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Research article

COMPARISON OF NUTRITION AND NUTRIENT RETURN IN PURE AND MIXED PLANTATIONS OF *POPULUS DELTOIDES* AND *ALNUS SUBCORDATA* IN SAFRABASTEH REGION OF GOUILAN

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ABSTRACT: Pure plantations reduce soil fertility so sustainable production can't be accessible. In these study nutrients of live and senescent leaves of plantations of *Populus deltoides* and *Alnus subcordata* have studied in pure and mixed plantations in a completely randomized block in Safrabasteh of Guilan. Foliage samples were collected from the stands in September 2009. The Samples were dried at 70^0C. Nitrogen was determined using the Kjeldhal, P using Spectrophotometer and K, Ca and Mg was determined using Atomic absorption spectrophotometer. Nitrogen content of live and senescent leaves of *A. subcordata* was greater than P. deltoids. P of live leaves of *A. subcordata* was greater than *P. deltoids* but P of senescent leaves of *A.subcordata* and P. deltoids don't show any significant differences. Live and senescent leaves of *P.deltoides* in mixed treatments with *A. subcordata* showed more N than pure ones. Finally we can conclude that mixing *A. subcordata* in plantations of *P. deltoides* in this location and with these conditions is profitable.

Key word: Mixed Plantation, Nitrogen Fixing Tree, Nutrition, Nutrient return, *Populus deltoides* and *Alnus subcordata*.

INTRODUCTION

Forest productivity is limited by the supplies of one or more nutrients in almost all forests, and forest nutrition management is a key issue in the management of commercial forests [1]. Mixed plantation systems seem to be the most appropriate for providing a broader range of options, such as production, protection, biodiversity conservation, and restoration [2-10], as they can ameliorate the sites to be more favorable to native tree seedling recruitment [11, 12]. In short periods of usage, the nutritional value of soil may be reduced [13]. As a result, forest planting production rely on nutritional value of soil; and as it seems management activities and species can change it [14]. Utilizing a new system of forest planting is necessary .Because of fertility decrease of soil, discontinuous production of forest planting, in the long run; especially in fast – growing species; nitrogen stabilizing trees are used in forest planting [15]. They produce high measures of nitrogen that suits for restoring soil's nitrogen, the cause of this shortage is continuous usage [13] and high speed of leaves' corruption [20]. Additionally each species has a special nutritional need and cycle, perhaps they require less nutritional material of soil than unmixed species [19]. Main purposes of the study are to investigate the amount of return of nutriment of nutritional elements by *Alnus subcordata* and *populus deltoids's* leaves in mixed and unmixed forest planting , and to measure the amount of nutritional elements and the return of elements by senescent and living leaves of *Alnus subcordata* and *populus deltoids* in unmixed and mixed forest – planting.

METHODS AND MATERIALS

Site Characteristics

The forest – planting site in this research is located in Astane-Ashrafiye, kilometer 5 of Astane-Bandar kiashar Road, near Sefidrod River 15 meters above surface of Caspian Sea, longitude 51, 49° east, latitude 19, 37° north, Guilan, Iran. There is unmixed and mixed forest planting of *Alnus subcordata* and *populus deltoids*.

Experimental Design

Experimental plantations were established in 1996 using a randomized complete block design that included four replicate 40 m × 40 m plots of each of the following treatments:

(i) 70% *P. deltoides* + 30% *A. subcordata*(70P:30A),

(ii) 50% *P. deltoides* + 50% *A. subcordata*(50P:50A),

(iii) 30% *P. deltoides* +70% *A. subcordata*(30P:70A),

(iv) *Populus deltoides* (100P),

(v) *Alnus subcordata* (100A),

Tree spacing within plantations was 4 m × 4 m and tow species were systematically mixed within rows.

