한국산학기술학회논문지
Vol. 10, No. 3, pp. 607-612, 2009

A study on the Effect of Plant Growth for Ecological Sound Barrier Development

Sarita Bashyal[1], Hae-Yong Cho[1*] and Chang-Ha Choi[2]
[1]**Department of Environmental Engineering, Sunmoon University**
[2]**Department of Hybrid Engineering, Sunmoon University**

생태방음벽 개발을 위한 식물생장의 효과에 관한 연구

사리타 버셀[1], 조해용[1*], 최창하[2]
[1]선문대학교 공과대학 환경공학과
[2]선문대학교 공과대학 하이브리드공학과

Abstract For the development of ecological sound proof wall, successful seed germination and growth of plants are very important. In our present study, we observed germination of thirty five different seed species in growth chamber at 24℃, humidity 60% and alternation of 12 hours photoperiods. Germination of same seeds were carried out at room temperature on 6:4, 7:3, 8:2, and 9:1 proportion of pure and mineral soils respectively. Out of studied species, maximum germination was recorded for *Perennial penant* (92%), followed by *Brassica napus* (86%), and *Silene armeria* (82%). The measurement of root/shoot length showed, maximum root/shoot length for *Perennial penant*, followed by *perennial sonata* and *Rebolsentri sp*. Based on germination percentage and root/shoot length of germinating seeds, we considered *Perennial penant*, *perennial sonata* and *Rebolsentri sp.* were proper species for the construction of ecological sound proof walls

요 약 생태방음벽에 있어서 구조도 중요하지만, 식물종자의 발아와 생장율을 고려한 선택도 매우 중요하다. 재래종과 외래종 35종을 선발하여 온도 24℃, 습도 60%, 그리고 12시간 주기로 낮과 밤을 조절하였고, 식생기반재로 일반토양과 유기물 토양의 비율을 6:4, 7:3, 8:2, 9:1로 하여 실험하였다. 실험한 종 중 8종은 2주 동안 발아하지 않았지만 그 외 나머지 종들은 시간차를 두고 모두 발아하였다. 가장 발아율이 좋은 종은 *Perennial penant* (92 %)이고, 다음은 *Brassica napus* (86 %), 그리고 *Silene armeria* (82 %) 순으로 나타났다. 본 연구에서는 발아한 종의 뿌리 및 줄기의 길이를 측정하여 분석하였다. 이번 연구에서 뿌리의 생장이 가장 좋은 3종 *Perennial penant, Perennial sonata, Rebolsentri* 가 생태방음벽 개발에 가장 적합한 종으로 사료된다.

Key Words : Germination, Seedling growth, Root measure, Shoot measure

1. Introduction

Noise is not a new phenomenon. Cities have always been noisy places and roads havealways been a source of noise. Urban populations are becoming more concerned about noise pollution caused by vehicles traffic and are demanding solutions[1]. In this situation, environmental sound barrier is commonly used to mitigate the noise impact produced by the traffic in highways. However, a barrier will finally become part of surrounding landscape and could be a cause of impact for both the road users those who live along the road side[2]. An environmental sound barrier combines the functions of a visual screen and a noise barrier to protect residential, recreational, and other vulnerable areas along the road side. A large body of research work dealing with the modeling and

*Corresponding Author : Hae-Yong Cho(chohy@sunmoon.ac.kr)
Received January 29, 2009 Revised Mar. 4, 2009 Accepted Mar. 23, 2009

