Effect of Jellyfish Fertilizer Application on Seedling Growth

CHUN, Kun Woo ^{*1)} · DAMDINSUREN, Enkhjargal ¹⁾ ·
YEOM, Kyujin ²⁾ · EZAKI, Tsugio ³⁾

- 1) College of Forest & Environmental Sciences, Kangwon National University,
Republic of Korea
- 2) Korea Forest Conservation Movement, Republic of Korea
- 3) Faculty of Agriculture, Ehime University, Japan

Abstract : The use of appropriate fertilizer rates has been an important factor in the growth and survival of seedlings. This research was conducted to evaluate the effect of use of jellyfish fertilizer on the growth and survival of the seedlings of different tree species in pots. The study results showed increased average height and stem diameter growth in all the tree seedling that were treated with jellyfish fertilizer compared to the trees with control treatment. The use of jellyfish fertilizer may thus be a practical way of improving the reforestation technique using recycled waste.

Keywords : jellyfish fertilizer, seedling growth, seedling mortality

1. Introduction

Fertilization is one of the most important cultural practices for seedling quality in reforestation as it can accelerate the growth of the shoots and roots of seedlings. Organic fertilizers are used to improve soil quality and to provide nutrients for plant growth (Bokhtar and Sakurai, 2005). Recently, the population of the giant jellyfish rapidly increased in Japan and South Korea. Swarms of giant jellyfishes are now causing severe setback to fishers.

By the way, Fukushi et.al, (2004) reported that jellyfish fertilizer has high nitrogen, total phosphorus and potassium content than that of *Aurelia aurita*. They used jellyfish fertilizer in the vegetables and determined effective for their growth.

In this respect, this research focused on the sustainable use of natural resources through recycling. In particular, the research was conducted to evaluate the effect of the

use of jellyfish fertilizer on the growth of seedlings of different tree species and to determine the optimum rates of use of jellyfish fertilizer.

2. Material and Method

The experimental field was located in Kangwon National University, Chuncheon, Gangwon Province. The five different tree species; *Pinus densiflora* Seib.et Zucc, *Pinus koreansis* Seib.et Zucc, *Pinus thunbergii* Parl, *Quercus acutissima* Carr and *Alnus japonica* (thunb.) Steud were selected for the pots experiment. In the first experiment, two conifer seedlings *P.densiflora* and *P.koreansis* and a broadleaf seedling *Q.acutissima* were selected. In the second experiment three conifer seedlings *P.densiflora*, *P.thunbergii* and *P.koreansis* and two broadleaf seedlings *Q.acutissima* and *A.japonica* were selected. Each treatment was replicated with nine times in the experiment.

2.1 Experiment I

In the first experiment, apart from a control treatment, jellyfish fertilizer was mixed with 7kg soil with different application rates of 1.4, 4.3 and 7.1g/kg, respectively. The seedlings were transplanted on May 18, 2010.

Their heights and stem diameters was measured once in two weeks with a ruler and a digital caliper. At the end of experiment the average seedlings heights and stem diameters were calculated.

During the research period, the broadleaf and conifer seedlings were watered once a week. Stem diameter was measured at 2 cm height from soil surface.

* Corresponding author: E-mail : kwchun@kangwon.ac.kr, Chuncheon 200-701, Gangwon Province, Republic of Korea.

2.2 Experiment II

In the second experiment, apart from control treatment, jellyfish fertilizer was mixed with top soil 3.5kg in pots, with 9 and 14g/kg application rates for the conifer seedlings, and 14g/kg and 29g/kg for broadleaf seedlings. The seedlings were planted on August 3, 2010.

The broadleaf seedlings were irrigated twice a week and the conifer seedlings were watered once a week. Seedlings growth parameters were measured using ruler and a digital caliper once in two weeks.

The soil moisture was measured with soil moisture meter (Model:PMS-714) once a week. Briefly, the soil moisture probe was placed into a 10 cm depth in the pot soil.

2.3 Soil and jellyfish fertilizer

2.3.1 Jellyfish fertilizer

The jellyfish fertilizer contained 10%, 4.27% and 0.18% of N, P_2O_5 and K_2O , respectively (Ezaki, 2009). The pH of jellyfish was 4.16 with an electrical conductivity value 2.16dS/m. Its saturation percentage (SP%) of jellyfish fertilizer was measured by adding distilled water to it until the its pores were filled with water and the saturation percent was calculated according to the increase of jellyfish weight.

2.3.2 Soil

The soil that was used sterile weathered granite soil, which contained 89.7% sand, 3.6% clay and 6.7% silt.

3. Result and Discussion

3.1 Experiment I

Fig.1 Average height (a) and stem diameter (b) growth of the conifer seedlings treated with different jellyfish fertilizer application rates.

3.1.1 Height and stem diameter growth

Seedlings height and stem diameter growth are influenced by jellyfish fertilizer application for conifer and broadleaf trees.