Methods

Leaf sampling was done on September and for every single species. There were 6 trees of every species in each sample section, in this way, 2 trees in the center and other 4 trees occupy each corner of the section. Leaf samples were collected from 1/3 of lower crown of each tree and main branches. Senescent leaves sampling was done in every sample section and for each species, as recent fallen leaves were gathered before corruption. Senescent leaves were collected after initial collection of leaves in consecutive days to make sure that leaves had been fallen recently. After that, samples were transported to lab and dried in oven at 70°C then were grined. Total measured amount of nitrogen by Kaljald L device is expressed by percentage .Phosphurs is measured by spectrophotometer by Atomic absorption method and so potassium, calcium and magnesium (all results are expressed by percentage).

Analyzing Method

Resulting data were analyzed using SAS computer program with design framework as totally random blocks. Variation analyze is used for general comparison, and for multiple comparison Tukey-HSD test is utilized.

RESULTS

Nitrogen

Amount of nitrogen in living and senescent of populus deltoides in mixed treatments with Alnus subcordata is higher than unmixed treatment; while mixed treatment shows no difference (Fig.1, 2)

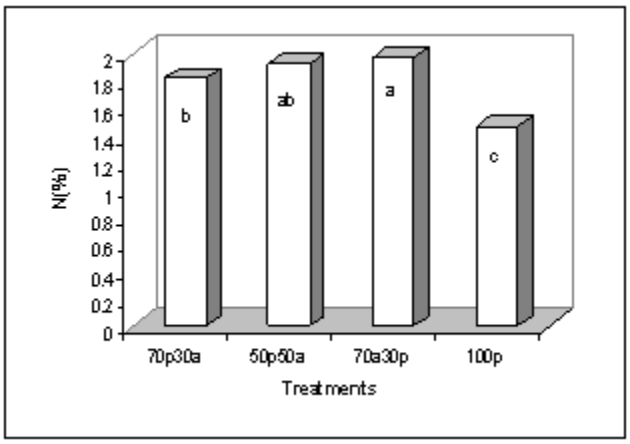

Fig.1. The amount of nitrogen in living leaves of Poplar. The letters on different column indicate a different comparison.

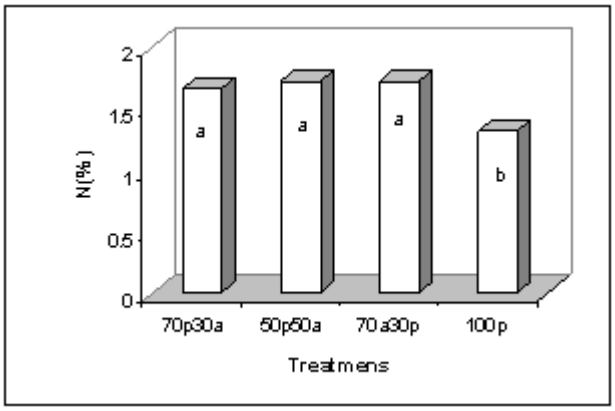

Fig.2. The amount of nitrogen in senescent leaves of Poplar. The letters on different column indicate a different comparison.

Phosphor

There is a meaningful difference between amount of phosphors existing in senescent leaves of populus deltoides in unmixed treatment and 70% mixed treatment of poplar (Fig.3,4).

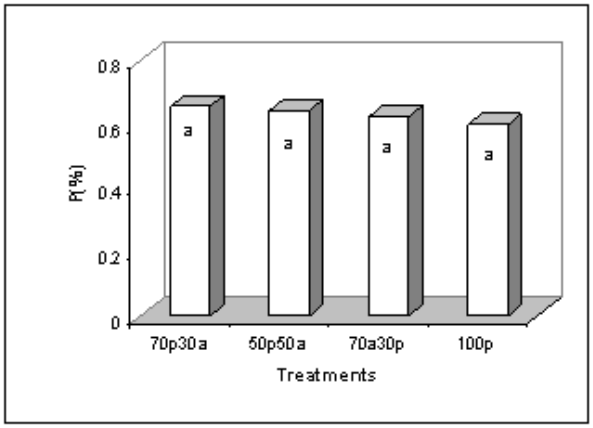

Fig.3. The amount of phosphor in living leaves of Poplar. The letters on different column indicate a different comparison.