engineering design of noise barriers can be found in technical literature[3,4]. In addition, many researchers have specifically aimed their work to predict the performance of noise barriers and to develop more efficient barrier designs[5]. Noise barriers can be constructed from earth, concrete, masonry, wood, metal, plastic, and other materials or combination of materials[6] and vegetative wall. Sound Wall is an obvious solution to reduce visual impact because it can be made to fit in with the landscape more naturally than any vertical structure, especially as it can support planting which greatly improves its appearance in most rural contexts. So, the planting wall is likely to be more attractive to both local residents and to road users. The fast growing and deep rooted plants are suitable to make the sound wall. Among all types of sound wall, vegetative wall was found more effective as environmental point of view and economically. Sound barrier wall was starting too built in different area like as residential, school, and city. So, since the last decades scientists have been focusing on vegetative wall[7]. Seed germination represents a risky transition from the stage most tolerant to environmental conditions to the weakest and most vulnerable stage in plant development, the seedling[8]. In addition germination is an irreversible process, and thus wrong timing or location of germination may cause the death of the individual, impacting population recruitment[9]. Different environmental factors may determine seed germination, although the essentials are as an appropriate combination of temperature, moisture and light[10]. After the seed germination and plant growth can be used to make a living wall which acts as an ecological sound barrier. The living wall naturalizes our urban and rural environments. Superior sound absorption, the environmental structure and the financial advantages of the living wall make it the ideal sound barrier solution when comparing it to other noise walls. Although, noise wall do not block all noise, but do reduce noise levels and provide excellent color, variety, and length of bloom, as well as, shelter and food sources for birds, butterflies, beneficial insects, and small mammals and to make environmentally friendly, cost effective, sustainable as well as aesthetically pleasing manner. In this study, we have tested the germination of thirty five different seeds species in the room temperature and growth chamber under the fixed condition and measurement of root and shoot length as well. Based on combined results of germination and root shoot length, three species namely: *Perennial penant*, *Perennial sonata* and *Rebolsentri* were considered as good speciesfor the construction of ecological sound proof walls.

2. Material and Method

2.1 Seed collection

Thirty five different seeds used for this study were purchase from seed hybrid center. Seeds were chosen to make up ecological sound proof wall which are able to grow naturally in any other condition. Faster growing plants are preferred because it can absorb and provide enough water for the plant growth and hold on the soil.

2.2 Growth Chamber Experiment

The germination experiments were performed in growth chamber. In the growth chamber the seeds of thirty five species were exposed on the two layers of moist Whatman No. 1 filter paper in plastic Petri dishes with 9cm diameter. Through out the study the growth chamber was adjusted 24°C temperature, 60% humidity and alteration of photoperiod (12 h light and 12h dark). Each species were tested in three complementary dishes containing 100 seeds. The moisture level of filter paper was maintained by adding distilled water as required. Germination was monitored daily from the date of seed sowing. Seed with radical emergence (>2mm) was considered as germination. After two weeks of seed sown all emerging seedlings were counted and measure its root length and shoot length.

2.3 Soil Based Experiment

The same seeds were sown in soil at room temperature in the laboratory. Soil composition is very important for the ecological sound proof wall to establish the plant based up on the kinds of soil. We used different proportion of pure soil and mineral soil to make ratio of 6:4, 7:3, 8:2, 9:1. Seedlings were watered every day to enhance the germination and proper growth. The emerging seedlings were grown for four weeks and then harvested to measure their root and shoot length.