The average heights of the 1.4, 4.3 and 7.1 g/kg jellyfish fertilizer treated *P. densiflora* treatment were 2.5, 2.9 and 4.2cm longer than that of the control, respectively (Fig.1a). For *P. koraiensis*, the application of jellyfish fertilizer did not increase the mean height, and the 4.3 and 7.1g/kg jellyfish fertilizer application rates were shown to be lethal for the seedlings. In case of mean diameter growth (Fig.1b), the *P. densiflora* and *P. koraiensis* showed similar growth pattern. In *Q. acutissima*, the 1.4 g/kg jellyfish fertilizer treatment showed higher height and stem diameter growth compared to the other treatments (Fig.2a, 2b).

Fig.2 Average height (a) and stem diameter (b) growth of *Q. acutissima* seedling treated with different jellyfish fertilizer application rates.

Fig.3 Survival rates of the seedling of the three species trees treated with different jellyfish fertilizer application rates.

3.1.2 Seedling survival rates

The survival rates of *P.densiflora* seedlings treated with 4.3 and 7.1g/kg jellyfish fertilizer were lower than those of the control and of the seedlings treated with 1.4g/kg jellyfish fertilizer (Fig.3).

Furthermore, the survival rate of *P.koreansis* was the lowest among all the species.

It seems that jellyfish fertilizer, especially with high application rates affect the growth all seedlings, and some species were adversely affected. This could be explained due to, the high EC value(2.16dS/m) of the jellyfish fertilizer.

3.2 Experiment II

3.2.1 Height and stem diameter growth

The application of jellyfish fertilizer appeared to have had very small effect on the conifer seedlings heights and stem diameters.

The average height growth was increased by 0.6 and 0.64 cm (*P.koreansis*), 0.4 and 0.6 cm (*P.densiflora*) and 0.3 and 0.5cm (*P.thunbergii*) in the 9 and 14g/kg treatments respectively, compared to the control treatment(Fig.4a).

Conifer seedlings showed similar average stem diameter growth(Fig.4b).

Similarly, for the broadleaf seedlings in the 14 and 29g/kg, the application of jellyfish fertilizer increased the average height growth by 4.5 and 3cm for *A.japonica* and 1.2 and 1.7 cm for *Q.acutissima*, respectively (Fig.5a).

The average diameter of control, *A.japonica* and *Q.acutissima* at different fertilizer application rates had shown in Fig. 5b. The average diameter was increased

with the increment in fertilizer application rates(Fig.5b).

Overall, jellyfish application enhanced the growth of seedlings, and this could be attributed to the ability of jellyfish fertilizer in supplying nutrients and organic matter to the soil.

3.2.2 Seedling survival

Three months later, the mortality of the broadleaf seedlings was shown to be high. As for the conifer seedlings, their survival rates were 77.8 and 55.6%(*P.koreansis*) and 77.6 and 88.9%(*P.densiflora*) and 88.9 and 88.9%(*P.thunbergii*) in the 9 and 14g/kg jellyfish fertilizer treatments (Fig.6a).

Fig.4 Average height (a) and stem diameter (b) growth of the conifer seedlings treated with different jellyfish fertilizer application rates.

Fig.5 Average height (a) and stem diameter (b) growth of broadleaf seedling treated with different jellyfish fertilizer application rates.

Fig.6 Seedling survival rate of the conifer (a) and broadleaf (b) seedlings.

Fig.7 Jellyfish fertilizer of saturation percentage

Fig.8 Moisture content of the broadleaf (a) and conifer seedlings (b) soil treated with different jellyfish fertilizer application rates.

The seedling survival rates of *Q. acutissima* and *A. japonica* were 66.7 and 44.4%, 55.6 and 22.2% in the 14 and 29g/kg jellyfish fertilizer (Fig.6b).

3.3 Effect of jellyfish fertilizer application on soil moisture

Jellyfish fertilizer treatment increased soil moisture more in all pots to which jellyfish fertilizer was applied than in the control pot.

Soil moisture content were 2.4 and 2.9 folds greater than that control(*P. thunbergii*), 12.5 and 13 folds greater than the control(*P. koreansis*) and 7 and 17 folds greater than

the control(*P. densiflora*) in the 9 and 14g/kg treatments, respectively(Fig.8a).

For the broadleaf seedling, addition of jellyfish fertilizer increased soil moisture contents 5 and 5.8 folds greater than untreated soil for *A. japonica*, and 4 and 4.5 folds greater than untreated soil for *Q. acutissima* in 14 and 29g/kg treatments, respectively (Fig.8b).

This result showed that jellyfish fertilizer increased moisture keeping ability of soil.

4. Conclusion

Jellyfish fertilizer treatment influenced the growth of the conifer and broadleaf seedlings parameters and which could point to the ability of jellyfish fertilizer to supply nutrients to the soil to keep moisture there in.

The results of study indicate that the application of jellyfish fertilizer may contribute to development of a green biotechnology for afforestation.

Some tree species' survival rates however were low. Thus, more time is needed to determine the appropriate jellyfish fertilizer application rates and applicability tests must also be conducted for other tree species.

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