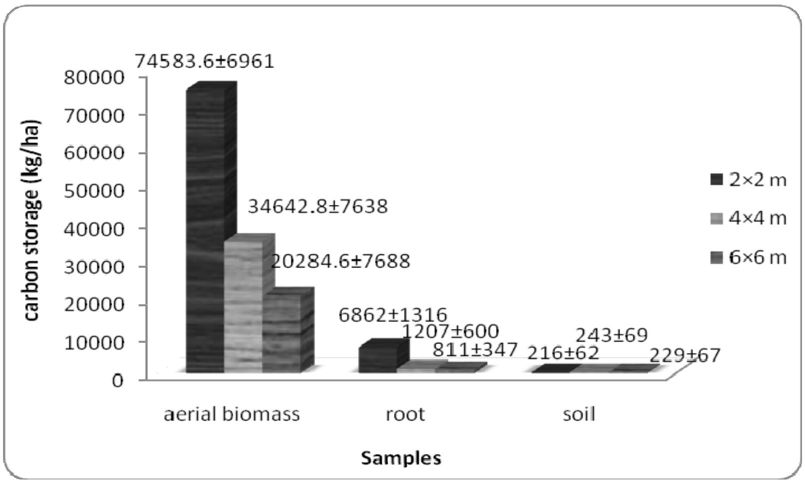

Fig. 1. The carbon storage in aerial biomass, root and soil

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