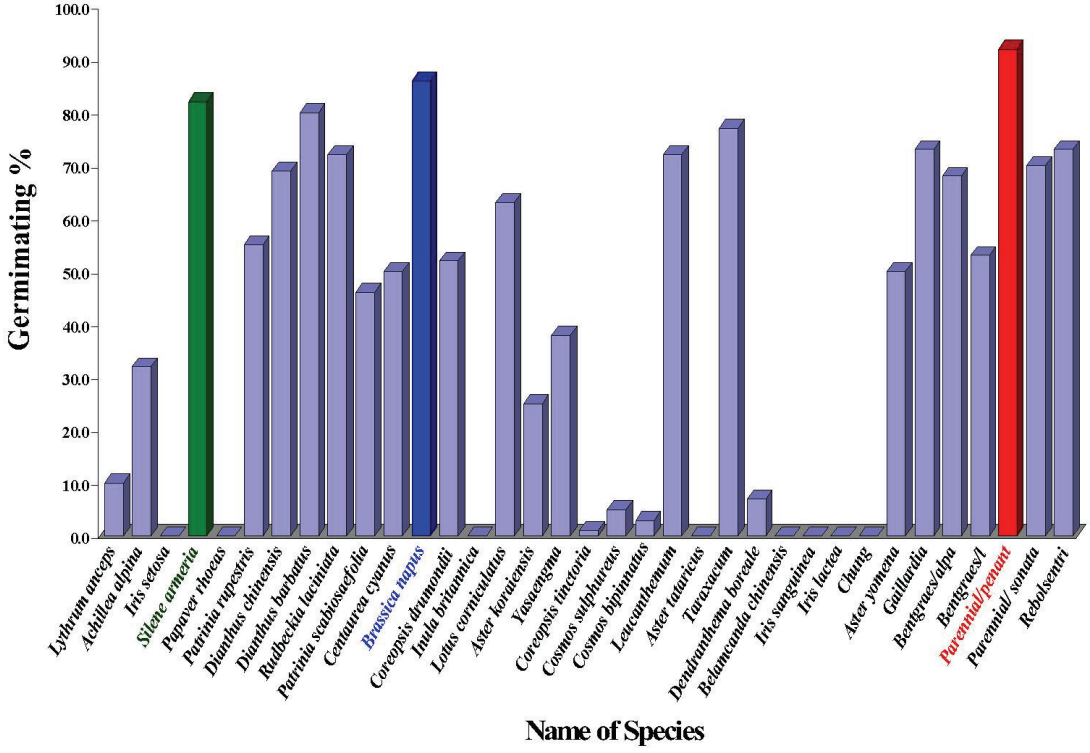
3. Results and Discussion

The germination of different seeds was observed in both growth chamber and room temperature as described in materials and methods. In growth chamber, the seeds were sown over the filter paper and incubated for 2 weeks with regular watering in equal volume in each plate. From the average of complementary plates of each seeds, we found *Achillea alpine, Centaurea cyanus, Coreopsis tinctoria* and *Cosmos sulphureus* were germinated with in two days but two species: *Iris setosa and* Papaver rhoeas had least germination power and germinated only after two weeks. Rest of seeds had moderate type of germination. Further more there was no germination of eight species: *Iris setosa*, *Papaver rhoeas*, *Inulabritannica*, *Aster tataricus*, *Belamcanda chinensis*, *Iris sanguinea*, *Iris lactea* and *Caryopteris incana* until two weeks. We had repeated the same

[Table 1] List of seed species and their germination period in growth chamber.

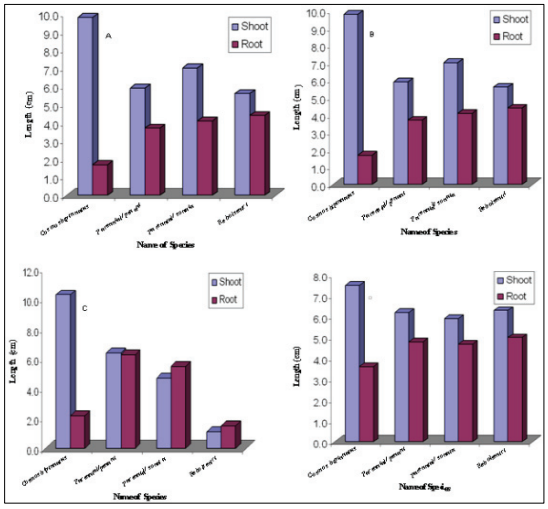
Name of species	Germination within (Days)						
	2	3	4	5	6	7	8 -14
Lythrum anceps				■			
Achillea alpina		■					
Iris setosa							
Silene armeria		■					
Papaver rhoeas							
Patrinia rupestris						■	
Dianthus chinensis		■					
Dianthus barbatus		■					
Rudbeckia laciniata			■				
Patrinia scabiosaefolia						■	
Centaurea cyanus	■						
Brassica napus		■					
Coreopsis drumondii			■				
Inula britannica							
Lotus corniculatus			■				
Aster koraiensis							■
Yasaengma		■					
Coreopsis tinctoria	■						
Cosmos sulphureus			■				
Cosmos bipinnatus	■						
Leucanthemum			■				
Aster tataricus							
Taraxacum		■					
Dendranthema boreale			■				
Belamcanda chinensis							
Iris sanguinea							
Iris lactea							
Caryopteris incana							
Aster yomena			■				
Gaillardia			■				
Bentgraes/alpa				■			
Bentgraes/l				■			
Parennial/penant			■				
parennial/ sonata				■			
Rebolsentri						■	