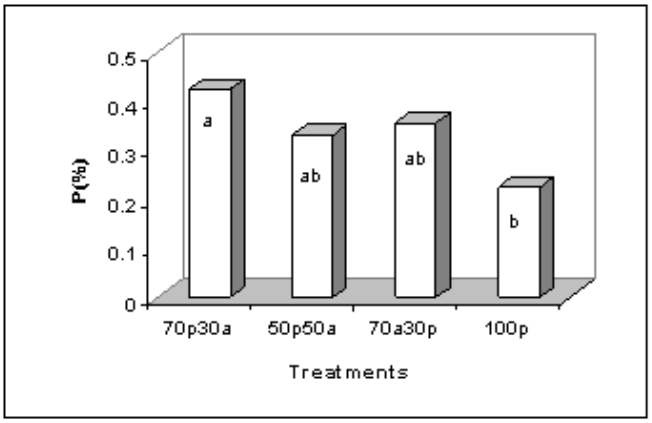

Fig.4. The amount of phosphor in senescent leaves of Poplar. The letters on different column indicate a different comparison.

Potassium

There is a meaningful difference between existing potassium in living and senescent leaves of populus deltoides in unmixed treatment and 30% treatment,50% treatment (Fig.5,6).

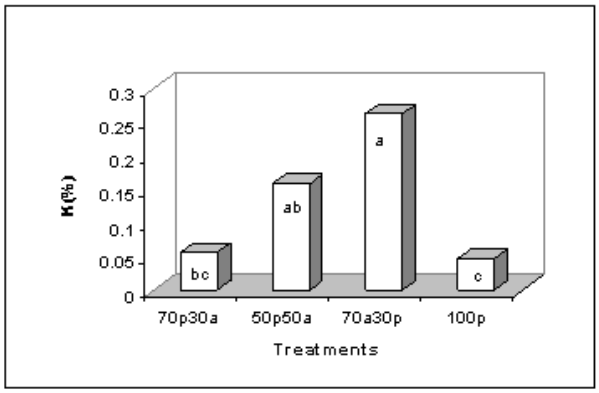

Fig.5. The amount of potassium in living leaves of Poplar. The letters on different column indicate a different comparison.

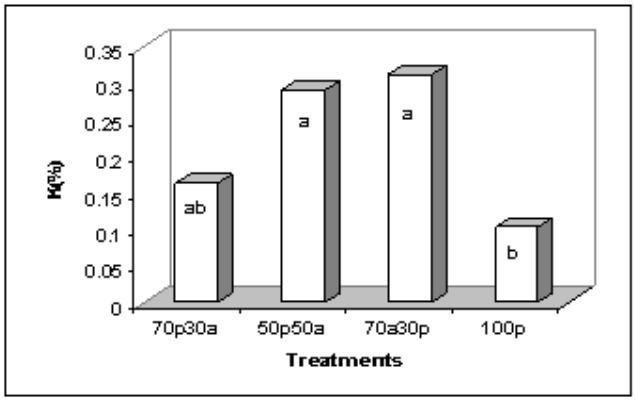

Fig.6. The amount of potassium in senescent leaves of Poplar. The letters on different column indicate a different comparison.

DISCUSSION

The measured amount of nitrogen in living and senescent leaves in populus deltoides is less than Alnus subcordata so Alnus subcordata absorbs more nitrogen than Poplar and as a result it returns more of it to soil. It is likely because Alnus subcordata is a nitrogen stabilizing species. [16] Founded that existing nitrogen in living and senescent leaves of Alnus subcordata is more than populus deltoides. [20] Also came to the conclusion that nitrogen stabilizing species return higher amount of nitrogen by their leaves. [19] Showed existing nitrogen in leaves of nitrogen stabilizing species is more than others. [17] Founded that Nitrogen concentrations in fully expanded leaves of *Quercus* were the highest in pure oak plantations and the lowest in mixed plantation of *Quercus* and *celtis* treatment. The existing nitrogen in living and senescent leaves of populus deltoides in mixed treatments with Alnus subcordata is more than nitrogen in living and senescent leaves of unmixed treatment of populus deltoides .It reveals that Alnus subcordata is effective in nitrogen absorption by populus deltoides and accompanying its return to soil by senescent leaves of populus deltoides in mixed treatments. [16] compared mixed and unmixed forest –planting of populus deltoides and Alnus subcordata and came to the result that existing nitrogen in living and senescent leaves of populus deltoides in mixed treatments with Alnus subcordata is more than unmixed treatment, while no difference is shown in mixed treatments [18] detected no difference between living leaves of eucalyptus in unmixed forest planting and mixed forest planting with acacia , while ,just like the present study , senescent leaves of nitrogen stabilizing species (eucalyptus) mixed forest planting along with acacia is more that unmixed forest – planting [19].