experiment for these eight species to cross check and found the same result in second time as well(Table 1). We had also observed the germination percentage of all thirty five species. Among the tested species, *Perennial penant* showed highest germinating percentage (92%) ,followed by *Brassica napus* (86%) and *Silene armeria* (82%). But five species namely, *Coreops istinctoria*, *Cosmos sulphureus*, *Cosmos bipinnatus*, *Dendranthema boreale* showed very low germinating percent less than 10% (Fig. 1). Germination was also observed in soil under the room temperature as growth chamber. Almost similar pattern had been observed for the species *Iris setosa*, *Inula britannica*, *Aster tataricus*, *Belamcanda chinensis*, *Iris sanguinea*, *Iris lactea l*and *Caryopteris incana* but with contrast, *Papaver rhoeas* was germinated with in one week. *Aster koraiensis* was germinated almost two weeks in soil (data not shown). This result clearly indicated that the germination pattern of all seeds were almost identical in both conditions. Among the germinated species, we have selected four species for the measurement of root shoot length. These species were selected on the basis of their germination in different proportion of soil. *Cosmos bipinnatus* showed the highest shoot length in all soil conditions but it showed lowest root length under all conditions. It was also observed that all of the species had highest root shoot length in 9:1 proportion of soil. Expect *Cosmos bipinnatus*, rest all species showed average shoot and root length in 8:2 proportion of soil. Interestingly, the *Rebolsentri* species showed lowest root and shoot length in 7:3 proportion of soil(in this case the length of root and shoot were almost equal i.e. three cm in length). From this study, we observed that though, *Cosmos bipinnatus* had highest shoot length, was not suitable for the sound proof wall because it couldn't live longer time. Rests of all species were found good for sound wall .Similarly 9:1 proportion of soil was the best proportion of soil to germinate the seeds and also to develop (Fig.2). The light condition and humidity were the two major factors responsible for seed germination. Almost all of seeds were germinated in growth chamber with in two weeks except few (Fig. 1), It was because that maximum seed were germinated at 2 5℃ and humidity at 60% under the alternation of light. Similar result was obtained by Ahmet work. The seeds which were native in origin had germinated faster than



[Fig.1] Germination percentage of seeds in growth chamber (X-axis: name of species, Y-axis: germinating percentage)

that of foreigner. The seeds were germinated slower in soil than in growth chamber. It was because seeds were buried in soil may take longer time to emerge out. The change in the soil composition also altered the seed germination it was because that heterogeneity of soil surface may determine the change of seed finding a suitable gap for germination. In all soil conditions, the shoot length of *Cosmos bipinnatus* had highest but root length was smaller than other species. But for the construction of ecological sound proof wall, this pattern was not suitable because longer the root length strongly bound to the soil surface and also greatly aids in absorbing water and nutrients required for growth and this type of species have shorter life time. Comparatively, in all soil conditions, root length of *Perennial penant*, *Perennial sonata* and *Rebolsentr*i were found higher and these species were considered as the suitable species for making sound proof wall. The root and shoot length of all selected species was found highest in 9:1 soil composition. This means that these species can survive stumpy nutrient condition. This point must be considered while constructing the ecological sound proof wall.



[Fig.2] Measurement of root and shoot length of different species with different proportion of soil. A. 6:4, B. 7:3, C. 8:2 D. 9:1

4. Conclusions

The encouraging results in this study showed those ecological sound proof walls are relatively simple to build and offer an effective and ecological alternative to conventional noise barriers used in urban areas. In our study, thirty-five seed species were chosen to test their germination percentage to use for further construction of ecological sound proof walls. Selections were based on rapidly growing species. Germination was examined in two conditions: growth chamber and soil based form in laboratory. In growth chamber, maximum germination was recorded for *Perennial penant* (92%), followed by *Brassica napus* (86%), and *Silene armeria* (82%). For the establishment of sound wall, root and shoot length are equally important because higher the root length strongly bound to the soil surface and also greatly aids in absorbing water and nutrients required for the plant growth and longevity of species. This study showed that maximum root length was observed for *Perennial penant* followed by *Perennial sonata* and *Rebolsentri* and these species were judged as an appropriate for the construction of ecological sound proof wall.

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Hae-Yong Cho [Regular Member]

- Feb. 1982 : BA, Dept of Landscape Architecture, Sungkyunkwan University
- Apr. 1990 : Master of Engineering, Dept of Environment Plan, Technical University Berlin
- Jul. 1994 : Ph.D.Dept of Environmental plan Technical University Berlin.
- Mar. 1994 ~ present : Professor, Dept of Environmental Engineering, Sunmoon University

<Research Interests>
Ecology, Environmental Impact Assessment

Sarita Bashyal [Regular Member]

- Jun. 2001 : Butwal Multiple Canmpus
- Jun. 2005 : Tribhuvan University central Department of butang, Kitipur, Nepal.
- Aug. 2007 ~ present : Doctor`s corse Dept of Environmental Engineering, Sunmoon University

<Research Interests>
Ecology, Environmental Impact Assessment

Chang-Ha Choi [Regular Member]

- Feb. 1984 : BA, Dept of mechanical Engineering Inha University
- Apr. 1996 ~ present : Professor, Dept of Hybrid Engineering, Sunmoon University

<Research Interests>
Noise, Vibration