Observed that among 3 species with unstabilizing quality, only the amount of nitrogen in leaves of one of them in mixed forest planting with nitrogen stabilizing species has been increased. Populus deltoides has no effect on nitrogen absorption by Alnus subcordata's leaves and their return to soil by leaves because amount of nitrogen in living and senescent leaves in unmixed and mixed with populus deltoides shows no difference [13] observed no difference between existing nitrogen in living and senescent leaves of acacia in mixed and unmixed treatments. Concerning nitrogen stabilizing species as acacia, [20] concluded similarly, there was no difference between living and senescent leaves, while [20] observed higher amount of nitrogen in living and senescent leaves of nitrogen stabilizing species and main species in mixed treatment in comparison to unmixed. The amount of phosphors existing in living leaves of Alnus subcordata and populus deltoides have no meaningful difference. It can be concluded that regarding absorption and return of this element at this particular age and time, there is no difference. But existing phosphors in senescent leaves of Alder and Poplar has meaningful difference. [16] showed that phophurs in living and senescent leaves of Alnus subcordata and populus deltoides has no meaningful difference. Montagnini [19] observed higher amount of phosphors in leaves on stabilizing species in comparison to non-stabilizing species. Equal amount of phosphors in living and senescent leaves of populus deltoides shows that mixture of two species has no effect on absorption of living leaves and its return by senescent leaves. [19] Also distinguished no difference between existing phosphors in leaves of stabilizing species and non-stabilizing ones in unmixed forest planting comparing with mixed planting.

[13, 18] observed higher amount of phosphors in living leaves of non stabilizing species – eucalyptus – and living and senescent leaves of acacia in unmixed treatment compare with mixed treatments ,but in case of senescent leaves of eucalyptus there is no meaningful difference between unmixed and mixed treatments. As a matter of fact [20] detected higher amount of phosphors in senescent leaves of nitrogen stabilizing species and main species in mixed treatment than unmixed .The amount of existing potassium in living leaves of Alnus subcordata is distinguishly higher than populus deltoides in unmixed forest planting. But potassium in senescent leaves of Alnus subcordata and populus deltoides in mixed forest planting has no meaningful difference. It shows that the two species considering return of element in this particular age and time are alike. [19] Observed higher amount of potassium in stabilizing species than no stabilizing ones. There is a meaningful difference between amount of potassium in living leaves of Alnus subcordata and populus deltoides in mixed and unmixed treatments that reveals these two species contribute each other to absorb nitrogen by living leaves. But equal absorption of potassium in senescent leaves of Alnus subcordata in mixed and unmixed treatments shows the mixture of the 2 species has no effect on return of this element by senescent leaves while in populus deltoides the difference between amount of potassium in senescent leaves of populus deltoides in mixed and unmixed treatments shows that the mixture of the two species has no significant effect on return of the element by senescent leaves of populus deltoides. [19] Detected no difference between the amount of existing potassium in living leaves of nitrogen stabilizing species and non-stabilizing ones. In mixed and unmixed forest planting [20] observed higher amount of potassium in senescent leaves of 2 nitrogen stabilizing species and main species in mixed treatment and unmixed.

REFERENCES

[1] Stape, J.L., Binkley, D., Jacob, W.S., E.N. Takahashi, A twin-plot approach to determine nutrient limitation and potential productivity in Eucalyptus plantations at landscape scales in Brazil. For. Ecol. Manage. 223, 358–362, 2006.

[2] Guariguata M.R., Rheingans R., F. Montagnini, Early woody invasion under tree plantations in Costa Rica: implications for forest restoration – Restoration Ecology, 3: 252–260, 1995.

[3] Keenan R.J., Lamb D., G. Sexton, Experience with mixed species rainforest plantations in North Queensland – Commonwealth For. Rev. 74: 315–321, 1995.

[4] Montagnini F., Gonzalez E., Porras C., R. Rheingans, Mixed and pure forest plantations in the humid neotropics: a comparison of early growth, pest damage and establishment costs – Comm. For. Rev. 74: 306–314, 1995.

[5] J. A. Parrotta, Prodactivity, nutrient cycling, and succession in single- and mixed-species plantations of Casuarina equisetifolia, Eucalyptus robusta, and Leucaena leucocephala in Puerto Rico. For. Ecol. and Manage. 124:45-77pp, 1999.

[6] Kaya Z., D.J. Raynal, Biodiversity and Conservation of Turkish forests – Biol. Conserv. 97: 131–141, 2001.

[7] Carneval N. J., F. Montagnini, Facilitating regeneration of secondary forests with the use of mixed and pure plantations of indigenous tree species – For. Ecol. Manage. 163: 217–227, 2002.

[8] Balandier P., Prevosto B., J. Guitton, Forest restoration in the French Massif Central Mountains (In: Restoration of Boreal and Temperate forests. Eds: J. Stanturf, P. Madsen) – CRC Press, 569 pp, 2005.
[9] Jogiste K., Vares A., Veiko U., H. Tullus, Baltic afforestation (In: Restoration of Boreal and Temperate forests. Eds: J. Stanturf, P. Madsen) – CRC Press. 569 pp, 2005.
[10] M.J. Kelty, The role of species mixtures in plantation forestry – For. Ecol. Manage. 233: 195–204, 2006.
[11] Guariguata M.R., Rheingans R., F. Montagnini, Early woody invasion under tree plantations in Costa Rica: implications for forest restoration – Restoration Ecology, 3: 252–260, 1995.
[12] Petit B., F. Montagnini, Growth in pure and mixed plantations of tree species used in reforesting rural areas of the humid region of Costa Rica, Central America – For. Ecol. Manage. 233: 338–343, 2006.
[13] P. K. Khanna, Comparison of growth and nutrition of young monocultures and mixed stands of Eucalyptus globulus and Acacia mearnsii. For. Ecol. and Manage. 94:105-113pp, 1997.
[14] Binkley, D., Giardian, Ch. and M. A. Bashkin, Soil phosphorus pools and supply under the influence of Ecalyptus saligna and nitrogen-fixing Albizia falcataria .For. Ecol. and Manage. 128: 241-247pp, 2000.
[15] Rhoades, C. and D. Binkley, Factors influencing decline in soil pH in Hawaiian Eucalyptus and Albizia plantations. For. Ecol. and Manage. 80: 47-56 pp, 1996.
[16]Sayyad,E.Hosseini,S.M,Mokhtari,J.,Mahdavi,R.,Jalali,S.G.,Akbarinia,M.,and M. Tabari, Comparision of growth, nutrition and soil properties of pure and mixed stands of Populus deltoids and Alnus subcodata.Silva Fennica 40(1):27-35, (2006).
[17] Hosseini, S.M., Raouhi -Moghaddam, E., Ebrahimi, E.,Rahmani, A., M. Tabari, Growth and nutrition of restored Quercus castanifolia versus native Celtis australis concervation perspectives of hyrcanian forest(Iran).Polish journal of ecology,58(1):41-54, (2010).
[18] P.K. Khanna, Nutrient cycling under mixed-species tree systems in southeast Asia. Agroforestry Systems, 38, 99-120 pp, 1998.
[19] F. Montagnini, Accumulation ln above-ground biomass and soil storage of mineral nutrients in pure and mixed plantations in a humid tropical lowland. For. Ecol. and Manage. 134: 257-270pp, 2000.
[20] Parrotta J.A., O.H. Knowles, Restoration of tropical moist forests on bauxitemined lands in the Brazilian Amazon – Restor. Ecol. 7: 103–116, 1999.